April 8, 2024

Work Plan for the GREAT SALT LAKE BASIN INTEGRATED PLAN

EXECUTIVE SUMMARY

The Utah Division of Water Resources (WRe) and United States Bu (Reclamation) are together undertaking an unprecedented collabo Salt Lake Basin Integrated Plan (GSLBIP). This Work Plan for the *G* (Work Plan) provides a roadmap to successfully complete the GSL

THE NEED AND CHALLENGE

Declining water levels in our lakes, reservoirs, rivers, and the Great Salt Lake (GSL) emphasize that our water supply is limited. Continued growth places additional demands on a water supply already declining due to drought and climate change. A resilient water supply that supports the requirements of all uses within the watershed is needed for generations to come. Ensuring a resilient water supply requires extraordinary vision and a collaborative effort. Solutions remain socially and technically complex as demands on this limited resource continue to increase. A GSLBIP will provide a roadmap to understanding, collaboration, decisions, and action. Today's water management decisions through the GSLBIP will shape tomorrow's possibilities.

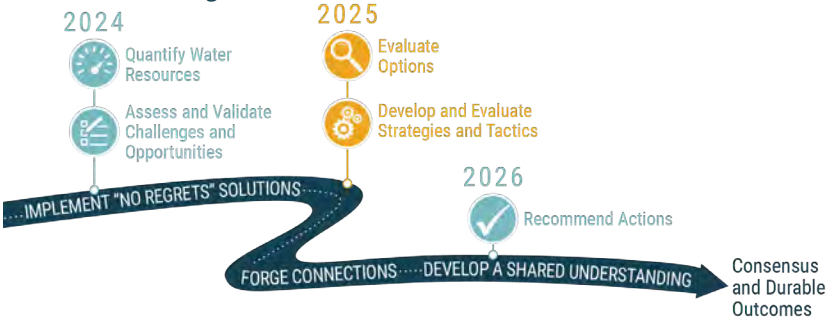
Key Objectives of the GSLBIP

- ✓ *Forge Connections*
- ✓ *Develop a Shared Understanding*
- ✓ *Quantify Water Resources*
- ✓ *Evaluate Options*
- ✓ *Recommend Actions*

AN INTEGRATED, COLLABORATIVE PROCESS

Connection (of individuals), a shared understanding (of the issues, concerns, options, tradeoffs, and decisions), and a commitment to a shared outcome are the critical elements that will create trust and enable our success. This Work Plan outlines an integrated collaborative process (Figure ES-1) that provides a process to drive consensus and durable outcomes. This collaborative process will engage stakeholders from throughout the GSL watershed to participate in developing sustainable and defensible solutions and choose and enable successful long-term implementation (Figure ES 2).

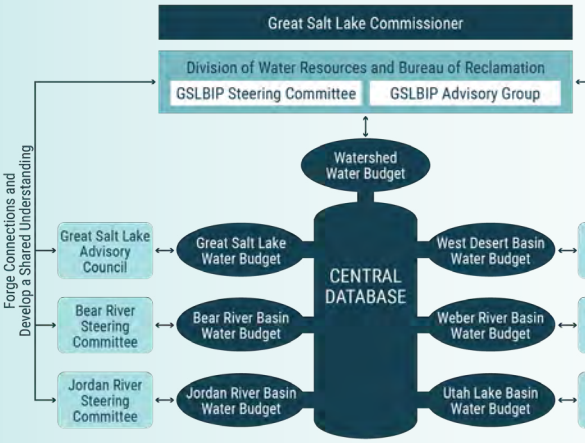
Figure ES-1. Integrated, Collaborative Process for the Work Plan for the Great Salt Lake Basin Integrated Plan



A ROADMAP TO ACTION

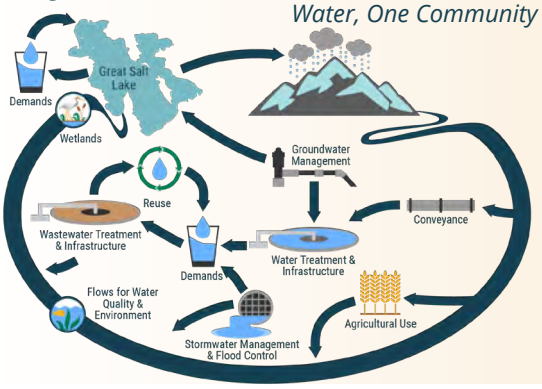
The GSLBIP project team completed a compreh from conducting interviews, sponsoring worksh strengths, gaps in available resources, and oppo origin for a roadmap for this Work Plan.

Figure ES-2. Stakeholder Integration into Great Salt La Integrated Plan Development



that achieves the requirements of Utah House B inform this core effort. The Making Decisions Tr GSLBIP decisions: (1) integrated collaborative pr model framework. This Work Plan additionally r Solution Development, Capacity Development, a of Figure ES-3 that, when completed in tandem others, such as the gap analysis, will best inform for future decisions beyond 2026, and be compl (Figure ES-4). Total available funding for the GSL

Figure ES-5. The Great Salt Lake Watershed: One Water, One Community



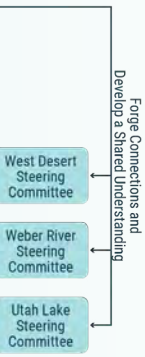
reau of Reclamation
orative effort to develop a Great
reat Salt Lake Basin Integrated Plan
BIP by November 30, 2026.

Goal of the GSLBIP

Ensure a resilient water supply for Great Salt Lake and all water uses, including people and the environment, throughout the watershed.

ensive gap analysis to inform the development of this Work Plan. Information collected ops, and reviewing available literature was organized into a database and used to identify ortunities for capacity development and further study. The gap analysis was the point of

ke Basin



Opportunities identified by the gap analysis were prioritized with input from the GSLBIP Advisory Group and GSLBIP Steering Committee based upon the capacity of those opportunities to meet the following criteria: (1) inform decisions to be made by 2026, (2) build a foundation for the future, and (3) be completed within the prescribed GSLBIP timeline and budget. These opportunities were then organized into five tracks (Figure ES-3) that, along with the GSLBIP integrated, collaborative process depicted on Figure ES-2, form the roadmap for this Work Plan (Figure ES-4).

Proposed work to be completed as part of the Making Decision Track (Figure ES-3) will integrate people and tools within a structured process designed to identify and solve problems and make decisions; this is the central effort of the GSLBIP Bill 429 and Reclamation, and all GSLBIP activities will ack comprises three components that will inform rocess, (2) scenario planning process, and (3) data and ecommends four additional tracks (Strategic Research, and Policy Opportunities), depicted on the outer ring with short-term opportunities and the efforts of many n decisions to be made during 2026, build a foundation leted within the prescribed GSLBIP timeline and budget LBIP is $8.1 million.

Figure ES-3. Five Tracks of the Roadmap for the Work Plan for the Great Salt Lake Basin Integrated Plan

Figure ES-4. Roadmap of Studies for the Great Salt Lake Basin Integrated Plan Work Plan

MOVING FORWARD

GSLBIP development will require innovation, flexibility, transparency, collaboration, and compromise to achieve the desired consensus. Meeting the GSL watershed's water and management challenges must be overcome and cannot wait. The GSLBIP must result in a timely action plan that the public will support and decision-makers can feasibly implement. We all use and rely upon one water (Figure ES-5); that one water is what makes our watershed one community, and it will take one community to preserve our one water for future generations.

The water legacy we will leave to future generations is on the line.

ACKNOWLEDGEMENTS

Advisory Group

Blake Bingham, Utah Division of Water Rights

Jim Bowcutt, Utah Department of Agriculture and Food

Jim Harris, Utah Division of Water Quality

Candice Hasenyager, Utah Division of Water Resources

Hugh Hurlow, Utah Geological Survey

Dagmar Llewellyn, U.S. Bureau of Reclamation

John Luft, Utah Division of Wildlife Resources

John Mackey, Utah Division of Water Quality

David O'Leary, U.S. Geological Survey

Chris Pennell, Utah Division of Air Quality

Ryan Rowland, U.S. Geological Survey

Dwight Slaugh, U.S. Bureau of Reclamation

Brian Steed, GSL Commissioner's Office

Ben Stireman, Utah Division of Forestry, Fire & State Lands

Paul Thompson, Utah Division of Wildlife Resources

Laura Vernon, Utah Division of Water Resources

Marisa Weinberg, Utah Division of Forestry, Fire & State Lands

Felix Yeung, U.S. Army Corps of Engineers

Steering Committee

Connely Baldwin, Rocky Mountain Power

Laura Briefer, Salt Lake City Department of Public Utilities

Derek Bruton, Central Utah Water Conservancy District

Gary Calder, Provo City

Lynn de Freitas, FRIENDS of Great Salt Lake

Nathan Daugs, Cache Water District

Wade Garrett, Farm Bureau

Joe Havasi, Compass Minerals

Tim Hawkes, Great Salt Lake Brine Shrimp Cooperative

Dustin Jansen, Utah Division of Indian Affairs

Jess Kirby, Summit County

Trevor Nielsen, Bear River Canal Company

Jon Parry, Weber Basin Water Conservancy District

Jack Ray, Utah Waterfowl Association

Marcelle Shoop, National Audubon Society

Soren Simonsen, Jordan River Commission

Brian Steed, GSL Commissioner's Office

Brent Tanner, Utah Cattlemen's Association

David Tarboton, Utah State University

Jacob Young, Jordan Valley Water Conservancy District

Jeff Young, Ensign Ranch

Consultants

Jacobs Engineering Group Inc

The Langdon Group

Hansen Allen & Luce

Clyde Snow & Sessions

Many Others

Thank you to the numerous individuals who participated in the situational assessment, interviews, workshops, meetings, and reviews of the many draft documents.

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ACRONYMS AND ABBREVIATIONS

$	United States 2023 dollars
DWR	Utah Division of Wildlife Resources
WRe	Utah Division of Water Resources
WRi	Utah Division of Water Rights
FFSL	Utah Division of Forestry, Fire & State Lands
GSL	Great Salt Lake
GSLAC	Great Salt Lake Advisory Council
GSLBIP	Great Salt Lake Basin Integrated Plan
GSLEP	Great Salt Lake Ecosystem Program
H.B.	House Bill
IWA	Integrated Water Assessment
IWAA	Integrated Water Availability Assessment
Reclamation	United States Bureau of Reclamation
SAC	Salinity Advisory Committee
Trust	Great Salt Lake Watershed Enhancement Trust
UDAF	Utah Department of Agriculture and Food
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

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A INTRODUCTION

The Utah Division of Water Resources and the United States Bureau of Reclamation are jointly undertaking an unprecedented collaborative effort to develop the Great Salt Lake Basin Integrated Plan (GSLBIP). The goal of the GSLBIP is to ensure a resilient water supply for Great Salt Lake and all water uses, including people and the environment, throughout the watershed.

The GSLBIP is intended to be utilized by water users and decision-makers for collective water resource management in the basin. More specifically the GSLBIP, seeks to address water supply imbalances, increase supply reliability and avoid degradation of the vital Great Salt Lake ecosystem. Given the size, scope and complexity of the project, the Division of Water Resources needs a road map to complete the GSLBIP. This GSLBIP Work Plan is the road map.

The draft Work Plan, completed in November 2023, contains valuable insights into the requirements for the GSLBIP and is the foundation that this work plan actions document builds from. Public comments received on the draft Work Plan have been integrated into the final Work Plan, where appropriate, and will be taken into account during the development of the GSLBIP.

Moving forward, the draft Work Plan document will be referred to as the Work Plan Foundation document. This document builds upon the recommendations in the Work Plan Foundation document by providing specific detail on the tasks necessary for the completion of the GSLBIP by late 2026 and will be referred to as the Work Plan Actions document. Together, the Work Plan Foundation document and the Work Plan Actions document will be referred to as the Final Work Plan.

While the Final Work Plan outlines the essential tasks, the basin planning process will continually evolve into the future. Adaptations to the processes will be made as necessary as more information and data become available.

After the release of the Work Plan Foundation document, the Office of the Great Salt Lake Commissioner released its first-ever Great Salt Lake Strategic Plan. The strategic plan intends to provide a balanced approach to water management in the Great Salt Lake Basin that protects the health and sustainability of Great Salt Lake. The GSLBIP will provide information and tools to improve water management decision-making in the Great Salt Lake Basin, supporting future planning and the implementation of the strategic plan. Throughout the development of the GSLBIP, the Office of the Commissioner will provide direction and guidance to the GSLBIP project team.

Figure A-1. GSLBIP schedule

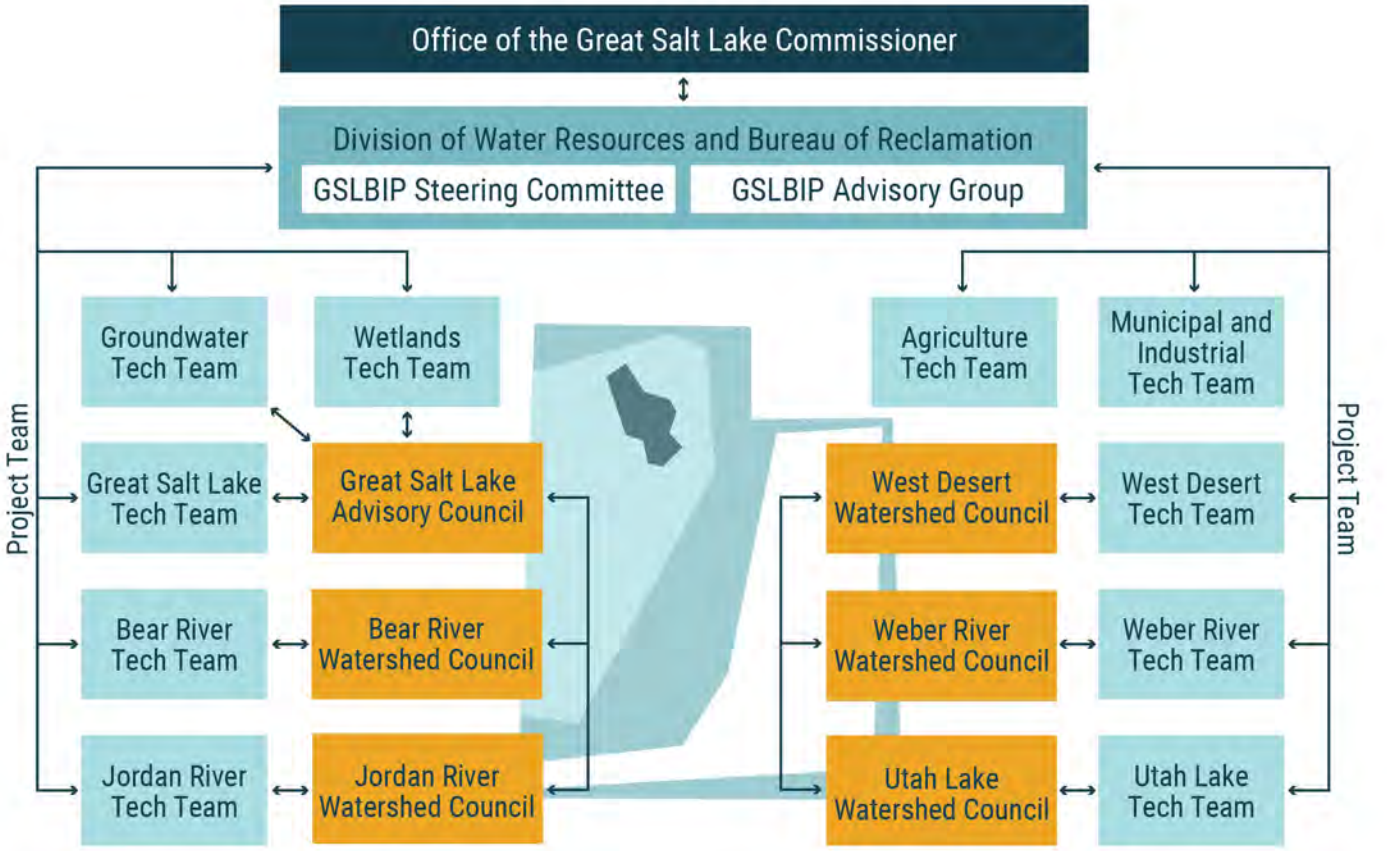
PARTNERS IN THE GSLBIP

Developing an effective water management plan for the Great Salt Lake Basin depends on careful and persistent collaboration with partners throughout the basin. Each part of the planning process requires involvement from a varied group of individuals.The success of the project depends on the partnerships and support that are developed throughout the planning process. Success will be achieved when basin water users willingly adopt and help implement this plan.

The term "partner," for the purposes of the GSLBIP, is considered an individual, group or entity that has a concern or interest in water planning in the Great Salt Lake Basin. The following partner groups will be involved in the development of the GSLBIP:

- **Great Salt Lake Commissioner** — A position established by the Utah Legislature in 2023, the commissioner is tasked with balancing the diverse interests in the basin that impact Great Salt Lake and ensure coordination of agencies' and entities' efforts related to the lake. The commissioner's office will provide oversight, review and guidance on all aspects of the GSLBIP. As mentioned above, the GSLBIP is also intended to inform the decisions made while implementing the 2024 strategic plan.
- **Project team** — The project team is composed of Division of Water Resources and Reclamation staff involved in developing the GSLBIP. It also includes contractors and specialists who are providing support to the division and Reclamation.
- **Advisory group** — Convened specifically for the development of the GSLBIP, the group is composed of state and federal agencies with an interest in managing water resources in the Great Salt Lake Basin. They will guide the GSLBIP development process, then review and advise the project team on activities, progress, technical products and findings from the GSLBIP development. The advisory group will also assess and advise the division and Reclamation on alignment with existing law, policy and efforts.

Figure A-2. Organizational chart illustrating the interplay between project partners



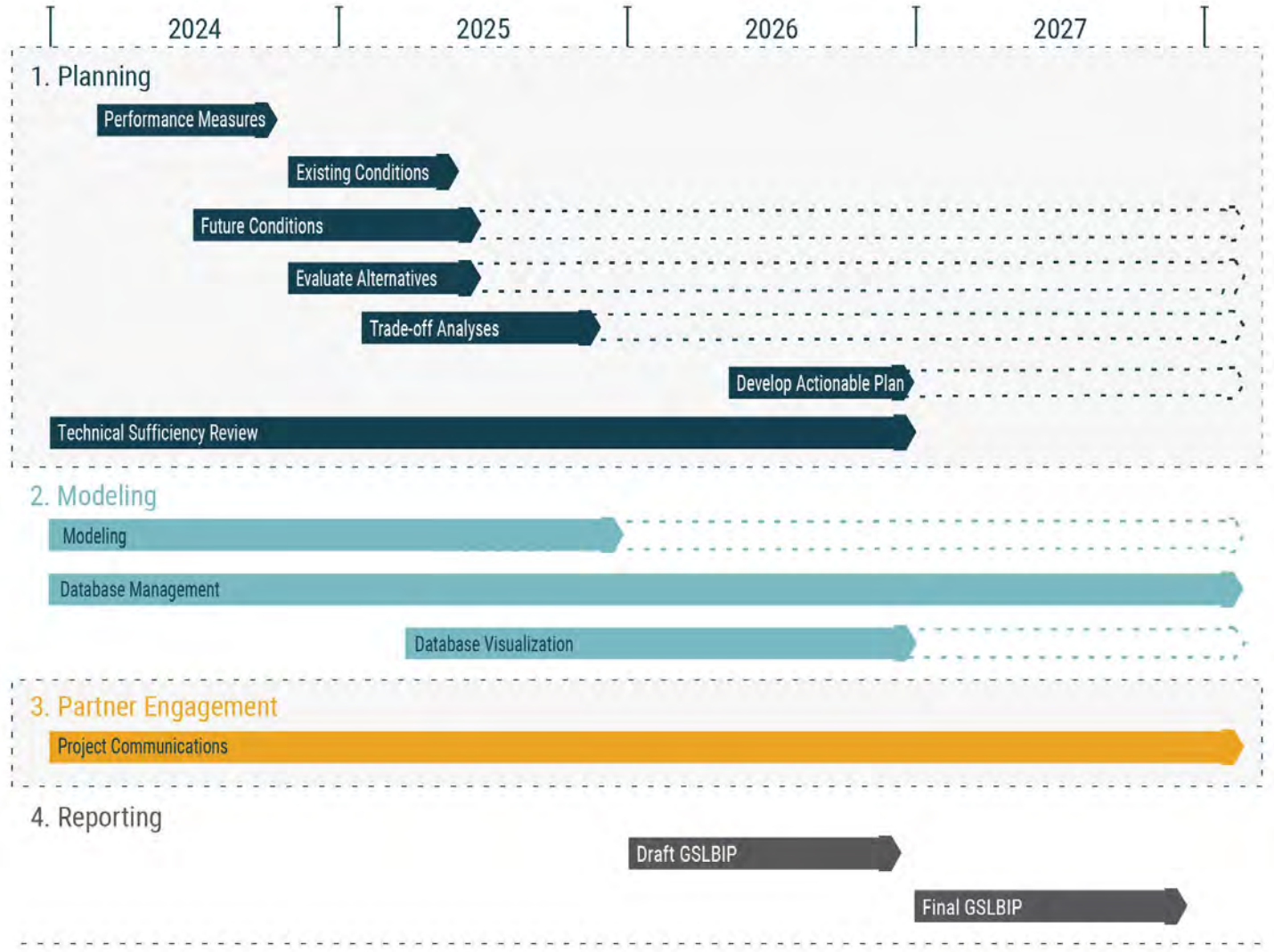
- **Steering committee** — Convened specifically for the development of the GSLBIP, the committee is composed of individuals representing diverse interests throughout the basin who have a stake in how water is used and managed. They will guide the GSLBIP development process, then review and advise the project team on activities, progress, technical products and findings from the GSLBIP development.
- **Technical teams** — The technical teams are a subgroup of the project team. They are created specific to each river basin and are composed of individuals who have the technical knowledge and experience with hydrologic modeling and data analysis. They will work closely with the project team and their respective watershed council or Great Salt Lake Advisory Council (GSLAC) throughout the modeling and planning phases of the project.
- **Watershed councils** — Initiated in 2020, the five watershed councils in the Great Salt Lake Basin provide a forum for discussions of water policy and watershed issues between balanced and diverse partners. With regard to the GSLBIP, each watershed council will represent the diverse interests of their respective river basin, advise the project team on the challenges they face regarding water supply and management, and review documents and make recommendations to the advisory group, steering committee and project team. Each watershed council will work with their respective technical team to define and assess their water budgets and evaluate potential solutions and trade offs during the GSLBIP planning process. Should formation of the Great Salt Lake Watershed Council occur, per the current language in the Watershed Councils Act, the project team will work with the Great Salt Lake Watershed Council in the same manner that it engages the basin watershed councils.
- **Great Salt Lake Advisory Council** — GSLAC will serve the same role as a watershed council, listed above, but do so for Great Salt Lake.
- **Water users** — Defined as large water right holders in the Great Salt Lake Basin, this group includes water conservancy districts, canal companies, wetland managers, municipalities, industries and other water right holders. Given their expertise and data, members of this group could be involved in the modeling and planning phases of the project. This could occur through individual consultation, meetings or workshops.
- **Public participants**
  - ***Relevant parties*** — County and city governments (non-elected officials), non-governmental and conservation organizations, industry groups and research entities.
  - ***Policymakers*** — Composed of federal, state and local office holders, members of this group include the Utah Legislature and local municipal officials such as mayors, city councils and county commissions.
  - ***Media*** — Media groups include print, radio and television at local and national levels.
  - ***General public*** — All interested parties and residents of the Great Salt Lake Basin.

STEPS OF THE GSLBIP

The following sections in this Work Plan Actions document highlight the steps necessary to complete the GSLBIP planning process. The tasks in each section are to be used as guidance as we work through this multi-year process. The tasks are dependent on one another and build upon each other. Given the complexity of the project, numerous tasks will be occurring simultaneously and tasks within each of the sections will inform tasks in other sections. The involvement of our basin partners is critical to project success and woven into the planning process, as indicated in the following sections. This Work Plan Actions document contains the following sections and elaborates on the information contained in Appendices C, H and I and of the Work Plan Foundation document:

- **Planning Approach**
- **Modeling Approach**
- **Partner Engagement**

Figure A-3. Timeline for the four sections of the GSLBIP: planning, modeling, partner engagement and reporting



B PLANNING APPROACH

INTRODUCTION

A plan for water management in the Great Salt Lake Basin is needed to articulate a view of the future that will enable coordinated decision-making and action to benefit water users, including Great Salt Lake. The GSLBIP Work Plan lays out the goal and objectives of the plan; essential strategies to achieve them; and the process for collaboration and decision making. This portion of the Work Plan details the planning approach that will be followed to accomplish those goals, strategies and collaboration. The development of the water management plan will utilize the information derived from the modeling process, discussed in the next section.

GOAL AND OBJECTIVES

The goal is to produce a plan which will, when implemented, ensure a resilient water system for Great Salt Lake and all water users in the basin. The plan will be the initial iteration of a planning process that will continue into the future.

Upon completion of the plan, interested and affected parties will be able to:

- Communicate the key water management issues to partners
- Quantify, qualify and display the current status of addressing key water management interests
- Assess how key water resource interests may be affected in the future
- Evaluate how alternative water demands, policies, operations and hydraulic infrastructure may impact key water resource interests
- Evaluate the robustness of those alternatives under plausible future climate conditions
- Provide an assessment of the trade-offs between the tested alternatives
- Select and combine the simulated alternatives into an implementable plan
- Build relationships with communities as the connectivity between water and community resilience is illustrated throughout the planning process

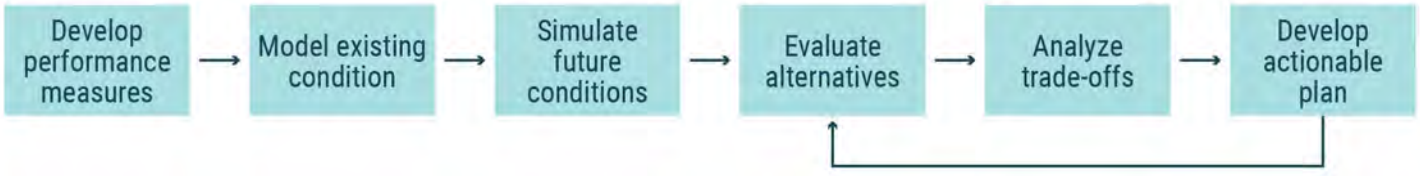
REPORTING

Annual briefs on project status, work completed and future needs will be drafted and presented to the advisory group and steering committee. Those reports will be written with Reclamation and will become initial drafts of the chapters in the final report. A draft outline for the plan will be created at the inception of the planning process with Reclamation and will continue to evolve and be completed as planning continues. Reclamation will draft the report to meet requirements of the Basin Study Grant. The division will add chapters, appendices and a summary once the final strategy is selected (Planning Component 6). The modeling report, discussed in the following section, will be appended to the general report. Throughout the project, the Technical Sufficiency Review, required by the USBR, will be conducted and reported on as outlined in Appendix F.

MAIN PLANNING COMPONENTS

1. **Develop system performance measures**
2. **Model the existing condition**
3. **Simulate future conditions**
4. **Evaluate alternatives**
5. **Analyze trade-offs**
6. **Develop actionable plan**

Figure B-1. Main planning components of the GSLBIP



1. DEVELOP PERFORMANCE MEASURES

Objective

Work closely with team members and partners to develop and share the best ways to measure their interest, evaluate the current water management system's effectiveness, and compare the costs and benefits of different planning options.

Description

The Project Team needs to measure and understand how the water management system behaves in different situations to meet the needs of water users and other project partners. This involves translating data into useful information for decision-making. Partner input and collaboration with the modeling team are crucial for this task. The specific performance measures will be included to evaluate each simulation scenario. These data are essential for trade-off analysis, which helps in selecting the best plan alternatives.

Tasks

- Present the concept of performance measures and the critical role they play in the trade-offs analysis and final development of the plan to project participants
- Outreach to the water user groups to inform them about the GSLBIP planning process and performance measures
- Participants develop draft quantitative, qualitative and graphical performance measures
- Modeling team designs a software tool to compute and display performance measures using dummy data until formal model outputs are available
- Performance measures and display tool are improved throughout the planning process

Partner Interactions

The project team will work with partners, including water users, through watershed council workshops and with the advisory group and steering committee to develop the suite of system performance measures.

Deliverable

A computer application that provides graphical, statistical and qualitative summaries from scenario simulations for the aspects of the water resource system that are of interest to partners will be created. This tool would be linked into the integrated model framework to organize and display results.

2. MODEL EXISTING CONDITION

Objective

Establish baseline performance measures by using the model to simulate an agreed upon representation of current conditions using the historical hydrology.

Description

Set the model to represent current water user demands (constant or conditional diversions and depletions), evapotranspiration rates, system configuration, hydraulic infrastructures and reservoir operations. Force the model using the historical hydrologic sequence for a time span (e.g.1990 - 2023). Generate performance measures using the tool developed in Component 1. Going forward these performance measures will represent the baseline condition to which all scenario performance measures will be compared.

Tasks

- Modeling team configures model to simulate existing basin conditions using the historical hydrologic sequence
- Modeling team derives the historical hydrologic sequence from observed time series with spatial and temporal gaps filled using the VIC model and historical climate data
- Outputs of the existing conditions model are post-processed into the performance measures
- Results are documented and presented to partners
- Feedback on the model results are received and the necessary adjustments are made to the model and performance measures

Partner Interactions

The technical team sets the model to simulate an existing condition. Model outputs are shared through the watershed council, water users workshops, advisory group and steering committee meetings. Once finalized, a report is drafted to document the existing conditions model. The resulting performance measures will be shared with partners, then be verified or adjusted as needed to best reflect partner interests. The performance measures will be documented in the report.

Deliverable

Validated existing conditions model with baseline performance measures. A report on the model and results.

3. SIMULATE FUTURE CONDITIONS

Objective

Develop a dataset of plausible projections of future weather (temperature, precipitation–including snowfall and snow accumulation, wind, relative humidity, solar radiation) and hydrology (soil moisture, watershed evaporation, streamflow) across the basin. This will enable simulation of the water resource system performance when using the best available scientifically derived and defensible representations of future climate conditions. These plausible hydrology and climate data sets are used to test the robustness and resiliency of proposed management alternatives.

Description

This task provides key input data to the GSLIM, river basin, groundwater and Water Demand models.

Tasks

- Engage partners to identify climate scenarios they wish to evaluate
- Process existing statistical downscaling climate data produced with MACA and CMIP5
- Apply statistical downscaling to produce 4 km grids of future climate over Great Salt Lake Basin using the MACA method applied to all CMIP6 simulations. Temporal disaggregation will be used. Apply dynamical downscaling using the WRF model. Select three cases to span the full range of CMIP6 results:
- Average of future projections
- Hottest and driest
- Coolest and wettest results
- Compile climate data and model input data and review for completeness and accuracy
- Use the climate data within the calibrated VIC model to derive inflow hydrographs at all the supply points in the RiverWare and GSLIM models.

Partner Interactions

Reclamation's Technical Service Center, the University of Utah and the division coordinate participant workshops and information sessions concerning scenario development, climate modeling and how they will be utilized in the planning process. The outcome of these workshops is direction on the type of climate scenarios, both plausible and possible, that partners would like to use to test the robustness and resiliency of the current system and of management alternatives.

The University of Utah completes the technical tasks to gather the Global Climate Model output, downscale, post-process then transfer to the Technical Service Center. The Technical Service Center runs the VIC model using the climate data set to produce hydrologic input to the RiverWare and groundwater models. The climate data is transferred from the Technical Service Center to the modeling database so that the data can be used as input to the GSLIM and Water Demand models.

Deliverable

Climate and hydrology datasets that represent plausible and possible future climate conditions which water users and scientists would like to use to test management alternatives and strategies.

4. EVALUATE ALTERNATIVES

Objective

Alter the existing conditions model with baseline hydrology according to demand, policy, operations and infrastructure scenarios identified, vetted and selected by partners. Evaluate system performance of each alternative using the performance measures.

Description

Many potentially feasible management (demand, policy, infrastructure) options have been identified in previous studies, committees and ad hoc efforts. This will include actions identified in the 2024 Great Salt Lake Strategic Plan. That list will be compiled, added to and then refined through engagement with partners. Other planning partners will be surveyed as well, including the Governor's Office of Planning and Budget, Office of the Great Salt Lake Commissioner and general public.

The initial list of management alternatives will pass through a screening process by removing ones that cannot be represented in the model or that are not supported by a significant number of partners or are untenable to water users and other criteria to be determined. Each alternative on the refined list will be independently incorporated into the existing conditions model and performance measures generated for each.

Tasks

- Compile list of existing management alternatives
- Survey and workshop with partners to identify additional management alternatives not yet considered or particular to their systems
- Refine the list through an initial screening process
- Simulate each alternative using the baseline hydrology and existing conditions model
- Generate performance measures for each alternative and create a means to communicate them

Partner Interactions

The project team will compile the initial list of management alternatives. All participant groups will be surveyed and invited to participate in workshops to enhance and refine the list. Participants work with the project team to represent the management alternatives within the existing conditions model.

Deliverable

Summary report of a range of management alternatives selected and vetted by partners along with the accompanying performance measures for each alternative evaluated using the baseline hydrology.

5. ANALYZE TRADE-OFFS

Objective

Assess how the water resource system would perform under each of the water management alternatives under a wide range of possible future conditions.

Description

Once the system performance under the alternative management scenarios has been assessed using the baseline climate and hydrologic conditions, they will be stress tested by simulating them under a range of possible, unobserved climate conditions. The climate scenarios used for testing the refined list of management alternatives will have been selected jointly by the project team and partners.

Tasks

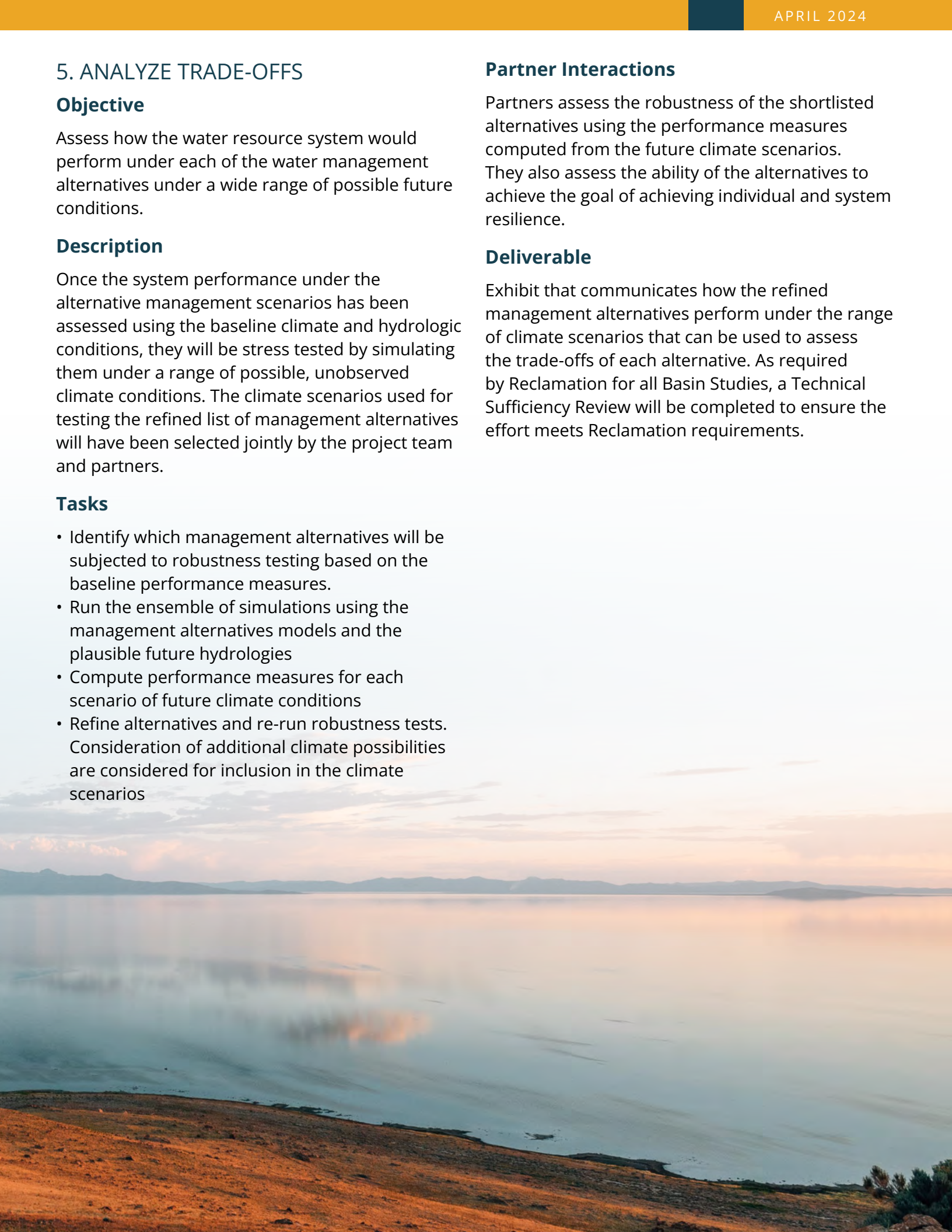
- Identify which management alternatives will be subjected to robustness testing based on the baseline performance measures.
- Run the ensemble of simulations using the management alternatives models and the plausible future hydrologies
- Compute performance measures for each scenario of future climate conditions
- Refine alternatives and re-run robustness tests. Consideration of additional climate possibilities are considered for inclusion in the climate scenarios

Partner Interactions

Partners assess the robustness of the shortlisted alternatives using the performance measures computed from the future climate scenarios. They also assess the ability of the alternatives to achieve the goal of achieving individual and system resilience.

Deliverable

Exhibit that communicates how the refined management alternatives perform under the range of climate scenarios that can be used to assess the trade-offs of each alternative. As required by Reclamation for all Basin Studies, a Technical Sufficiency Review will be completed to ensure the effort meets Reclamation requirements.



6. DEVELOP ACTIONABLE PLAN

Objective

Formulate the suite of alternatives (actionable water resource plan) acceptable to water users and non-water right holding interests in the basin through a partner selection process.

Description

The final planning component involves significant communication, collaboration and involvement between water users, project team and partners to select a plan for collectively managing water resources in the Great Salt Lake Basin. Using the tested and narrowed list of management alternatives, different suites of alternatives are selected and tested. Scenarios and performance measures can be refined as necessary. Opinions are collected from decision makers and the general public which can be incorporated into the facilitation process that the project team and water users employ to select a final plan. The plan is adopted by water users and made a resource they can use to assure consistency with their individual water resource plans.

Tasks

- Identify which management alternatives will be combined for testing their interactions based on the robustness tests
- Make any final refinements deemed necessary to the performance measures, alternatives or climate scenarios
- Select different suites of alternatives with varying trade-offs
- Identify how those water users who may be impacted by the implementation of the alternatives could be compensated
- Host workshops to present options for alternative suites to partners including water users, watershed councils, and the advisory group and steering committee
- Survey the general public and specific population sectors to obtain data on public sentiment of the alternatives
- Facilitate final workshops with partners, including water users, watershed councils, and the advisory group and steering committee to recommend a plan to the division and Reclamation, which includes a specific suite of alternatives, phased implementation of that suite of alternatives and compensations for those negatively affected by the suite of alternatives

Partner Interaction

Using the further refined list of alternatives as well as input from partners, the technical team will test different combinations of alternatives. They work with the project team to make any refinements to the analysis. Then water users select the suite of alternatives and work with other partners to determine the best approach for implementation and compensation.

Deliverable

An actionable plan adopted by water users for collective water resource management in the basin that balances water supply and demand while avoiding the deterioration of agriculture, industry, municipalities and ecosystems. The plan describes the current water management system, water users, partner interests, policies, infrastructure and measures of existing performance. It describes the existing system robustness by predicting what performance could be under possible and plausible future climate and demand scenarios.

Importantly, the plan presents a partner recommended suite of management (demand, policy and infrastructure) alternatives to the current management and how that suite of alternatives would have changed the existing system performance and conditions had it been in effect throughout recent history. Furthermore, the plan reports how robust the alternatives are and how they impact system resiliency. The plan recommends alternative phasing and compensation mechanisms to improve conditions for all water users, including Great Salt Lake.

C MODELING APPROACH

INTRODUCTION

A model of the Great Salt Lake Basin's hydrology and management system is needed to support the GSLBIP. Appendix H of the GSLBIP Work Plan recommends that two modeling approaches, near-term and mid-term, be completed simultaneously, and a long-term approach be completed after the mid-term is finished. Upon further consideration, the division decided to forgo the near-term approach and instead focus all efforts on the mid-term approach while planning for long term future improvements. This document describes the mid-term modeling approach and details how to implement it.

GOAL AND OBJECTIVES

The main purpose of the model is to support planning and the ultimate adoption of a basin-wide water resource strategy. The model will support the planning objectives by allowing the planning team to explore impacts on water users and Great Salt Lake that result from scenarios of changes in climate, water supply, water demand, hydrosystem policies and hydraulic infrastructure. It is important to note that existing water quality data and tools will be incorporated as appropriate and available, particularly for Great Salt Lake, Utah Lake and Bear Lake. This initial creation of the basin-wide model will not include the development of new water quality data. As more water quality data, tools and research become available after the creation of the initial model development it can be added to the model.

The general goal of the model is to help water managers and policymakers approximate the amount of water that can be used while considering the impacts to the lake and tradeoffs.

A secondary goal is to identify potential water management policies and infrastructure that could benefit the lake and other water users. These objectives support the goal of the GSLBIP to build a resilient water resource system.

Upon completion (2025), the mid-term modeling approach will:

- Build trust and confidence among various partners
- Provide planning-level information at both the water user and basin scale
- Be used to establish an objective, factual basis on causes and effects in the basin
- Quantify the timing, frequency and magnitude of water required to sustain essential functions of the lake under various scenarios of water availability
- Identify the level of water conservation required to sustain essential functions of the lake
- Determine options for how water use reductions could be distributed among water users
- Evaluate different demand, policy and reservoir operation scenarios under a range of supply conditions
- Provide an objective, analytical trade-off analysis to help decision-makers balance water supply and demand and avoid deterioration of agriculture, industry and ecosystems
- Provide information to assist decision-making about how urban conservation, water reuse and agricultural efficiency improvements affect individual water users and the lake
- Leverage and combine existing models

WATER USERS AND PARTNERS IN THE MODEL DEVELOPMENT

The mid-term approach intends to represent the top water users (part of the partner groups) in the basin. A group of organizations with the greatest water rights holdings have been identified. They will be assured representation in the model and will be invited to participate in at least two workshops. Since the model represents physical water supplies and demands, there is no way to represent non-water right holder interests directly in the model. Those will be represented with water users interests by using performance measures to:

- Assure that their hydrosystem and water demands are adequately represented
- Work with the water demand models to come up with demand scenarios and other alternatives to address water resource problems

REPORTING

A final report on model development including assumptions, structure, parameters and input data will be prepared for inclusion as an appendix to the final GSLBIP report (and Basin Study report). Reports on the modeling will be provided to Reclamation as required. The report will include instructions for running and updating the model as well as recommendations for continued maintenance and development. As mentioned in the Planning Approach section above, the Technical Sufficiency Review, required by Reclamation, and pertaining to the model will be conducted and reported on as outlined in Appendix F.

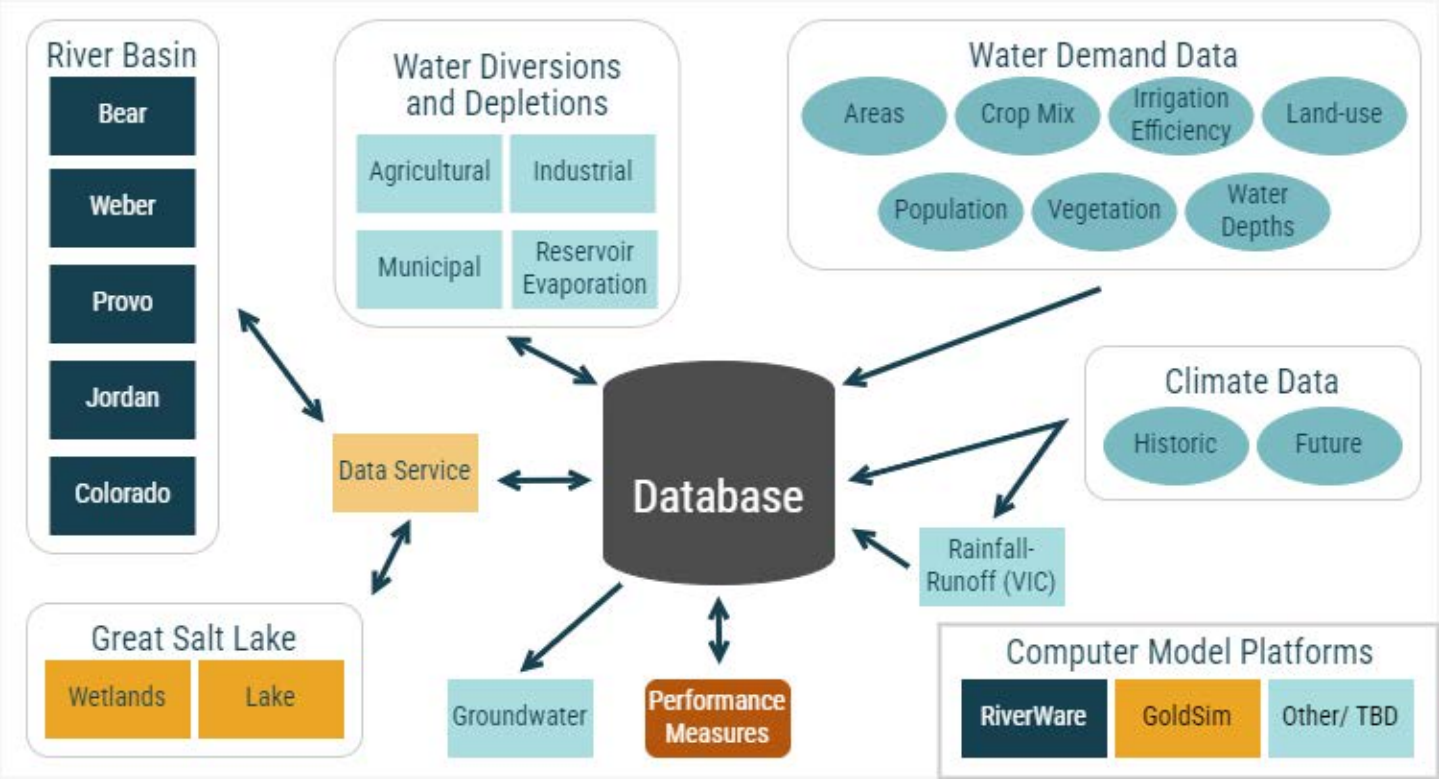
MAIN MODELING COMPONENTS

The mid-term approach will include the primary surface water and groundwater supply sources, including imports from the Colorado River. Additionally, it will represent the major hydraulic infrastructure and the policies which govern their operation. Components to be completed in the mid-term modeling approach include:

1. **Surface Water Supply:** Final calibration and application of a basin-wide rainfall-runoff model and developing future projections of climate change a part of surface water supply
2. **Surface Water System:** Updating, expanding, improving and consolidating four river basin surface water operations models into a single model
3. **Groundwater System:** Developing an empirical groundwater model using knowledge from existing models and studies
4. **Great Salt Lake and Wetland System:** Updating and improving the Great Salt Lake Integrated Management Model (GSLIM), an existing model that helps water managers understand how Great Salt Lake water levels and salinity are influenced by potential changes in inflow and withdrawals from the lake
5. **Water Demand:** Enhancing municipal, industrial, agricultural and environmental water demand models
6. **Database Management and Data Integration:** Designing a database(s) and data access tools to centralize information sharing between models and to loosely integrate models in disparate platforms
7. **Data Visualization and Mapping:** Developing data visualization tools to communicate modeling results

Detailed tasks to complete each component are specified below.

Figure C-1. Modeling components of the GSLBIP



MODELING TEAMS

Each component is completed by a technical team or sub-team. Each team has a leader, working members and advisory members. Working members complete tasks such as data gathering and technical modeling. Where appropriate and feasible, private contractors with unique sub-basin experience will be utilized. Advisory members work with technical members to derive the overall approach and to assure that the model is functioning as intended to adequately represent water users, operations or administration of the water resource system. The advisory group and steering committee are represented through the recommendation of technical team members.

Initially, the technical team will meet weekly as the approach is being determined. A schedule will then be decided and to allow for completion of the technical tasks as needed to adhere to the planning schedule. Method selection, completed tasks, assigned tasks and communication needs will be documented in meeting minutes, then distributed to team members. Quarterly meetings are held with advisory technical team members (or as frequently as needed) for model review and verification. Meetings are organized with water users as needed, but at least two workshops are held with all water users through the modeling process; likely this will be done through the watershed councils. Every two weeks, progress briefs are submitted to the project team manager and project team. Monthly briefs and oral reports are provided to the advisory group and steering committee. Presentations and work sessions are anticipated at every watershed council meeting.

1. SURFACE WATER SUPPLY

Objective

Develop and calibrate a rainfall-runoff model for the entire Great Salt Lake Basin that simulates weather (temperature, precipitation, wind, relative humidity, solar radiation) and hydrology (soil moisture, watershed evaporation, streamflow).

Description

This task develops a rainfall-runoff model which provides key input data to the GSLIM, River Basin, Groundwater and Water Demand models. The variable infiltration capacity (VIC) model is a large-scale, semi-distributed hydrologic model and is commonly coupled to GCMs or used for hydrologic studies, such as in the Colorado River Basin. The VIC model is a grid-based macroscale hydrologic model that focuses on climate change impact assessment. The division has nearly completed development and calibration of a VIC model for the mountainous regions of the basin. The VIC model will provide consistent hydrologic data across the basin. The primary application of VIC output will be a natural flow data set which provides natural flow at key inflow locations in the river basin model.

Tasks

- Review and evaluate the hydrologic model
- Update the hydrologic model and revise as needed, such as to include the portion of the Colorado River Basin that yields waters imported to the Great Salt Lake Basin or to cover the MODFLOW model boundary
- Run hydrologic simulations to produce historic natural flow and climate scenario hydrologies
- Draft chapter on hydrologic model and model simulations
- Provide output data for storage in the database
- Provide simulation data and calibration results for validation by a review team

Technical Team Members

Results of the hydrologic modeling for historic conditions will be presented to the steering committee and advisory group and watershed councils for review and validation.

- Reclamation: Maribeth Kniffin
- University of Utah: Court Strong

Special Considerations

This task relies upon the expertise of Reclamation's Technical Service Center and the University of Utah. Division of tasks and communication between the two will be coordinated by them. The current version of the VIC model and related data are transferred from the division to the Technical Service Center. Data is transferred between the university and the Technical Service Center. Lastly, weather and hydrologic data are transferred from the Technical Service Center to the division. Agreements for this task must be approved of and signed.

Deliverable

A calibrated VIC model capable of predicting natural flow of the streamflow network throughout the Great Salt Lake Basin will be created along with associated documentation. Historical hydrological data and regional downscaled future projections will be shared with the Division of Water Resources. These data are the primary inputs to the river operations model (RiverWare).

2. SURFACE WATER SYSTEM

Description

Current models exist for each individual river basin. RiverWare models will be prepared to align with the others in simulation period and timestep. The Weber River model will be ported into the Utah Lake model and connected via the Weber-Provo Canal. Then the Jordan River model will be converted from GoldSim into the combined RiverWare to connect with the Utah Lake system. Lastly, the Bear RiverWare model will be ported in the combined model. Rules will be written to connect operations between Weber and Utah Lake models. A simple model representing water availability and imports from the Colorado River basin will be included. It is yet to be determined whether the groundwater system will be represented explicitly in the RiverWare model. Input data management interfaces will be consolidated and linked to a single datasource (Excel Workbook, which is the current input/output data storage for all RiverWare models, until a more advanced option is available) and a single output data management interface created. Each model network will need to represent water users by basin. Generally, all models need some level of improvements to the following: accounting, revised rules, inclusion of new users, important streams, water user return flows and key hydraulic infrastructure.

Tasks

Bear River Model

- Update the model to run through water year 2023
- Add the Logan, Cub, Blacksmith Fork, Little Bear and Malad Rivers
- Convert to monthly timestep
- Improve rules that determine Bear Lake release
- Change forecast rules
- Include accounting for storage and contract limits
- Include U.S. Fish and Wildlife Service as water user (depending on how they are handled in the wetland model)
- Include hydropower methods
- Add return flows
- Review by Idaho Department of Water Resources, PacifiCorp, Wyoming State Engineer's Office and other water users

Weber River Model

- Update the model to run through water year 2023
- Meet with the Division of Water Rights and Provo River Water Users Association to model operation of the Weber-Provo Canal
- Expand model to represent Davis County streams and corridor inflows to Farmington Bay
- Include accounting as needed
- Add return flows
- Include M&I demands as needed
- Include Division of Wildlife Resources as water users (wildlife management areas) and other users downstream of Plain City (depending on how they are handled in the wetland model)
- Explicitly represent water users (currently many users are aggregated)
- Consider improvements to ruleset
- Include discharges from wastewater treatment plants

Jordan River Model

- Update the model to run through water year 2023
- Convert objects, links, parameters and methods into RiverWare
- Include features and system representation from newer versions of the GoldSim models as appropriate (e.g. Salt Lake City's model)
- Include streams, reservoirs and water users who are not included in the current model
- Explicitly represent all major streams
- Include accounting as needed
- Include Division of Wildlife Resources as water users (wildlife management areas) and other users downstream of the bifurcation of the Surplus Canal and Jordan River (depending on how they are handled in the wetland model)

Provo River/Utah Lake Model (Colorado River)

- Update the model to run through water year 2023
- Meet with the Division of Water Rights and Provo River Water Users Association to model operation of the Weber-Provo Canal
- Include outflows from wastewater treatment plants
- Add Salt Creek and Mona Reservoir
- Add water users and infrastructure to each tributary as needed
- Determine the best approach to simulate water supply availability, imports from the Colorado River Basin and impacts to that basin
- Link outflow from Utah Lake and Salt Lake City aqueducts to the Jordan River model components
- Consideration for including the HSPF water quality model for Utah Lake as a post-processing tool
- Include Division of Wildlife Resources as water users given their implementation of the June Sucker Recovery Program and involvement with water rights, administered by Central Utah Water Conservancy District, for June Sucker recovery

Technical Team Members

Teams will coordinate with water users individually and through the watershed councils to identify, collect and organize the data required to improve the models. Work with them to assure that the model satisfactorily represents the water resource network, operations, and management and that the model will be able to evaluate the water management alternatives they will wish to investigate.

Bear River Model

- Division of Water Resources: Jake Serago
- PacifiCorp: Connely Baldwin
- Utah State University: Beth Neilson
- Division of Water Rights: Michael Lasswell
- Idaho Department of Water Resources: David Hokema
- Wyoming State Engineer's Office: Mike Johnson
- Division of Water Rights: Sue Odekirk
- Division of Water Quality: Mike Allred

Weber River Model

- Division of Water Resources: Scott Mcgettigan
- Division of Wildlife Resources: Rich Hansen
- Weber Basin Water Conservancy District: Riley Olsen
- Davis-Weber Canal Company: Rick Smith
- Weber River Commissioner: Kent Wilkerson
- Division of Water Quality: Paul Burnett

Jordan River Model

- Division of Water Resources: Danyal Aziz
- Division of Water Rights: Susan Odekirk
- Division of Wildlife Resources: Dave England
- Utah Division of Water Quality: Nick von Stackelberg
- Rudy Duck Club: Justin Dolling
- Upper Jordan River Commissioner: Kyle Johnson
- Lower River Commissioner: Lane Jensen
- Metropolitan Water District of Salt Lake and Sandy: Eric Sorensen
- Jordan Valley Water Conservancy District: Jacob Young
- GoldSim: Jason Lilywhite
- Kennecott Utah Copper: Ted Balling
- Salt Lake City Department of Public Utilities: Tamara Prue

Provo River/Utah Lake Model (Colorado River)

- Central Utah Water Conservancy District: Rachel Musil
- Utah Division of Wildlife Resources: Russ Franklin
- River Commissioner: Scott Bergendorf
- Division of Water Rights: Sue Odekirk
- Division of Water Quality: Scott Daly

Special Considerations

Many technical details have yet to be determined. The best approach will be determined by the modeling teams. While each river basin has its own expert team, members from the various teams also form the basin-wide team. Alternatives that involve physical configurations or alterations to the hydraulic infrastructure will require a separate model file, whereas alternatives involving demands or policies can be simulated using the baseline model. As no surface water model of the

West Desert Watershed exists, that area is not represented in the surface water system model. The approach to simulate surface-groundwater interactions has yet to be determined. Configuration of the model for sharing and the method of model development are critical to completing this component by the deadline.

Deliverable

A single RiverWare model file representing current conditions of the major surface waters in the basin will be developed. The baseline supply will be 30-year hydrologic inflow and demands from observed data with gaps filled using the water demand models described in Component 5. This model will represent all the largest water right holders as well as all key hydraulic infrastructure and water management policies.

3. GROUNDWATER SYSTEM

Description

The approach to represent the groundwater system has not yet been determined. However, one is needed because 57% of public supply water in Utah was from groundwater withdrawals in 2015. Within the Great Salt Lake Basin, more than 30% of the municipal use and 15% of agricultural use comes from groundwater pumping. Groundwater use is anticipated to increase in the future. Groundwater may contribute a larger proportion of inflow to the lake than previously thought. For basin planning purposes, the project team needs to be able to predict the impacts on the water supply of climate and pumping on recharge, surface-groundwater interactions, and groundwater discharge to Great Salt Lake.

A method is needed that can do the following, in priority:

- Account for changes in recharge and withdrawals on streamflow and/or discharge to the lake
- Represent groundwater recharge
- Represent groundwater withdrawals
- Track groundwater storage

Tasks

- Summarize the state of knowledge, groundwater data availability, aquifer characteristics and condition of available models
- Identify options to model the groundwater system(s) in the basin
- Select an approach and document the rationale and needed assumptions
- Execute the approach

Technical Team Members

- University of Utah: Kip Solomon
- U.S. Geological Survey: Tom Marston
- Central Utah Water Conservancy District: Derek Bruton
- U.S. Geological Survey: Kyle Davis
- U.S. Geological Survey: Melissa Masbruch
- Division of Water RIghts: Keyvan Asghari
- Utah Geological Survey: Hugh Hurlow
- U.S. Geological Survey: Sam Lopez
- University of Utah: Paul Brooks

Special Considerations

There are several ways to approach this, ranging in complexity:

- Utilize existing groundwater models only
- Build a single groundwater model
- Represent the groundwater system in the surface water models
- Build a conceptual model applying knowledge from existing models and studies

Deliverable

While the exact final product is not yet determined, the outcome will be a modeling tool that allows for quantifying the groundwater budget and to simulate the budget under different demand and supply scenarios.

4. GREAT SALT LAKE AND WETLAND SYSTEM

Description

GSLIM routes surface water flow through the peripheral wetlands of Great Salt Lake as well as the water and salt balance in the lake. By linking the river operations models and groundwater with GSLIM, we will be able to evaluate how the lake responds to scenarios of changes to upstream supply, demand, infrastructure and policy. While GSLIM is usable in its current condition, several improvements can be made to the model to better represent the hydraulics and hydrodynamics of the lake and surrounding wetlands.

Tasks

- Improve causeway flow DLL (Dynamic Library Link file). Assure work by Utah State University:
  - Improves current simulation
  - Has methodology that can be used for various berm configurations
  - Verifies DLL is the correct format and language to be used in GSLIM
  - Tests DLL with GSLIM
  - Provides documentation and code
  - Improves the salinity bidirectional flow through the breach
- Improve evaporation equations. Study various evaporation methods which provide the best results with the least amount of input data
- Improve the salinity balance
  - Obtain better initial conditions for Bear River Bay and Farmington Bay salinity levels
  - Improved capability to predict the formation and extent of deep brine layer
  - Improved representation of return flows
  - Add the flushing of mineral ponds
  - Better represent the mineral company operations
- Improve the way the model reads and writes data
- Consider how the model could be modified to simulate physical changes to the lake hydraulics and effective area
- Remove the river basin module components so that GSLIM can be used with a student license
- Verify the outflow points from each managed and unmanaged area into the lake module bays
- Verify the inflow points and routing through the wetland areas
- Update the vegetation types, evaporation coefficients and spatial representation as needed
- Include open water areas and corresponding evaporation model
- Include wetland operations, dike elevations and flow throughs

Technical Team Members

Technical team members will work with pertinent water users and GSLAC to gain guidance on model purpose and intent, as well as to understand challenges, questions, policies, operations, hydrology and hydrography within the wetlands and the lake. Results of the model and model improvements will be presented to the steering committee, advisory group and GSLAC for review and validation. GSLAC will approve of the model for use in the GSLBIP.

- Division of Water Resources: Leila Ahmadi
- Division of Water Resources: Craig Miller
- Division of Wildlife Resources: Rich Hansen
- University of Utah: Bill Johnson
- Utah State University: Som Dutta
- U.S. Geological Survey: Christine Rumsey

Special Considerations

GSLIM requires precipitation and temperature input data. This data will have to be consistent with climate/supply scenarios. In its current form, GSLIM is usable as a planning tool. However, there are numerous aspects of the model that should be improved. These must be prioritized for their respective impact on planning scenarios.

Deliverable

An upgraded GSLIM model capable of representing the primary hydrologic and hydraulic characteristics of the open water and wetland systems will be created. A more flexible model that can simulate different wetland management, mineral company operations and physical lake configurations.

5. WATER DEMAND

Description

The amount of water used and consumed or depleted by human activities is the only decision variable that is entirely within human control. Yet, not all water diversions, depletions, system losses and return flows are measured. Models are used to fill in areas where measured data is not available as well as to simulate water demand under different conditions than current or historical. Demand scenarios based on selected variables such as population, consumption rate, land use, system efficiency, crop type, climate scenarios, etc. are derived from these models of municipal, industrial, agricultural and environmental models. Some version of a demand model exists for each water user type. Therefore this work is about assessing the adequacy of those models, then upgrading them as needed to meet project objectives. The purpose of these models is to provide inputs to the RiverWare operations models for determining diversion amounts.

Tasks

- Update the Division of Water Resources' Municipal Water Demand Tool
  - Determine whether a basin-wide model can be applied to all municipal water users and what methods, if any, need to be altered in the tool
  - Identify municipal water provider service area boundaries
  - Determine method to estimate outdoor demand for current conditions and future conditions
  - Determine method to estimate indoor demand for current and future conditions
  - Determine approach for quantifying system losses and system efficiencies
- Quantity and model water demand from industrial uses
  - Primarily mineral extraction ponds around the lake. These demands are represented in the GSLIM model
  - Verify dike elevations and pond areas
  - Represent basic pond operations include units and water depths
  - Refine evaporation rates
  - Refine return flow quantities, quality (salt loading) and locations
  - Assess whether any other industrial users should be accounted for in the models (e.g. sand and gravel, mining, food processing)
- Model agricultural water demand
  - Simulate major water users (those agricultural uses in the water user list)
  - Work with Utah Department of Agriculture and Food, watershed councils and water users to derive data and methods for this model
  - Quantify volumetric and temporal aspects of requested depletions and diversions
  - Utilize Water Related Land Use Map
  - Update GridET data flow to use climate scenario data in the database
  - Identify service area boundaries
  - Estimate system losses and efficiencies
  - Identify return flow points
  - Assess how to compute water demand for urban areas with secondary water
- Compute potential evaporation rates
  - Compute reservoir evaporation rates for input into the RiverWare model and possible the GSLIM model (depending on how wetland open water evaporation and Great Salt Lake evaporation are handled in GSLIM)
  - Quantify water demand at natural and managed wetlands around Great Salt Lake and significant wetlands upstream of the lake
  - Quantify a flow demand pattern for the open water zone of the lake based on assumptions of target elevation/functionality and time to reach target (when lake is at or above the target
- Collect all pertinent data and store it in the data repository system built in Component 6

Technical Team Members

The technical team members will work with water users individually and through the watershed councils to identify, collect and organize the data required to improve the models. Working with them will assure that the model satisfactorily represents their water supply system and the water demands. They will also give input so that the models can be built to evaluate the water management alternatives they will wish to investigate. Watershed councils will approve of the model for use in the GSLBIP.

- Division of Water Resources: Scott McGettigan
- Division of Water Resources: Clay Lewis
- Division of Water Resources: Leila Ahmadi
- Division of Water Rights: Brandon Mellor
- Division of Water Rights: Skyler Buck
- Department of Agriculture and Food: Brian Christensen
- Compass Minerals: Joe Havasi
- Rudy Duck Club: Justin Dolling

Special Considerations

These models need to be built in collaboration with those water users whose demands are being modeled. Thus there should be a basic level of verification and model adjustment to ensure that the models represent the water users' historic demands adequately enough for planning. This task is difficult, but the models are critical to assist planning and obtain an understanding of water use in the basin.

Deliverable

Refined models that can simulate the components of water demand for all the major water users in the basin will be created. The models are developed and linked to the model database in such a manner that demand scenarios based on climate and water user decisions can be readily generated, cataloged and simulated in the overall system model.

6. DATABASE MANAGEMENT AND MODEL INTEGRATION

Description

This task links together discrete, pre-existing models to effectively provide a basin-wide simulation. Primarily it involves the digital infrastructure to pre-process data, store data (in various formats) and access the data for both simulation and post-processing (Component 7). The digital infrastructure facilitates the simulation of a variety of scenarios as well as the orderly storage of the model results. It also provides access to data through simple scripting, a web platform or a desktop GUI.

Tasks

- Identify and catalog all data and data types which will be stored and accessed by the various models
- Organize model sharing and storage system
- Design the data storage system and a management approach
- Build the data storage system
- Design supporting software to access and view the data storage system
- Program a digital workflow to maintain model concordance, run the full simulation with all cascading models and organize and access scenario simulations

Technical Team Members

- Division of Water Resources: Jake Serago
- Division of Water Resources: Clay Lewis
- Reclamation: Maribeth Kniffin
- University of Utah: Jeff Horsburgh

Special Considerations

Design specifications and particulars of the data storage system can not be identified without first inventorying all the data inputs and types which will be used by the various models. The data storage and digital modeling infrastructure will need to allow for users from different locations to work on the model simultaneously. As the model is intended to be run only by those with permission to do so, it will not be part of this task to design a public facing platform.

Deliverable

A system for running the different models together, reading input data from a database(s) and writing the model output to the database(s) will be developed.

7. DATA VISUALIZATION AND MAPPING

Description

Communication of climate data, water supply data, water demand data, the structure of the models and the model results. Initial mapping supports modeling approaches and decisions by providing a visual, spatial format of what is represented by the models. This will allow the model teams to identify which areas of the basin are represented in the models and which areas are deemed too important to exclude. Such efforts will identify inflow points in the RiverWare model so that they can be spatially communicated to the technical service center to extract the VIC model outflow at those locations.

Additionally, this task creates tools for communicating data and modeled scenarios. This determines in large part how effective the modeling effort is because the way that results are communicated is just as important as how the system is modeled. The task includes identifying which data and exactly how they are presented, providing support for how the visualizations and maps are published or displayed to the public, decision-makers and partners.

Tasks

- Map domains and structural components of each model
- Utilize those maps in conjunction with available spatial layers, water user list and spatial data derived with or by the partners to identify areas of the model that need to be added to the models
- Map the following for each major water user:
  - Major hydraulic infrastructure
  - Key hydrography
  - Major production wells
  - Points of diversion
  - Places of use corresponding to the of points of diversions
  - Land use in the places of use
  - Return flow points, including wastewater treatment plants
- Identify the audiences for different types of information available from the model
- Coordinate partner workshops to support their development of key indicators
- Design statistics, graphs, infographics and maps to communicate results
- Build visual aids of quantities and qualities (key indicators or key performance measures) which are important to the various audiences. Determine how best to share and display those key indicators, some ideas include:
  - Report
  - Story map
  - Web interface to access the data and post-processed data from the storage system
  - An online decision support dashboard
  - Distributable GUI connected to transferable database

Technical Team Members

- Division of Water Resources: Tom Moore
- Division of Water Resources: David Gunther
- Division of Water Resources: Summer Dawn Shumway
- Central Utah Water Conservancy District: Derek Bruton
- Reclamation: Brennan Young

Special Considerations

Visual aids such as graphs, infographics and maps can be presented using various software tools but are limited by the data available. Particulars about how the available data are communicated will be dependent upon what partners wish to see. Information content such as water user trade-offs can not be communicated in any format unless those trade-offs are quantified or qualified by committee members, project partners or water users.

Deliverable

A GIS map with pertinent model and analysis data, including the key spatial information from the models will be created. A story map utilizing the GIS map in conjunction with data from the data storage system, including the scenario analysis to communicate important information, key indicators and tradeoffs necessary to support development of a basin-wide water resource strategy will also be developed. In addition, there will be a data display tool tailored to the preferences of water users, the advisory group and steering committee.

D PARTNER INVOLVEMENT

INTRODUCTION

As mentioned in the introduction and in Appendix C of the Work Plan Foundation document, the development of a successful basin planning tool requires extensive collaboration and engagement. Robust involvement from a diverse group of partners is essential to developing consensus and a vested interest in the GSLBIP process and outcomes.

Methods, messages and opportunities for partner engagement for the GSLBIP process are presented below. There will be a need for general project messaging throughout the process and targeted engagement during the modeling and planning phases. While opportunities for partner engagement are highlighted below, they are subject to change as the project demands.

GOALS AND OBJECTIVES

The three goals of partner involvement throughout the development of the GSLBIP are to engage partners in the process, foster collaboration throughout the basin and raise public awareness about the importance of water management planning in the basin.

Goal 1: Engage Partners

Objectives:

- Forge connections and shared understanding between diverse partners and enhance internal communications across the GSLBIP project team and partners
- Integrate lessons learned from the Situational Assessment completed during the work plan stage and continue to assess partners' perceptions of the problems and potential solutions
- Provide feedback and input through the work plan implementation
- Coordinate project timelines and objectives with the Great Salt Lake Commissioner

Goal 2: Foster collaboration and a shared understanding of connectedness within the Great Salt Lake Basin

Objectives:

- Utilize the five constituent local watershed councils (Bear, Weber, Jordan, West Desert and Utah Lake) and the Great Salt Lake Advisory Council to ensure representation of diverse interests that take into account varying backgrounds, geographies and perspectives from throughout the Great Salt Lake Basin
- Ensure regular and effective communication with policymakers in the Great Salt Lake Basin through resource tours, testimony at committee meetings, individual meetings and conferences for city and county leadership
- Support and inform the project steering committee's efforts to represent the GSLBIP
- Build and communicate consensus around actions and policy recommendations

Goal 3: Raise public awareness and a commitment to action

Objectives:

- Leverage new opportunities to inform and engage the public about the importance of protecting and restoring a resilient water supply in the basin and actions they can take or support to achieve a resilient water supply in the basin
- Provide numerous opportunities for gathering public input
- Organize and facilitate public meetings
- Maintain and provide relevant and timely information via the project website and division social media platforms
- Prepare press releases to highlight strategic points and milestones

KEY MESSAGES

Key communications messages should be short and convey the essence of the GSLBIP and its process. These messages will be consistent throughout all communications to project partners.

- Ensuring a resilient water supply requires extraordinary vision and concerted collaboration. Solutions are socially and technically complex as demands on this limited resource continue to increase. Today's water management decisions shape tomorrow's possibilities
- The GSLBIP will pioneer collaborative efforts, yielding a comprehensive action plan as its outcome
- The GSLBIP will leverage the success of existing tools, data and plans and seeks to integrate and streamline meaningful partnerships and programs; it should not duplicate efforts
- The state of Utah is a responsible steward of Great Salt Lake and is actively working with partners to find solutions to secure a resilient water supply for the lake, its basin and all uses
- The GSLBIP intends to foster a culture of trust — bringing voice and value to diverse perspectives and water uses — while also providing a platform for concerns when they arise.

ENGAGEMENT, COLLABORATION AND RAISING AWARENESS

The division will articulate an overarching, unifying key message about our connection to the Great Salt Lake Basin that resonates with audiences. The key messaging will also convey how the GSLBIP process will help connect us to the watershed. The division will develop key messaging and create a strategic approach to delivering the watershed connection messaging.

Next Steps

- Work with public relations experts to develop and execute a key watershed connection message. This messaging will be developed immediately and maintained throughout the life of the project and will be emphasized at modeling and planning milestones, discussed below. (March 2024 - December 2026)
- Create a toolkit and media assets for ongoing use in emails, social posts, newsletters, meetings, public events and on division websites such as:
  - Key messaging and talking points
  - Presentation templates
  - Info sheets
  - Brochures
  - Graphics
  - Images
  - Other as needed (March 2024 - December 2024)

Key Communication Methods

- Press releases
- Email and newsletter updates
- Social media posts
- Website updates

Key Outreach Methods

- Open houses
- Legislative updates
- Great Salt Lake Basin site visits
- Conference presentations
- Connection workshops

PLANNING APPROACH

This phase of the project will require the greatest amount of partner involvement. Partners will have the opportunity to shape performance metrics, scenario development, mitigation strategies and trade-offs. The project team will be responsible for partner engagement during this phase. The key messages mentioned above will be delivered throughout this phase, but input from partners will be targeted and specific to the Work Plan Actions document planning components.

- Develop performance measures
  - Engage partners — including water users, watershed councils, advisory group and steering committee — to develop a suite of performance measures (March–June 2024)
  - Convene water users and other partners via the watershed councils at basin-specific workshops to talk face-to-face about performance measures (May 2024)
  - Communicate performance measures for partner feedback via watershed council meetings, website and social media updates (July 2024)
- Model existing basin conditions
  - Share draft and final model outputs through the advisory group, steering committee and watershed councils for feedback on validating existing conditions (October 2024–May 2025)
  - Simulate plausible future conditions
  - Coordinate partner workshops and information sessions regarding scenario development (July 2024–June 2025)
  - Provide updates and solicit feedback from advisory group, steering committee and watershed councils (October 2024–July 2025)
- Evaluate alternatives
  - Engage partners — including water users, watershed councils, advisory group and steering committee — to develop a suite of management alternatives (October 2024–March 2025)
  - Convene water users and other partners via the watershed councils at basin-specific workshops to talk face-to-face to refine alternatives (December 2024)
  - Communicate management alternatives for partner feedback via watershed council meetings, website and social media updates (April 2025)
- Analyze trade-offs
  - Engage partners — including water users, watershed councils, advisory group and steering committee — to assess the value of shortlisted alternatives and the ability of the alternatives to achieve the goal of individual and system resilience (February 2025–November 2025)
  - Convene water users and other partners via the watershed councils at basin-specific workshops to talk face-to-face about trade off implications (April 2025)
  - Communicate the trade-off implications for partner feedback via watershed council meetings, website and social media updates (May 2025–December 2025)
- Develop actionable plan
  - Engage partners — including water users, watershed councils, advisory group and steering committee — to select the suite of alternatives that best represent system resilience and develop actions for implementation (January 2026–December 2026)
  - Convene water users and other partners via the watershed councils at basin-specific workshops to talk face-to-face about developing actions to ensure resilience (March 2026)
  - Communicate the alternatives that best represent system resilience and the actions recommended to ensure resilience for partner feedback and a Draft Final GSLBIP via watershed council meetings, press releases, website and social media updates (May 2026)
  - Host a GSLBIP Open House for partners to review and comment on the project. (November 2026)
  - Communicate the Final GSLBIP to partner groups via presentations, press releases, website and social media updates (December 2026)

MODELING APPROACH

The majority of tasks to be completed during the approximately two-year modeling phase will be completed by the project team and technical teams. The project team will disseminate technical information, modeling approaches and results throughout the development of the models. Opportunities for engagement between the partner groups are as follows:

- Initial weekly technical team meetings to initiate modeling efforts (2024)
- Technical team communications to water users and watershed councils to collect data and organize and improve models as necessary (throughout 2024–2025)
- Monthly written briefs by the project and technical teams to be disseminated as necessary (throughout 2024–2025)
- Quarterly modeling presentations to the watershed councils (throughout 2024–2025)
- Creation of data visualization tools once modeling efforts reach key milestones to be consumed by all partners in the basin (throughout 2024–2025)
  - GIS maps
  - Web interface
  - Story map

MOVING FORWARD

Development of the GSLBIP will require innovation, flexibility, transparency and collaboration to achieve the desired consensus. The tasks outlined in this Work Plan Actions document will frame and guide the creation of an effective planning tool that will be supported and used by water managers and partners throughout the basin. The planning and modeling efforts outlined in this document will require technical expertise and effective communication throughout the basin. Conveying the technical information to our partners throughout the basin will be vital to developing a shared understanding of the issues, concerns, options, trade-offs and decisions involved in the implementation of the GSLBIP. The shared understanding and commitment to solving the Great Salt Lake Basin water management challenges begins with the successful creation of the GSLBIP.

1 INTRODUCTION

Water represents life. It is what likely first attracted indigenous peoples to the shores and tributaries of Great Salt Lake (GSL). Harnessing its life was a priority for Euro-American pioneers when they arrived in Utah and first diverted City Creek. Its life is the legacy that subsequent generations worked and sacrificed to leave us and enable the growth and development we have enjoyed throughout the GSL watershed ever since.[12, 18]

What is an Integrated Water Assessment?

An integrated water assessment (IWA) is a means to understanding problems and challenges and evaluating options that enable informed decisions. An IWA is a planning process that holistically looks at planning and managing the entire water cycle and considers it as a single and connected system.[11] It ensures that development and management of a community's resources are coordinated to maximize social and economic benefits while minimizing impacts on the community and the environment. Per House Bill 429, the IWA is intended to provide recommendations for an action plan that will achieve the defined goal.

Recent drought and the observed decline in GSL water levels have elicited significant concern to no surprise. These concerns represent a potential risk to continued economic growth, public health, and vibrant ecosystems and communities in and throughout the GSL watershed.[14, 18, 26] They also represent an urgent challenge to be faced today for generations tomorrow.[12, 14]

Against this backdrop, the Utah Legislature took the significant step in 2019 to recognize "the critical importance of continued water flows to GSL and its wetlands and the need for solutions to address declining water levels, while appropriately balancing economic, social, and environmental needs."[26] The Utah Legislature built upon resulting recommendations to commission and direct the Utah Department of Natural Resources, Division of Water Resources (WRe), to complete a GSL Watershed Integrated Water Assessment (IWA) in 2022.[28] The IWA, within the context of the GSL watershed, must accomplish the following:

- **Assess** the current and future water supply
- **Assess** current and future water demands
- **Investigate** the potential benefits of forest management and watershed restoration
- **Assess** the quality of available water resources
- **Identify** and **evaluate** best management practices that provide adequate flow to sustain GSL, its wetlands, and other ecological functions in its watershed
- **Study** the impact of stormwater management practices on the water budget of GSL

Most importantly, the IWA must integrate ongoing efforts and systems, develop collaborative solutions, and recommend actions that shape a lasting water legacy for future generations.

The GSL Watershed IWA is a roadmap to understanding and action.

ABOUT THIS WORK PLAN

Soon after House Bill (H.B.) 429[28] was passed, WRe and its partners applied to the U.S. Bureau of Reclamation (Reclamation) for a WaterSMART grant for additional funds for preparing the GSL Watershed IWA. WRe was successful and notified in December 2022 that Reclamation would provide up to $3,174,000 in matching funds for a GSL Basin Study. WRe and Reclamation combined H.B. 429's GSL Watershed IWA with Reclamation's GSL Basin Study into one effort: the GSL Basin Integrated Plan (GSLBIP). WRe and Reclamation will jointly manage and deliver this effort using in-house staff, the efforts of partners, and work by contractors. This Work Plan meets the requirements for a Work Plan as outlined in both H.B. 429 and Reclamation's Basin Studies Directives and Standards;[34] these are listed in Table 1-1). This Work Plan represents a roadmap toward developing the GSLBIP—a roadmap to action.

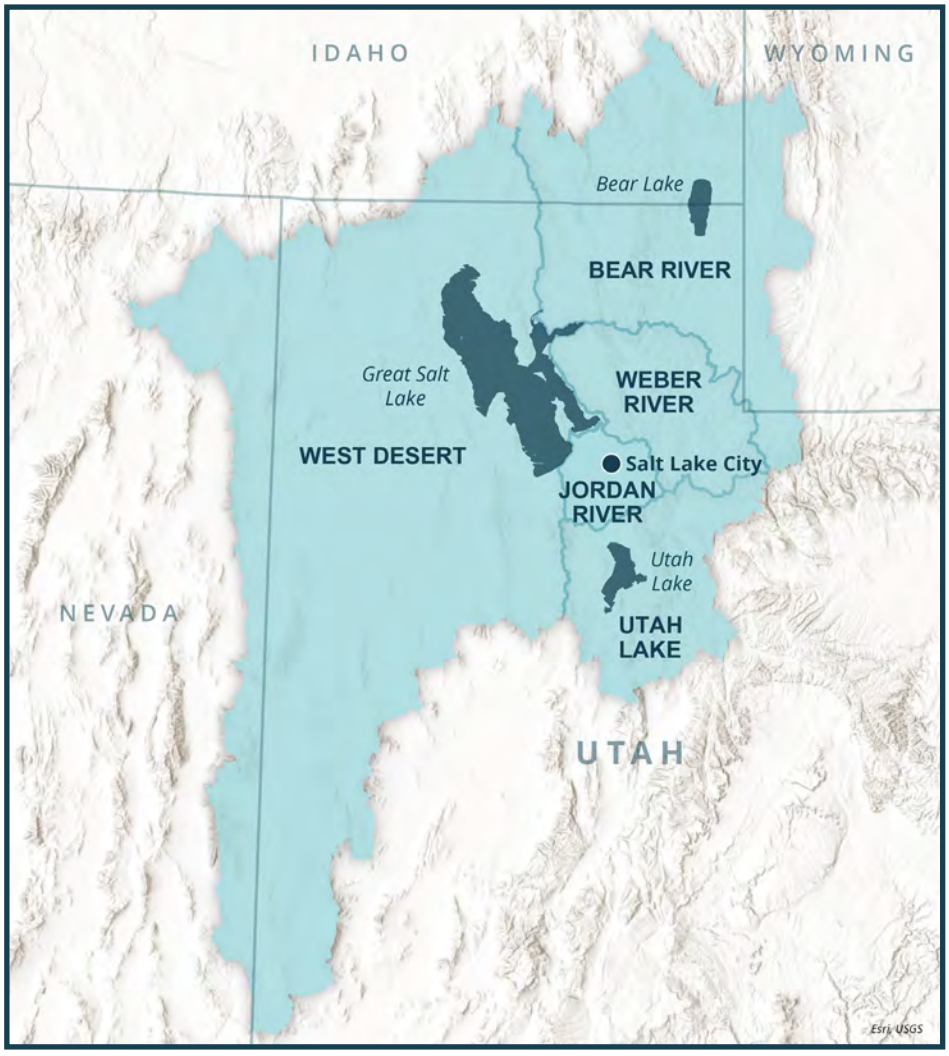
Table 1-1. Requirements for This Work Plan

House Bill 429	Basin Studies Directives and Standards (WTR 13-01)
• Completion by November 30, 2023 • Synthesis of available information, literature, and data • Development of a water budget for the entire watershed, including GSL and its associated wetlands • Assessment of scientific, technical, measurement, and other information needs • Implementation of the Work Plan description before November 30, 2026	• Basin study management structure • Decision-making process • Project team roles and responsibilities • Study team coordination • External communication and outreach processes • Technical analysis methodologies • Task and milestone schedules • Budget and cost control • Deliverables and project documentation requirements • Description of study review process, including reporting requirements

GREAT SALT LAKE WATERSHED STUDY AREA

The GSL watershed is a 36,199-square-mile closed basin within the Great Basin region. GSL is the largest saline lake in the western hemisphere and receives all waters not evaporated or consumed in the watershed. Figure 1-1 illustrates the four states with territory in the watershed: Utah, Wyoming, Idaho, and Nevada. The watershed is home to 2.8 million people (83 percent of Utah's population) living in 141 municipalities. More than 1.4 million acres of farmland are irrigated[45] with water stored in more than 909 reservoirs.[47] While Utah is the fourth fastest-growing state in the nation, GSL's water level has been in long-term decline, with serious implications to wildlife habitat, recreation, public health, industry, agriculture, ecosystem services, and the regional hydrologic cycle. GSL fell below its historical low elevation during 2022, resulting in more public attention on, and engagement with, the lake than perhaps ever before. Similarly, due to the limited water supply, many water supply systems in the GSL watershed were also severely stressed. All five river basins contributing to GSL—Bear River, Weber River, Jordan River, Utah Lake, and West Desert—and GSL itself will be considered in the GSLBIP (Figure 1-1). Each river basin, along with their smaller streams, springs, imported water from the Colorado River Basin, and regional aquifers, supports large agricultural areas, small towns, a growing metropolis, and unique ecosystems. All river basins contribute any water that is not utilized to GSL, the lowest point in the watershed. The GSLBIP will be the first effort to attempt to fully integrate the water cycles and management of each river basin and GSL itself within the context of the GSL watershed.

Figure 1-1. Great Salt Lake Watershed Study Area



THE CHALLENGE TO OVERCOME

The challenge to overcome by the GSLBIP initially appeared to be straightforward and clear. GSL's gradual decline, culminating in a record low water level in 2022, poses a significant risk to Utah's economy, public health, and ecosystems.[14, 26] Exposed lakebed, resulting dust emissions, reduced habitat, and ecosystem impacts from elevated salinity[13; 15] became most acute in 2022 and attracted widespread publicity and concern.[9; 20] The GSL Strike Team, which comprises state agency professionals and researchers from Utah State University and the University of Utah, recently concluded that "the situation requires urgent action."[14] Upon further evaluation, however, GSL's decline appears to be a symptom of more consequential water resource challenges in the watershed.

As a terminal lake that receives inflow from its watershed but has no outlet, GSL reflects the change its watershed has experienced over time. Thus, the long-term decline of GSL, even as punctuated by the floods of the 1980s, reflects similar symptoms observed in its watershed and surrounding region. Population growth,[17] recent declining trends in instream flows,[14, 22] declining groundwater levels,[49] increasing impacts from drought to agriculture,[36] increasing risks from wildfire[38] and from reduced flows to habitat, wildlife, and water quality,[24] aging infrastructure,[3, 29] growing water challenges,[29, 34] and increasing efforts and investments in water management to sustain the status quo in the GSL watershed[8, 27, 29] are consistent with GSL's symptoms. The decline of reservoirs in the Colorado River system, groundwater levels in Utah's other Great Basin aquifers,[25] and in terminal lakes[1, 26] throughout the western United States[3]5 are also consistent with GSL's symptoms. All are symptoms that point toward a long-term impact from climate change, increasing water use in the watershed[14] and an increasingly complex social, political, and regulatory system of systems.[29] Together, they point toward what is considered a wicked problem[16, 23]—a problem or a challenge that cannot be definitively defined due its social and technical complexity (refer to Appendix A, *Challenge Statement Development Technical Memorandum*).

Challenge Statement

Ensuring a resilient water supply requires extraordinary vision and collaborative effort. Solutions remain socially and technically complex as demands on this limited resource continue to increase. Today's water management decisions shape tomorrow's possibilities.

The challenge was organized to describe the social and technical complexities as follows (Appendix A provides more details):

Social complexity

- Social challenges
- Awareness challenges
- Fragmentation
- Organizational and institutional challenges
- Legal challenges

Technical complexity

- Water supply
- Water management
- Land management
- Quantification
- Environmental challenges

Ensuring a resilient water supply requires extraordinary vision and collaborative effort. Solutions remain socially and technically complex as demands on this limited resource continue to increase. How can we build a resilient water supply that sustains the health and growth and enables the future we envision for GSL and all water uses in its watershed? The challenge is to make water management decisions today that determine whether adequate water is available to support the needs of all uses within the watershed for generations to come. Today's water management decisions shape tomorrow's possibilities.

THE GOAL TO ACHIEVE

An outcome-oriented goal statement provides clarity about the desired outcome to be accomplished over time; it also provides an opportunity for stakeholders to forge early consensus around a vision for the result of their efforts. The goal statement helps facilitate connection and create an incentive to participate in the process.

The following goal statement for the GSLBIP was developed and refined over time to reflect the intent of H.B. 429 and input received throughout Work Plan development:

> **Ensure a resilient water supply for GSL and all water uses, including people and the environment, throughout the watershed.**

A proven means of maintaining focus during an investigation is to also cast the goal as a question, as follows; all studies and projects to be completed as part of the GSLBIP should work to answer the question and achieve the goal:

> **How do we ensure a resilient water supply for GSL and all water uses, including people and the environment, throughout the watershed?**

What is a resilient water supply?

The means are in place to provide a water supply that can meet the following criteria:

- Anticipates the effects of short- and long-term water-related shocks and both acute and chronic stresses:
  - –Acute— drought, spills, infrastructure failure, wildfire, earthquake
  - –Chronic— climate change (increasing temperature and evapotranspiration), growing water demands, water storage and management to meet growing water demands, declining aquifer and lake levels, water quality and habitat degradation
- Is prepared and can resist disruptions
- Can survive through and recover from adverse impacts of those events
- Can adapt and transform in a way that allows us to learn and thrive
- Can balance both human and environmental needs/demands

OBJECTIVES FOR THE GREAT SALT LAKE BASIN INTEGRATED PLAN

Objectives are the measurable steps taken toward achieving the stated goal. The following strategic objectives will help enable successful GSLBIP completion and implementation:

1. **Forge connections—**Just as the water cycle connects GSL with its watershed, the GSLBIP must connect the water supply and water uses of GSL with those in its watershed. Our social, political, regulatory, organizational, and research structures must connect; that is, relationships must be established to build resilience in the watershed. Connections are typically forced upon us when crises occur to enable us to respond. Building resilience demands that we anticipate and create these connections. The GSLBIP will forge lasting connections throughout the watershed that build and sustain a resilient water supply for GSL and all water uses in its watershed. These connections will be the basis for integrated collaborative solutions.
2. **Develop shared understanding—**Building resilience requires a common understanding of the GSL watershed's complex hydrology, its built and natural environments, and the political, regulatory, and legal regimes that govern them. We must agree what the challenges are and why they must be addressed. We must have a transparent technical dataset and analyses that form the basis for decisions. We must understand our options and own our actions. Through GSLBIP development and implementation, stakeholders throughout the watershed will develop a shared understanding of the issues.
3. **Quantify water resources—**H.B. 429 rightly emphasizes the importance of developing a water budget for GSL and its watershed. We must understand the available water supply, its quality, and the demands placed upon it in the past, present, and future to build a resilient, sustaining water supply.[28] This requires active and accurate measurement, assessment, and forecasting tools, processes, and infrastructure. The GSLBIP must develop the means to quantify the existing water supply and water demands and forecast the future water supply and water demands for GSL, its associated wetlands, and its watershed.
4. **Evaluate options—**The GSLBIP must consider the following: (1) GSL watershed potential points of failure and determine how these weak points can be protected or backed up, (2) the means to build flexibility into water systems to facilitate quick response and deep recovery, (3) the means of minimizing impacts and stopping cascading losses, (4) options that will enable a return to healthy systems as quickly as possible, and (5) options that promote active learning, rapid adaptation, and improved response. The GSLBIP must identify and evaluate options that will mitigate risks, adapt to and mitigate potential water shortages, embrace future uncertainties, address the challenges and achieve its goal.
5. **Recommend actions—**GSLBIP development must carefully consider the values and requirements of the human and natural systems, minimize short- and long-term risks, evaluate potential conflicts and tradeoffs, and develop consensus around a suite of recommended actions. The GSLBIP also must include a robust trade-off analysis to help decision-makers balance water supply and demand and avoid deterioration of agriculture, industry, communities, and ecosystems. The final GSLBIP will include recommendations for actions for achieving its goal.

THE EXPECTED OUTCOME

This Work Plan outlines a roadmap for the GSLBIP of engagement, monitoring, study, modeling, and analyses intended to uncover and develop durable and defensible solutions that overcome the challenge and achieve the GSLBIP's goal. Developing the GSLBIP will require innovation, flexibility, transparency, collaboration, and compromise to achieve consensus. There will be a temptation to expand the scope, a need to delve into more detail, and a desire to extend the schedule. The challenge the GSLBIP must overcome, however, cannot wait. The GSLBIP must result in a timely action plan that the public will support and decision-makers can feasibly implement. The water legacy we will leave to future generations is on the line.

2 INTEGRATING PARTNERS AND ACTIVITIES

The water resource management challenges we face today require an integrated approach that considers the entire water cycle and treats GSL watershed as a single and connected system – a system of systems. Sustainable and resilient solutions will require the GSLBIP to integrate not just surface and groundwater supplies, but also the social, legal, economic, and political structures; local and regional water infrastructure and operations; and environmental requirements of the entire watershed (Figure 2-1). To do so, the GSLBIP must begin with and be founded upon trust and partnership, and it must integrate the goals, objectives, and work of partners and participants to boost connection and alignment, minimize duplication of effort, leverage available expertise and funding, and achieve the best result.

Figure 2-1. Elements to be Integrated as Part of the Great Salt Lake Basin Integrated Plan

To learn more, contact Laura Vernon/WRe at gslbasinplanning@utah.gov.

PARTNERS AND PARTICIPANTS

WRe and Reclamation have developed a growing list of partners who have already formally committed time, information, and resources to GSLBIP development (Table 2-1). WRe and Reclamation are committed to bolstering these existing partnerships as well as forging new ones. Each partner will become involved with and participate in tasks depending upon their unique interests, mission, expertise, and mandate. An ebb and flow of participation among partners is expected throughout the GSLBIP development.

Numerous entities and individuals also are already involved in some way or have or may indicate their desire to participate. These include local water management agencies, irrigation companies, tribes, municipalities, educational institutions and organizations, nongovernmental organizations, community organizations and individuals. Some participants may participate in executing tasks, while others may simply observe and be informed of study activities. All stakeholders throughout the watershed will be invited and given the opportunity to participate and share their insights related to the GSLBIP.

Table 2-1. Growing Partnership Committed to the Great Salt Lake Basin Integrated Plan

Great Salt Lake Basin Integrated Plan Partners	
Academic and Advisory	
Agricultural Water Optimization Committee	Growing Smart Initiative
Bear River Watershed Council	Jordan River Watershed Council
Great Salt Lake Advisory Council	University of Utah
Great Salt Lake Ecosystem Program	Utah Lake Watershed Council
Great Salt Lake Salinity Advisory Committee	Utah State University
Great Salt Lake Strike Team	Utah Water Ways
Great Salt Lake Technical Team	Weber River Watershed Council
Great Salt Lake Watershed Enhancement Trust	West Desert Watershed Council
Environmental and Conservation	
FRIENDS of Great Salt Lake	The Nature Conservancy
National Audubon Society	
Federal Agencies	
U.S. Army Corps of Engineers	U.S. Fish and Wildlife Service
U.S. Bureau of Reclamation	U.S. Forest Service
U.S. Bureau of Land Management	U.S. Geological Survey
U.S. Environmental Protection Agency	
State Agencies	
Idaho Department of Water Resources	Utah Division of Water Resources
Utah Division of Air Quality	Utah Division of Water Rights
Utah Division of Conservation	Utah Division of Wildlife Resources
Utah Division of Forestry, Fire & State Lands	Utah Geological Survey
Utah Division of Indian Affairs	Utah Division of State Parks
Utah Division of Water Quality	Wyoming Office of the State Engineer
Water Suppliers	
Bear River Canal Company	Metropolitan Water District of Salt Lake and Sandy
Bear River Water Conservancy District	Ogden River Water Users Association
Cache Water District	Provo River Water Users Association
Central Utah Water Conservancy District	Salt Lake City Department of Public Utilities
Jordan Valley Water Conservancy District	Weber Basin Water Conservancy District

ONGOING ACTIVITIES TO BE INTEGRATED INTO THE GREAT SALT LAKE BASIN INTEGRATED PLAN

Water planning is not something new in Utah. The water plans of our predecessors are what enabled the growth and development of the communities and economy we enjoy today; those plans left an incredible water legacy. The partners listed in Table 2-1—plus numerous more—continue that important planning legacy. The GSLBIP must capitalize upon this wealth of information, knowledge, and experience; integrate past and ongoing efforts; and identify opportunities to bring them into alignment.

WRe's first task related to H.B. 429, as described in Section 1, was to partner with Reclamation to capitalize upon its expertise in water planning, development, conservation, and management and the regional water infrastructure it has had a significant role in developing and operating throughout the GSL watershed. The result is the development of this Work Plan for the GSLBIP. Many previous and ongoing activities were identified as part of situational and gap assessments completed for this Work Plan. Many activities are already under way or beginning soon that will be important to integrate with the GSLBIP; some activities are summarized in Table 2-2.

FUNDING SOURCES

Primary funding for the Work Plan and also GSLBIP development will come from $5 million appropriated by the 2022 Utah Legislature and $3.17 million in matching funds from a WaterSMART grant provided by Reclamation. Reclamation's funding may be via in-kind services or direct funding to WRe. WRe is actively working with the GSL Strike Team, other state agencies at the Utah Department of Natural Resources, Utah Department of Agriculture and Food, and Utah Department of Environmental Quality, and other federal agencies at the United States Department of Interior and United States Department of Agriculture to leverage existing and identify new sources of funding for additional work. Reclamation is also assisting with investigating potential additional funding sources.

Table 2-2. Critical Activities to be Integrated into the Great Salt Lake Basin Integrated Plan Development

Plan	Description	Details
Great Salt Lake Stormwater Study	H.B. 429 funded an independent evaluation of how low-impact development best management practices associated with post-construction stormwater permit requirements may impact the water budget of GSL.	This study has been completed in coordination with WRe and DWQ and will be presented to the Legislature in November 2023.
USGS Saline Lakes Ecosystems IWAA[1]	Authorized by the 2022 Saline Lake Ecosystems in the Great Basin States Program Act, the Saline Lakes IWAA includes numerous studies to collect data and investigate the interplay between saline lake hydrology and ecology to inform water management in the western United States. USGS has 11 active studies as part of this IWAA that include GSL and its watershed.	The Saline Lakes Ecosystems IWAA is currently funded through October 2024 and includes the following: • Water quality and quantity monitoring • Avian movement and habitat monitoring • Remote sensing analyses of habitat, hydrology, and water quality • Aquatic ecology monitoring • Water budget development • Analyses of watershed land use changes • Communications • Database development
GSL Watershed Enhancement Trust[2]	The GSL Watershed Enhancement Program Act (H.B. 410) in 2022 provided $40 million for a water trust to enhance GSL water quantity and quality and GSL wetlands and restore and protect wetlands and habitat in the surrounding GSL ecosystem to benefit lake hydrology. The Trust has already facilitated or funded several temporary and permanent water transactions and wetlands projects and is conducting assessments and studies to preserve essential habitats and hydrology that can be protected, enhanced, and restored.	This Trust, established and co-led by National Audubon Society and The Nature Conservancy received a $40 million grant from the state to achieve the GSL Watershed Enhancement Program Act goals. The Trust Advisory Council advises on matters related to the mission of the Trust and major project proposals.
USGS and UGS GSL Basin Groundwater Model	This effort was funded by the 2021 Utah Legislature to develop a groundwater model of the GSL Basin to better quantify the groundwater contribution to GSL and its wetlands. The goal is to help with future planning and water management decisions affecting the lake, its wetlands, and surrounding areas.	This collaborative effort is scheduled to be completed in 2025.

Plan	Description	Details
GSL Tech Team Hot Topics Research Grants	FFSL has been funding novel research of GSL since 2009 via its Hot Topics research grant program. The GSL Tech Team recommends key topics of interest that will further knowledge of GSL. FFSL solicits and funds proposals annually. Results are published to the community.	FFSL has funded approximately $200,000 in grants annually through fiscal year 2023. FFSL intends to increase this amount to $500,000 with a renewed focus upon research that informs and improves management of GSL.
GSL Strike Team	This team was originally formed in 2022 to bring together researchers at the University of Utah, Utah State University, and state agencies to provide data and answers to key questions needed for saving GSL. The GSL Strike Team is currently assisting the GSL Commissioner develop his strategy.	This team published its *Great Salt Lake Policy Assessment*[3] on February 9, 2023, for the 2023 General Legislative Session.
GSLAC, GSL Technical Team, GSLEP Technical Advisory Group, and GSL SAC	These groups comprise stakeholders and scientists completing ongoing studies to identify risks and opportunities and recommend studies and management strategies. Each group has a different point of focus.	Information about these groups is available online.[4, 5, 6, 7]
Water Suppliers And Managers	Numerous irrigation companies and municipal wholesale and retail water suppliers operate in the GSL watershed. All perform water planning at some level, provide expertise and data, and are important partners for the GSLBIP.	Example water-planning documents they maintain include 40-year water requirement plans, water conservation plans, annual water use plans and reporting, and system water master plans.
Agricultural Water Optimization Program	UDAF was appropriated $200 million in 2023 to invest in helping agriculture optimize water use while maintaining or improving agriculture production.	Applications for projects must demonstrate water savings. Also, all projects require using flowmeters and demonstrating improved and protected surface and groundwater quality by reducing overwatering of crops.
GSL Inflow Monitoring	WRi is working with Utah State University to complete a gap analysis of flow measurement infrastructure in the GSL watershed to identify priority locations for the installation of new flow measurement infrastructure.	A total of $5 million was appropriated to WRi for this program, but it expires on June 30, 2024.

Plan	Description	Details
GSL Recovery Program	Funding was identified in the 2022 GSL Recovery Program Act for the USACE to study drought conditions and protect the long-term health of GSL. WRe is currently coordinating with the USACE.	WRe has signed a Memorandum of Agreement with the USACE to begin an initial assessment of project needs. This assessment will begin in 2023 and likely conclude in 2025.
GSL Comprehensive Management Plan	FFSL intends to begin updating its *Final Great Salt Lake Comprehensive Management Plan and Record of Decision*[8] in 2023. This plan is intended to identify potential issues and strategies to manage GSL resources at different lake levels.	This important effort, which will help determine whether developing safe operating water levels for GSL is feasible, will begin during late 2023 and likely conclude in 2025.
Utah Wildlife Action Plan	This plan is an Endangered Species Act listing prevention plan that provides a roadmap on what species need conservation attention in Utah, what habitats they rely upon, what stressors they face, and important conservation actions.	The Utah Wildlife Action Plan is required to be revised every 10 years, and the DWR and partners are currently revising the plan with a timeline for completion being fall 2025. For this revised plan, Utah conservation partners have placed more emphasis on the GSL ecosystem, including saline lakes habitat and expansion of the species that need conservation attention, which comprise species that rely on GSL (for example, brine flies and birds reliant on GSL are being considered for inclusion).

[1] More information is available at https://www.usgs.gov/special-topics/saline-lakes-ecosystems-integrated-water-availability-assessment

[2] More information is available at https://www.gslwatertrust.org/

[3] *The Great Salt Lake Policy Assessment* can be accessed at https://gardner.utah.edu/great-salt-lake-strike-team/

[4] More information is available at https://deq.utah.gov/great-salt-lake-advisory-council/great-salt-lake-advisory-council

[5] More information is available at https://ffsl.utah.gov/state-lands/great-salt-lake/great-salt-lake-technical-team/

[6] More information is available at https://wildlife.utah.gov/gslep.html

[7] More information is available at https://ffsl.utah.gov/state-lands/great-salt-lake/great-salt-lake-salinity-advisory-committee/

[8] More information is available at https://ffsl.utah.gov/wp-content/uploads/OnlineGSL-CMPandROD-March2013.pdf

Notes:

$ = United States 2023 dollars
DWR = Division of Wildlife Resources
WRe = Utah Division of Water Resources
WRi = Utah Division of Water Rights
FFSL = Utah Division of Forestry, Fire and State Lands
GSL = Great Salt Lake
GSLAC = Great Salt Lake Advisory Council
GSLEP = Great Salt Lake Ecosystem Program
H.B. = House Bill
IWAA = Integrated Water Availability Assessment
SAC = Salinity Advisory Committee
Trust = GSL Watershed Enhancement Trust
UDAF = Utah Department of Agriculture and Food
USACE = United States Army Corps of Engineers
USGS = United States Geological Survey

3 AN INTEGRATED COLLABORATIVE PROCESS

Most of us are familiar with and have participated in a collaborative process. We engage the right people from within the right circles to solve our problems. We collect the right information to answer the right questions to make decisions. Then, we involve the right people to make or communicate those decisions that achieve the desired outcomes. These collaborative processes happen every day – in our homes, neighborhoods, organizations, companies, and communities. They can be simple and involve quick decisions or entail extensive study and deliberation. Connection (of individuals), a shared understanding (of the issues, concerns, options, tradeoffs, and decisions), and a commitment to a shared outcome are the critical elements that create trust and enable our success.

What is a collaborative process?

A collaborative process is a structured process that brings together the right people asking the right questions and evaluating the right information to achieve informed, thoughtful, balanced, and durable outcomes.

The GSLBIP must implement a similar process to create trust and enable success, but at a large scale, across the GSL watershed. A successful GSLBIP will require a process that is appropriate for and rises to the challenges we face and the goals we seek to achieve.

CONSTRUCTION OF AN INTEGRATED COLLABORATIVE PROCESS

The first step of any integrated water resources management plan is to build a collaborative process. The collaborative process will be the foundation and framework that the GSLBIP will depend upon to achieve its objectives. Not only must the GSLBIP involve watershed stakeholders to achieve Objectives 1 and 2, but it must also integrate them directly into the technical analyses completed to achieve Objectives 3, 4, and 5. Utah's 2001 State Water Plan stated it succinctly as "The responsibility for making many water-related decisions resides with local leaders."[39] These leaders (as stakeholders) must be integrated into developing the GSLBIP so that their decisions align with GSL watershed goals and objectives.

Public engagement traditionally uses a robust communications plan and a steering committee to gain input, insight, and recommendations as technical analyses are completed in parallel. The GSLBIP, however, seeks to take the traditional approach a step further by also directly engaging key stakeholders as part of completing the technical analyses. Developing sustainable and durable solutions that stand the test of time requires participants to have a vested interest in the process and results. An integrated collaborative process achieves those kinds of solutions.

Why do we need a collaborative process?

Input derived from a situational assessment[30] (provided in Appendix B) validated recommendations from previous efforts to evaluate strategies for water for Utah and GSL.[8, 11, 12] Stakeholders in the watershed want and simply must have a vested interest in the solutions. Not only do adjacent communities want to connect with each other as they wrestle with water concerns, but they must do so within the context of both their river basin and the GSL watershed. Stakeholders want to and must participate in the process, accept the data, actively use the models, understand the issues and solutions, and assume a stake in the solutions.

ESSENTIAL STRATEGIES

An integrated collaborative process must implement the following strategies for it to succeed:

Ensure a public and transparent process

The process must enable any interested person or organization within the GSL watershed to be able to explore, learn, and participate in the GSLBIP. Processes, work products, data, and results must be transparent to ensure ease of access and accountability and engender trust.

Implement a strong communications plan

The process must include implementation of a strong communications plan that provides all interests with an opportunity to learn about and participate in developing the GSLBIP and also engages the broader community in reviewing, accepting, and implementing the plan. The communications plan must provide an opportunity for education and participation and allow individuals to explore and develop their own paths. Appendix C includes the *Communications and Outreach Plan* for the GSLBIP.

Engage diverse interests

The process must involve and represent diverse interests that balance and integrate different backgrounds, geographies, and perspectives from throughout the GSL watershed. These diverse interests need to be balanced with those of government agencies who are mandated to manage and protect GSL watershed resources.

Cross-connect at multiple levels

The process must facilitate cross-connection among government entities, interest groups, and participants across the GSL watershed, at the river-basin level, and even at the local level (Figure 3-1). These cross-connections are the means to forge the relationships, partnerships, shared understanding, and trust that will be required to formulate durable solutions and outcomes for the watershed. The more connected people feel to each other, the issues, their watershed, their GSL, and their solutions, then the more likely the outcomes will be successful, sustainable, and durable.

Integrate policy with science at the local level

The process must integrate and facilitate a discussion of policy and science that will be unique to each river basin. Watershed councils in each river basin will be best positioned to forge the required connections and shared understanding unique to their backyard. The councils will best understand their systems, data, and how solutions in their river basin will affect them, their river basin, and their place in the GSL watershed. They must participate in developing the solutions they will need to implement.

Foster learning by taking no regrets actions

Decisions are already being made, and actions are already being taken to address the risks we face and make use of opportunities we have. Near-term no regret actions are, and will continue to be, essential to the process. These no regret actions enable connection, encourage innovation as a means of learning, refine our understanding of the issues, "move the needle," and engender trust among participants. These actions maintain forward momentum, demonstrate progress, and naturally facilitate an active, adaptive management process. Collaborative problem-solving is a critical element in taming a wicked problem. Appendices D and E provide technical memorandums that discuss "no regrets" opportunities identified as part of developing this Work Plan.

Develop a vested interest in results

Stakeholders with diverse values and views should be engaged and invested in from the beginning of the process. These stakeholders must gain a shared understanding of the issues, help shape the work to be done, oversee the work's completion, interpret results, evaluate tradeoffs, and participate in crafting solutions – all to ensure that the stakeholders have a vested interest in the GSLBIP's results and recommendations. A vested interest is essential for durable outcomes.

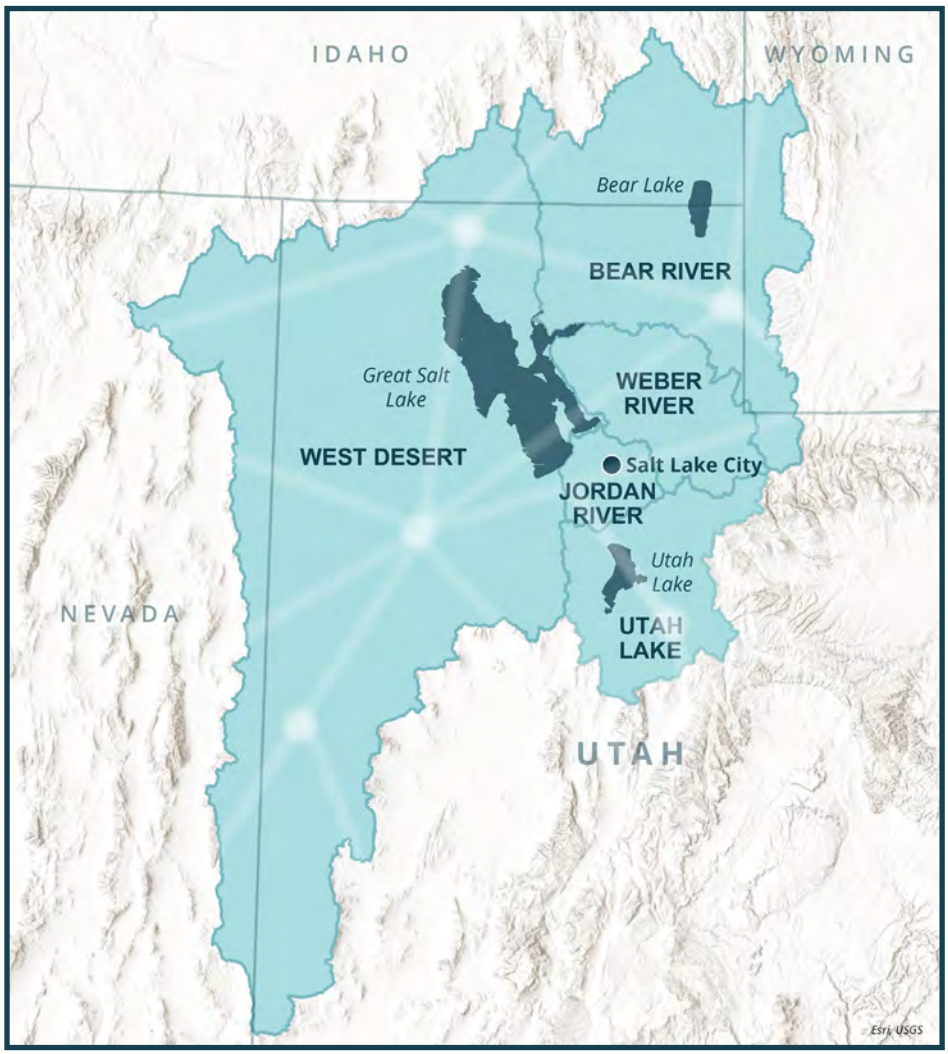
Facilitate inclusive and balanced deliberations

The process should be inclusive and balanced. Deliberations cannot be approached as a zero-sum game; we must reject an either/or approach in favor of identifying strategies that seek to balance needs and support multiple uses.

Forge consensus-driven decisions

Decisions by consensus means that stakeholders will strive to find common ground and unanimous approval but that, in the end, a minority may disagree while the rest can agree or reach acceptance. Even then, the views of the minority are respected and advanced to decision-makers for consideration along with the consensus recommendation. Consensus will provide a solid foundation for the GSLBIP; it will indicate long-term support and commitment from a diverse group of partners and participants.

Figure 3-1. Connecting Communities within Their River Basins and with Their Watershed and Great Salt Lake



Utah's Statewide Water Commitments[29]

- Utah is committed to increasing the resiliency of its water supply and quality by maintaining and improving current water infrastructure, improving data collection, and investigating opportunities for new water supply and storage.
- Utah is committed to using its existing water supply as wisely as possible by reducing the amount of water consumed through implementing conservation, ensuring access to safe and reliable drinking water, and improving the quality of water as it leaves its communities.
- Utah is committed to optimizing the use and management of its finite water supplies to preserve the state's agricultural economy and ensure a sustainable and prosperous future.
- Utah is committed to maintaining and improving the health of its waters and watershed – with emphasis on our forests, GSL, Bear Lake, and Utah Lake – to support their continued multiple uses.

INTEGRATED COLLABORATIVE PROCESS

Figure 3-2 illustrates the GSLBIP's integrated collaborative process. Stakeholders will be engaged throughout and as part of the technical analyses to develop a vested interest in results, drive consensus, and result in sustainable and durable outcomes. No regrets actions will drive momentum, demonstrate progress, and facilitate collaboration via active adaptive management throughout the effort. Technical analyses allow stakeholders to be engaged throughout the process. The GSLBIP will not be solely a WRe and Reclamation plan; it must be the entire GSL watershed's plan. To that end, the integrated collaborative process will be driven by a cross-connected structure of watershed stakeholders who participate in developing tools, interpreting results, evaluating options, and recommending solutions at the river basin and watershed scale. Stakeholders are not only advising, but they are truly participating.

The GSLBIP will leverage several existing collaborative efforts, such as the GSLBIP Advisory Group, GSLBIP Steering Committee, GSL Advisory Council (GSLAC), and various watershed councils to capitalize upon their momentum and effectiveness while minimizing additional burdens on organizations and individuals.

WRe and Reclamation will be responsible for engaging, facilitating, and coordinating the efforts of these groups within the GSLBIP framework.

GSLBIP Advisory Group and GSLBIP Steering Committee

The GSLBIP Advisory Group will engage and represent state and federal agencies with a stake in managing water in the GSL watershed. The GSLBIP Steering Committee will represent diverse interests from across the GSL watershed with a stake in how water is used and managed. Both will also contribute to the following:

- Guiding the GSLBIP development process and achieving the GSLBIP goal and objectives
- Recruiting the involvement of governmental and nongovernmental entities, the private sector, and citizens working to develop the GSLBIP and encouraging ongoing collaboration and communication among them
- Reviewing and advising WRe and Reclamation on activities, progress, technical products, and significant findings from GSLBIP development
- Reviewing and providing GSLBIP recommendations to WRe

The GSLBIP Advisory Group will additionally assess and advise WRe and Reclamation on alignment with existing law, policy, and efforts.

Figure 3-2. The Integrated Collaborative Process: Framework to Drive Consensus and Durable Outcomes

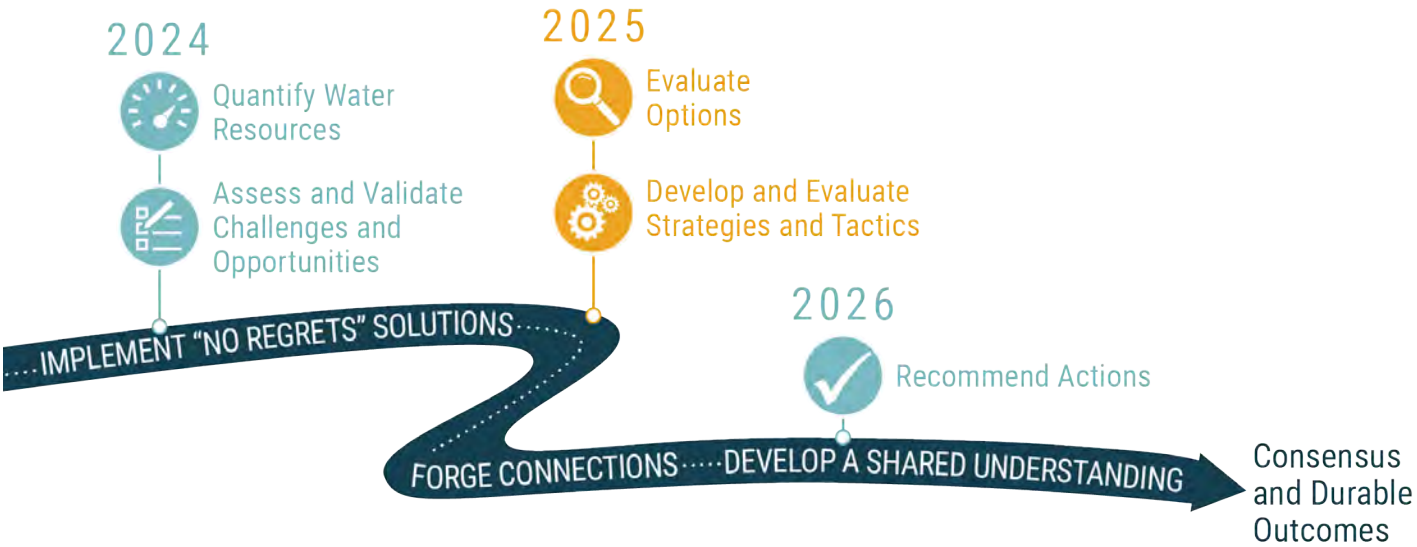
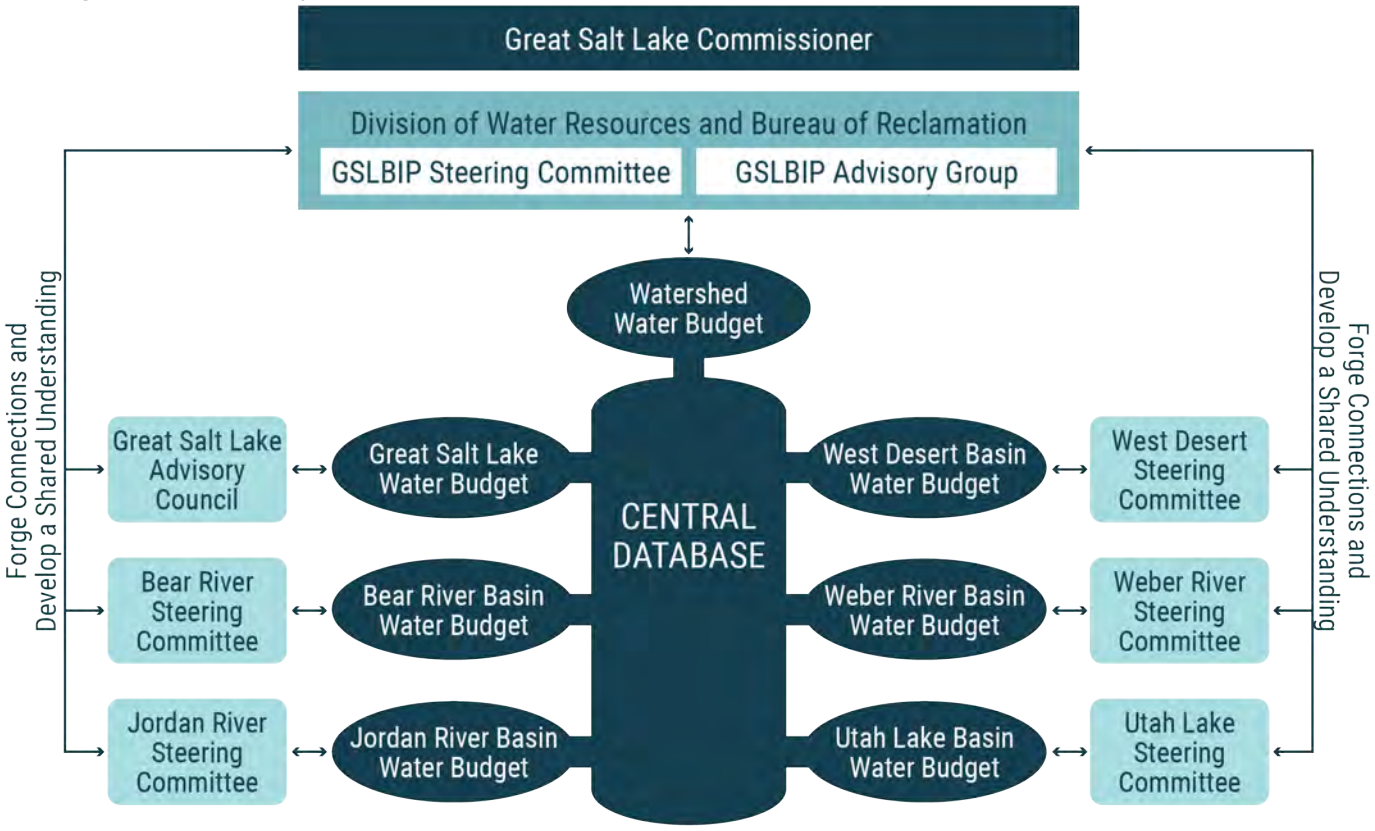


Figure 3-3. Integrating Stakeholders into Great Salt Lake Basin Integrated Plan Development



At the watershed scale, WRe formed a GSLBIP Advisory Group comprising representatives from participating state and federal agencies in June 2022 to advise its efforts to implement H.B. 429. The GSLBIP Advisory Group has continued advising WRe and Reclamation in developing this Work Plan. A GSLBIP Steering Committee comprising diverse interests (non-state and federal agencies) from across the entire GSL watershed was formed in July 2023 to also advise in Work Plan development. Both groups will continue to work closely with each other and with WRe and Reclamation throughout GSLBIP development. The roles of the two groups will continue to be advisory; they will represent watershed interests, guide GSLBIP development, and provide final recommendations to WRe.

This Work Plan proposes to use the newly formed watershed councils within each river basin to engage participants at a more local level and integrate them into the technical analyses (Figure 3-3). The GSLBIP will leverage the expertise of these watershed councils to understand their challenges and water systems and support them in developing their own river basin water budgets.

River Basin Watershed Councils

The watershed councils will contribute the following:

- Represent diverse interests at GSL or within their respective river basin that have a stake in their water supply.
- Define, assess, and advise WRe and Reclamation regarding challenges they face in water management.
- Define and assess their respective water budgets and evaluate potential solutions within the GSLBIP framework.
- Review and advise the GSLBIP Advisory Group and GSLBIP Steering Committee pertaining to GSLBIP activities, progress, concerns, technical products, and significant findings.
- Review the GSLBIP and provide recommendations to the GSLBIP Advisory Group and GSLBIP Steering Committee.

The river basin water budgets will then be used to help inform and validate and the overall watershed water budget and solutions. The watershed councils will be asked to help consider challenges, identify options, and evaluate water management strategies within the context of both their river basin and watershed. These connections, if in alignment with GSL watershed goals, are what will sustain actions into the future. Direction from the top alone will not create durable outcomes; they must be owned at the local level for water users to choose and enable successful long-term implementation.

Work performed as part of this GSLBIP must be science based, technically correct, and defensible. Reclamation will form an independent Technical Sufficiency Review Team of experts who will provide an independent review of GSLBIP deliverables. Appendix F, *Technical Sufficiency Review Plan Technical Memorandum*, provides details on the composition and responsibilities of the Technical Sufficiency Review Team and Plan.

Figure 3-4. Great Salt Lake Basin Integrated Plan Decision Hierarchy

DECISION-MAKING PROCESS

GSLBIP's integrated collaborative process implements a model that engages and cross-connects diverse interests at multiple levels to drive toward consensus-driven decisions. Stakeholders throughout the GSL watershed will have multiple venues to participate in the process's analyses and discussions. In the end, the GSLBIP Advisory Group, GSLBIP Steering Committee, river basin watershed councils, and GSLAC must consider input from the diverse interests they represent to make recommendations to the groups and decision-makers above them. All groups must strive to make decisions by consensus; all must strive to find common ground and unanimous approval. Views of the minority will be respected and advanced to decision-makers for consideration, along with the group's consensus recommendation.

Figure 3-4 illustrates the decision-making process. Communication will flow in both directions, but recommendations and requests for decisions will be forwarded following the illustrated hierarchy. Reclamation will not have the authority, nor the ability, to enact changes to current state water operations or policy through the GSLBIP. Reclamation will codirect GSLBIP development with WRe through the trade-off analysis step (Task 6) whereupon WRe will direct the final decision analyses for recommendations to be included in the draft and final GSLBIP. The GSL Commissioner will have the ultimate authority to direct policy that seeks to protect GSL and will coordinate directly with the Utah Legislature and Office of the Governor.

SUCCESS METRICS

An often-cited means to measure the success of GSL policy is for GSL water levels to reach a specific or range of elevations. While such a metric would indicate an increase of inflows to and a reduction of risks within GSL, this metric alone will not accurately measure the success of the GSLBIP for "Great Salt Lake and all uses, including people and the environment, throughout its watershed." One task during GSLBIP development (Task 2) will be to establish and refine specific metrics that can be used to implement and actively manage identified solutions.

> **Success must be evident in the short term and measured in the long term.**

Following are short-term success indicators:

- On-time and on-budget delivery of studies, plans, tools, and recommendations
- Significant participation in communication efforts, project meetings, and development of data, tools, and solutions
- Positive feedback from participants that they feel listened to and represented in the process and results
- Improved connection and shared understanding of the challenges, options, and solutions for managing the future water supply
- Continued changes in water use observed to be demonstrated by increasing participation in water conservation and optimization efforts that do no harm to GSL or other water uses
- Consensus on an action plan for balancing needs and supporting multiple uses throughout the watershed

Success as a Metric

Success is not either/or; for example, success cannot be either watershed needs, including people and the environment, or GSL water levels. Success must balance needs and support multiple uses.

Following are indicators of long-term success:

- **GSL water levels—**The ongoing decline of lake water levels is arrested and water levels are stabilized within a defined range.
- **Critical ecosystems—**A resilient water supply is provided that sustains high-priority ecosystems in the watershed.
- **Information—**Systems are in place to create, collect, store, make available, and process data for water management.
- **Policy framework—**Policy is thoughtfully refined to provide the economic, legal, and institutional mechanisms needed to incentivize a reduction in consumptive water use, share available water, and benefit all water uses, including people and the environment, throughout the GSL watershed.
- **Investments—**A source of sustainable funding is in place to facilitate, incentivize, and compensate water users to reduce consumptive use, implement changes in organizational infrastructure, and build, maintain, and operate required water infrastructure.
- **Water supply status—**Although the water supply may be limited, water needs are balanced through a proactive, collaborative process without a need for legal action.

In summary, and most importantly, success will be measured by the long-term outcomes. Actions taken due to the GSLBIP will ensure a resilient water supply that sustains the health and growth of GSL and enables the future we envision for GSL and all water uses in its watershed. The GSLBIP will foster a lasting water legacy for future generations.

4 A ROADMAP TO ACTION

Leveraging the integrated collaborative process, the GSLBIP must incorporate a robust technical approach to achieve its goal and objectives. It must optimize available resources while embracing the challenges we face and the inherent uncertainty of the future. It must drive collaborative decisions that create durable outcomes and shape a future that achieves our goal. This section of the Work Plan provides an overview of the origin and a roadmap toward achieving the GSLBIP ultimate goal—action that ensures a resilient water supply for GSL and all water uses, including people and the environment, throughout the watershed.

GAP ANALYSIS

H.B. 429 required the WRe to complete "a synthesis of available information literature, and data, and an assessment of scientific, technical, measurement, and other informational needs…" to inform the GSLBIP Work Plan development.[28] Knowledge gained from interviews, workshops, and a review of available literature was organized in a database and used to identify strengths, gaps in available resources, and opportunities for capacity development and further study. Methods and results from the gap analysis were shared with various participating experts to help validate results and are summarized in the *Gap Analyses Report* (provided in Appendix G). The gap analysis does not in and of itself prioritize new technical analyses; it provides an invaluable synthesis of information pertinent to the GSLBIP goal and objectives. It was the point of origin for a roadmap for this Work Plan.

Key Findings from the Gap Analysis

- We have a solid foundation to build upon. A significant body of work has been completed, is in process, or will be developed soon that will be useful for the GSLBIP. Coordination will be vital to success.
- Opportunities abound to improve our data, tools, processes, and decisions. The challenge is in where to start.
- Decisions can be made today. Completing targeted studies now will enable better decisions tomorrow.
- Studies and solutions have typically been discussed in terms of different timelines. The GSLBIP will consider those to be completed today (in 2023), tomorrow (2024 through 2026 as part of the GSLBIP), and beyond (2027+). The primary purpose of the GSLBIP is to enable informed long-term decisions in 2026.

A ROADMAP FOR THE WORK PLAN FOR THE GREAT SALT LAKE BASIN INTEGRATED PLAN

H.B. 429 required the WRe to provide "a description of how the Work Plan will be implemented to address the needs [that is, opportunities] …" identified as part of the gap analysis.[28] The opportunities identified by the gap analysis were prioritized with input from the GSLBIP Advisory Group and GSLBIP Steering Committee based upon the capacity of the opportunities to accomplish the following: (1) inform decisions to be made by 2026, (2) build a foundation for the future, and (3) be completed within the prescribed timeline and budget for the GSLBIP. The opportunities were then organized into five tracks that, along with the GSLBIP integrated collaborative process, form the Work Plan roadmap (Figures 4-1 and 3-3):

- **Decision-making—**Proposed work will integrate people and tools within a structured process designed to identify and solve problems and make decisions. This is the central effort of the GSLBIP that achieves the requirements of H.B. 429 and Reclamation's WTR 13-01. All GSLBIP activities will serve to inform this core effort.
- **Strategic research—**Proposed work is intended to investigate and provide essential information that will improve confidence in long-term decisions to be made.

> At a minimum, the GSLBIP must meet the following criteria:
>
> - Make projections of future water supply and demand for GSL, its associated wetlands, and its watershed
> - Analyze how water infrastructure and operations will perform
> - Develop appropriate adaptation and mitigation strategies
> - Complete a trade-off analysis (WTR 13-01).

- **Solutions development—**Numerous solutions have been previously recommended. Proposed work will advance selected options and strategies to better characterize these options and inform GSLBIP decision-making.
- **Capacity development—**Proposed work will improve the ability of individuals, organizations, and communities to consider, anticipate, monitor, and make decisions as part of the GSLBIP and beyond. Maximum value from many of these projects may not be realized during GSLBIP development but beyond 2027. They help set both a foundation and trajectory for the future.
- **Policy opportunities—**Opportunities were identified to enhance existing policy to improve process, inform better decisions and enable better outcomes from GSLBIP implementation.

Figure 4-1. The Five Tracks and Integrated Collaborative Process of the Work Plan for the Great Salt Lake Basin Integrated Plan Roadmap

Scenario Planning Process

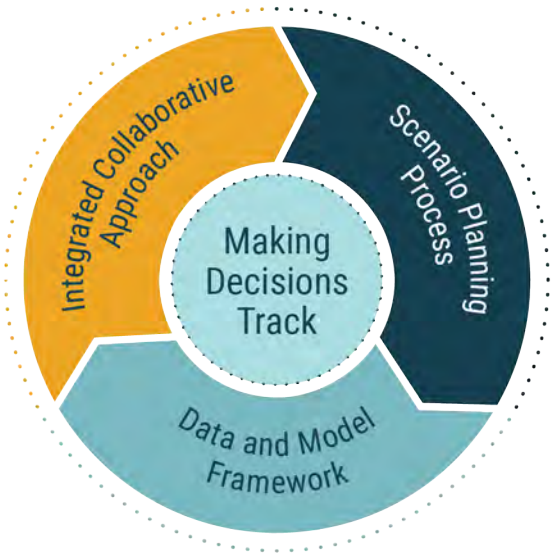
The process involves identifying the key forces or drivers that will likely influence future water supply and water demand, ranking of the driving forces as to their relative influence and uncertainty, and using the most influential and uncertain driving forces to identify various themes and storylines (narrative descriptions of scenarios) that describe how water conditions (water supply and water demand) may evolve in the future. The water conditions of the various scenarios are then quantified and used to assess future system reliability and risks and then assess the performance of options and strategies.

The following sections summarize the recommended approach to develop each track in support of the GSLBIP.

Decision-Making

Tasks in this track serve as the core of the technical approach and will inform the decisions that must be made today (2023), tomorrow (2024 through 2026) and beyond (2027+). As such, development of these tasks is the top priority for the GSLBIP. Tasks will be facilitated by the integrated collaborative process and incorporate a scenario planning process and a new model framework and database (Figure 4-2).

Figure 4-2. Three Components of the Making Decisions Track of the Work Plan



Integrated Collaborative Process

The integrated collaborative process described in Section 3 will be central to developing the GSLBIP.

Scenario Planning Process— A Strategy for Coping with Uncertainty

The water resource management decisions we must make must consider the future amount of water that is available and required in GSL's watershed over the next 50 years. The future of water is highly uncertain, dependent upon a complex interplay between natural and human systems, and driven by climatic, demographic, economic, social, institutional, political, and technological factors. The precise trajectory of this interplay over time, and the resulting state of the physical system over time, are uncertain and

Figure 4-3. General Steps Involved in the Scenario Planning Process

cannot be adequately represented by a single view of the future or even consideration of anticipated "good," "satisfactory," and "poor" conditions. The range of uncertainty in the factors that influence future water supply and water demand is simply too broad.

> An integrated collaborative framework using a scenario planning process will best position Utah to develop an actionable GSLBIP for the future.

A scenario planning process (Figure 4-3) will be implemented to consider the broad uncertainty and vast range of future possibilities and portray the broad range of plausible futures in a manageable number of scenarios. Scenario approaches have been widely applied in water planning and management, from global to regional scales, although specific methodologies have varied considerably.[2, 7, 10, 21, 33, 48] A scenario planning approach allows for the identification and consideration of risks and uncertainties and also how different combinations of strategies may mitigate those risks and uncertainties.

Scenarios are alternative views of how the future might unfold; they are not predictions or forecasts of the future. A set of well-constructed scenarios represents a range of plausible futures that assists in the assessment of future risks and the development of mitigation and adaptation options and strategies.

Figure 4 4. Conceptual Representation of a System's Uncertain Future (also known as the Cone of Uncertainty) Source: Adapted from Timpe and Scheepers, 2003.

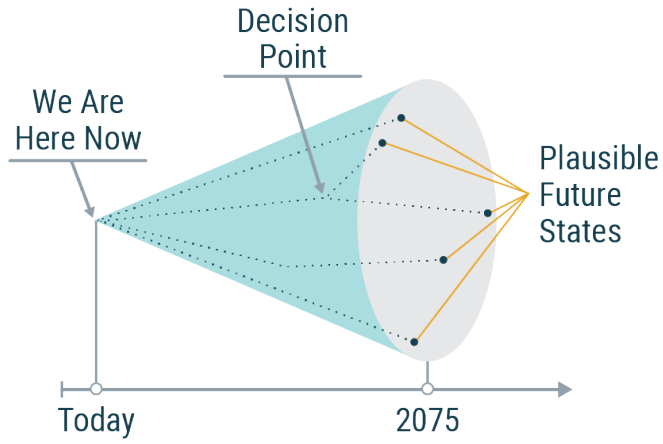


Figure 4-4[31] illustrates this concept. We have a present understanding of the current state of the GSL watershed, represented as "today". Future uncertainty increases with time; represented by the funnel. The integrated collaborative approach will be used to identify and define a range of plausible future states or scenarios at a future time; represented by 2075. The suite of scenarios used in the planning effort should be sufficiently broad to span the plausible range. This approach will facilitate the identification of critical signposts (decision points) when a water supply shortage might be expected within the study planning horizon, the potential magnitude of the shortage and how much inflow may be required to maintain different water levels in GSL. This will help the State of Utah respond to the key planning question of when and how much of a potential water shortage the watershed might experience and evaluate and select the best combination of actions to implement to ensure a resilient water supply.

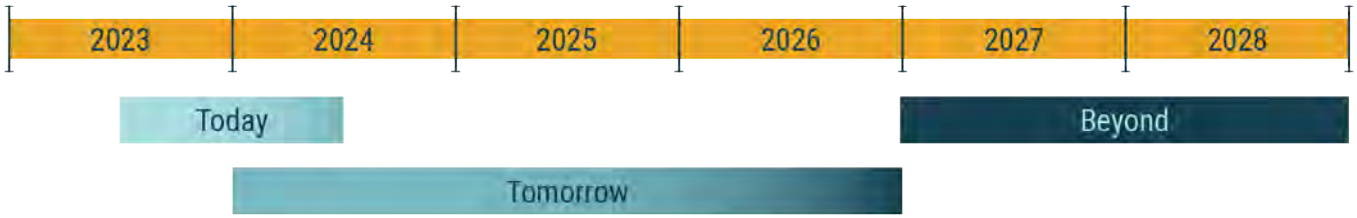
Data and Model Framework

Central to the GSLBIP technical approach will be development of a framework of data and models that will enable the scenario planning process and accomplish the GSLBIP's objectives.[46] The model framework must inform our decisions today, tomorrow, and beyond (Figure 4-5). Planning is not a finite event; it is and will be a continual process we must be prepared for.

> **The GSLBIP must enable an adaptive approach toward stakeholders making better and better decisions into the future.**

Decision Horizons for the Great Salt Lake Basin Integrated Plan

Figure 4-5. Decision Horizons for the Great Salt Lake Basin Integrated Plan



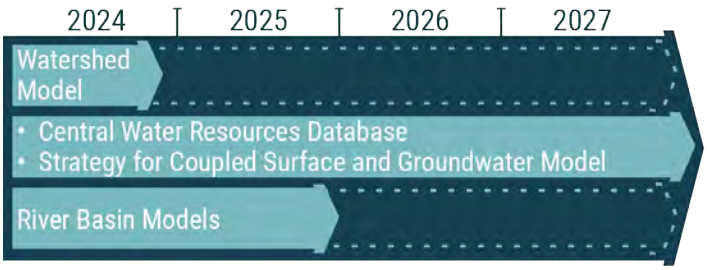
Today (2023)

Informed decisions can be made with the models and data we have today. The State of Utah has invested significantly in studying how to manage water resources in GSL[5, 19] and throughout its watershed,[39, 40, 41, 42, 43, 44] how changes in climate and throughout the watershed can influence GSL,[10] and developed recommendations to preserve flows for GSL.[11, 26] Data, tools, and recommendations are available for decisions today. In most cases, however, existing analyses do not consider the watershed as a whole or downstream impacts upon GSL, nor adequately capture or enable an evaluation of future possibilities.

Tomorrow (2024 through 2026)

H.B. 429 prescribes that the GSLBIP must be completed by November 30, 2026.[28] As illustrated on Figures 4-6 and 4-7, data and tools must be available in December 2024 to identify and locate the water gaps in the GSL watershed and begin assessing and validating challenges and opportunities. Additional data and tools must be available in 2025 to enable stakeholders from throughout the watershed to evaluate options and develop and evaluate strategies and tactics to adapt to and mitigate potential water shortages.

Figure 4-6. Model Development Schedule



Trade-off analyses must begin by August 2025 to enable final recommendations for actions in August 2026. The *Scoping Plan for the Water Resources Planning Tool* (provided in Appendix H) describes the recommended modeling and database approach for the GSLBIP.

And Beyond (2027+)

The central water resources database and model data and algorithms developed as part of the GSLBIP will eventually be integrated into a coupled surface and groundwater model that can be used to inform future river basin implementation plans, water right distribution models, and local water-planning decisions. A strategy to guide development of this model should be prepared as part of the GSLBIP.

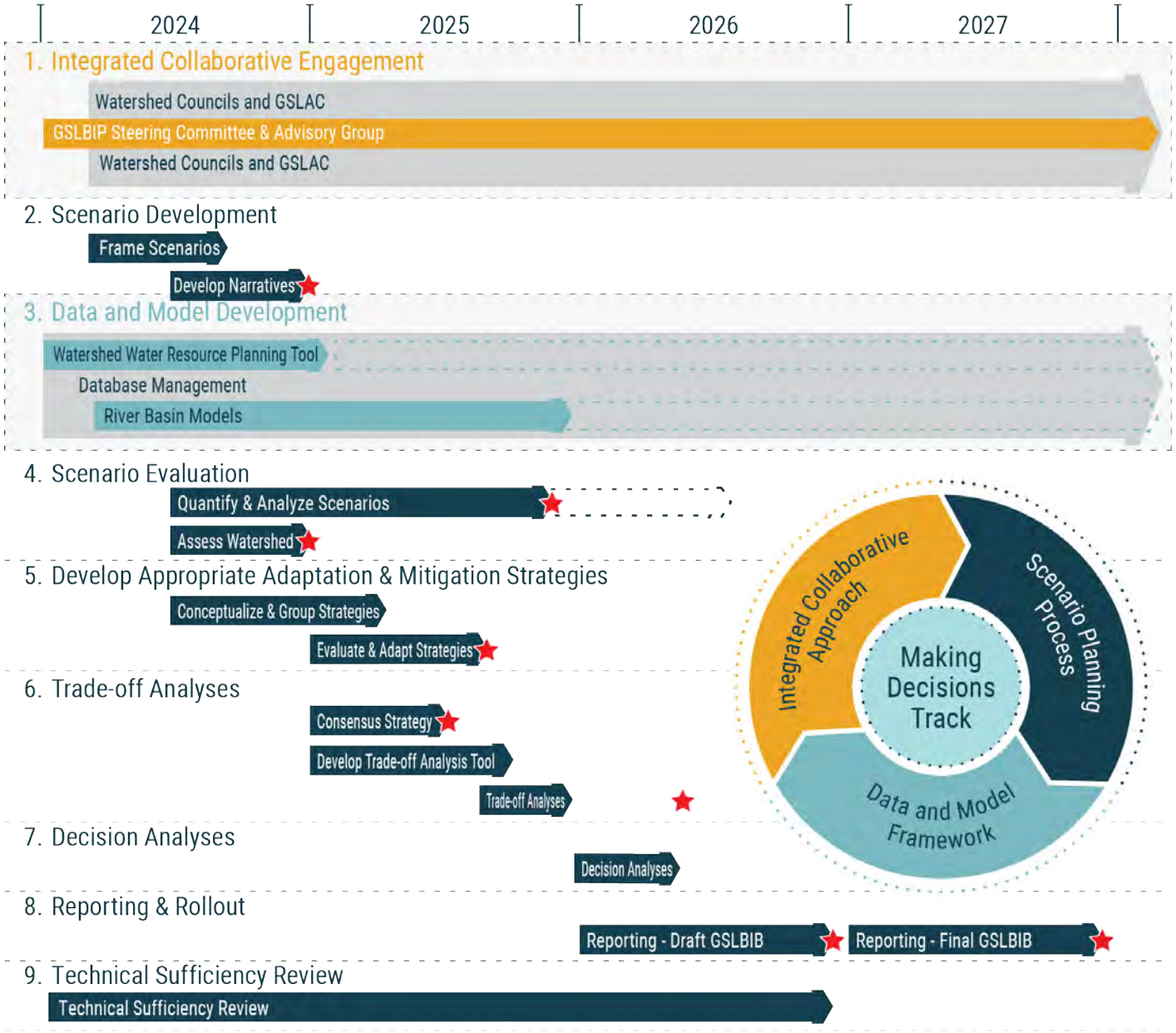
Technical Sufficiency Review

An important GSLBIP objective will be to ensure that technical information, data, models, analyses, and conclusions resulting from GSLBIP development are technically supported and defensible. A *Technical Sufficiency Review Plan Technical Memorandum* has been prepared to outline the approach and methods to be used for reviewing this information and is provided in Appendix F.

Key Tasks for Decision-Making

The core effort of leading and delivering the required tasks for decision-making will be completed by WRe and Reclamation. The GSLBIP budget for this track is $4,500,000. A detailed description of task goals, activities, deliverables, and assumptions is in Appendix I.

Figure 4-7. Decision-Making Tasks and Schedule for the Work Plan for the Great Salt Lake Basin Integrated Plan



STRATEGIC RESEARCH

Numerous gaps could and should be investigated. The proposed projects in the strategic research track focus upon informing the decisions to be made by 2026. They will fill an important role of investigating essential questions and providing information that can make a significant improvement in confidence in the long-term decisions to be made as part of the GSLBIP. However, they cannot be completed alone. They must be integrated with results from numerous efforts already being implemented by others (Figure 4-8). A detailed fact sheet for each GSLBIP-funded strategic research study is found in Appendix J. Note that recommended funding amounts are subject to change.

Available Data and Tools

For decisions today

- Great Salt Lake Policy Assessment[3] based upon WRe's 2023 GSL Water Budget Model
- GSL Integrated Model[10] based upon WRe's 2017 Water Budget Model data

For decision tomorrow

- WRe's 2023 Water Budget Model
- WRe's 2023 climate and natural flow projections for the GSL watershed through the year 2100
- A rebuilt GSL Integrated Model based upon updated information that enables planning efforts by December 2024
- New river basin models developed with stakeholders to represent the same water resources data as the GSL Integrated Model and also incorporate detailed local operations, enable connection, and develop a shared understanding and validation of strategies by December 2025
- New, centralized water resources database with climate, water supply, water demand, and land use data developed during the GSLBIP
- New, long-term strategy to develop a coupled surface and groundwater model

SOLUTIONS DEVELOPMENT

Numerous options and strategies have been recommended in past studies, however, very few have been advanced to evaluate their feasibility, costs, and how they might be implemented. The proposed studies in the solutions development track focus on the most likely solutions, investigate their feasibility and potential costs, and provide input into the evaluation to be completed in 2024 and 2025 and long-term decisions to be made in 2026. However, they cannot be completed alone. They must be integrated with results from numerous efforts already being implemented by others (Figure 4-9). A detailed fact sheet for each GSLBIP-funded solutions development studies is found in Appendix J.. Note that recommended funding amounts are subject to change.

CAPACITY DEVELOPMENT

A number of programs and studies were identified in the gap analyses that work to improve the ability of individuals, organizations, and communities to consider, anticipate, monitor, and make decisions as part of the GSLBIP and beyond. Planning and implementation of these efforts and the maximum value from their investments may not be realized until after 2027. However, the proposed study in the capacity development track will work in concert with and will help inform the GSLBIP even as it builds a strong foundation and steers the trajectory for implementation beyond 2027. However, it cannot be completed alone. It must be integrated with results from numerous efforts already being implemented by others (Figure 4-10). A detailed fact sheet for the GSLBIP-funded capacity development study is found in Appendix J. Note that recommended funding amounts are subject to change.

Figure 4-8. Targeted Strategic Research Studies

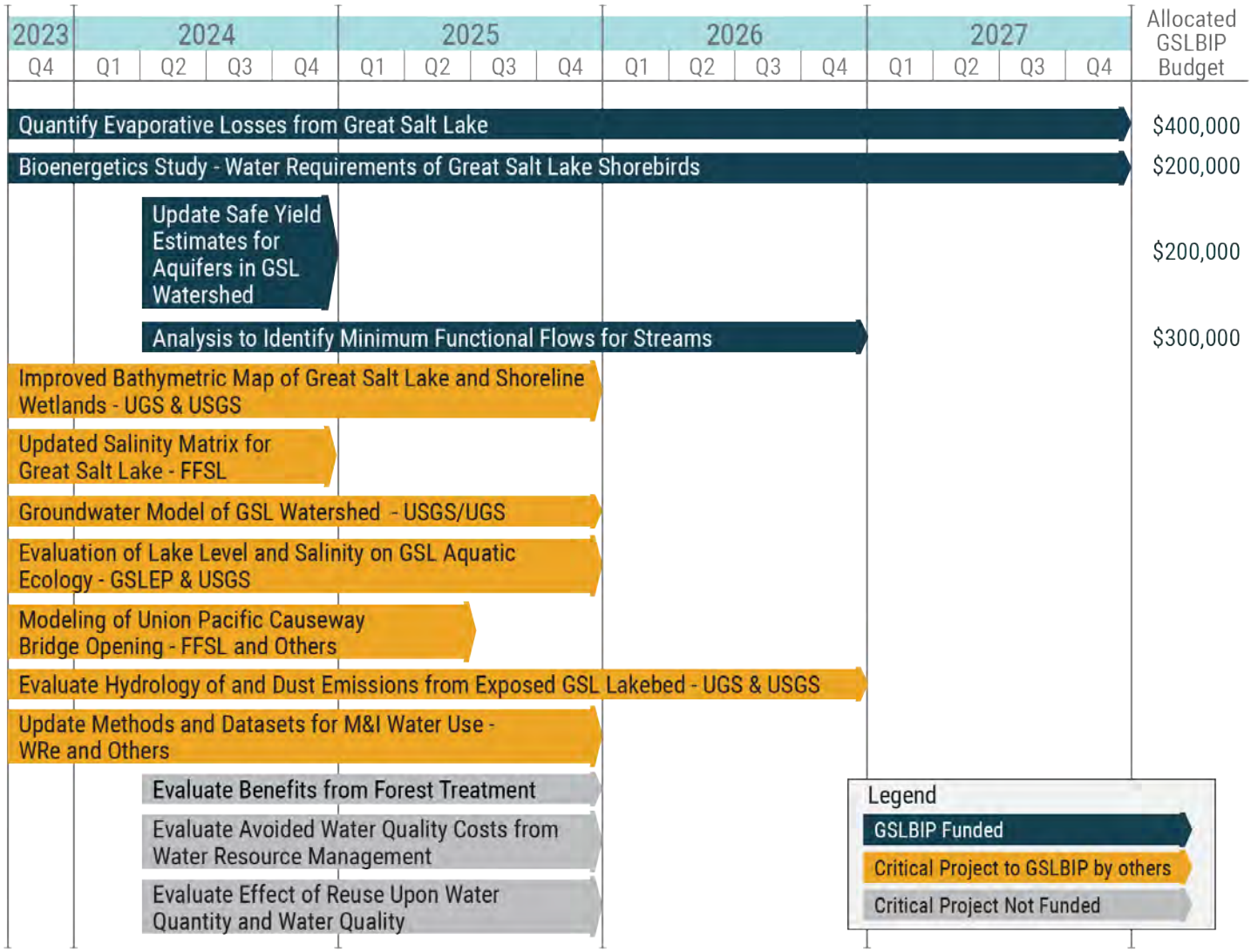


Figure 4-9. Targeted Studies for Solutions Development

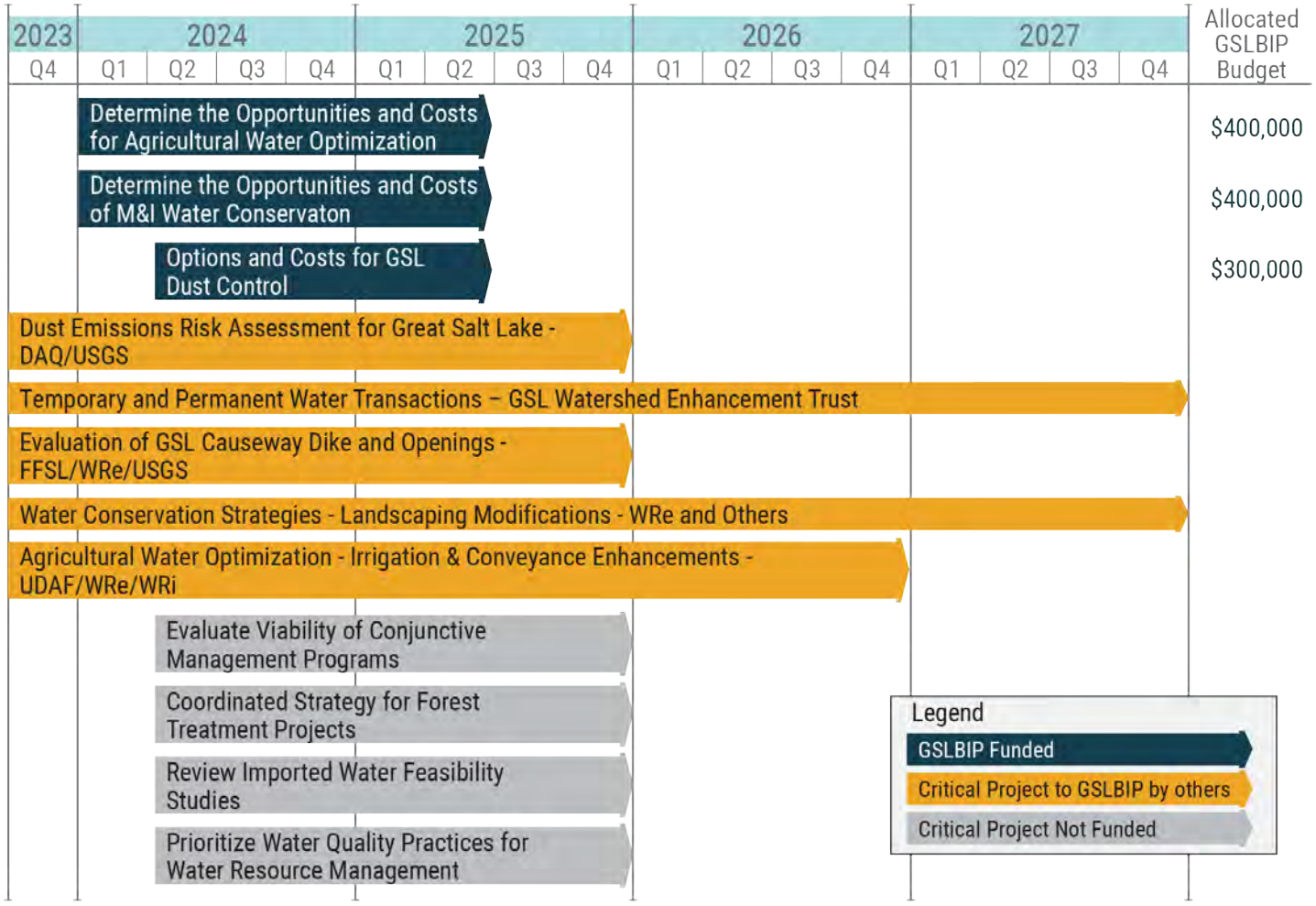
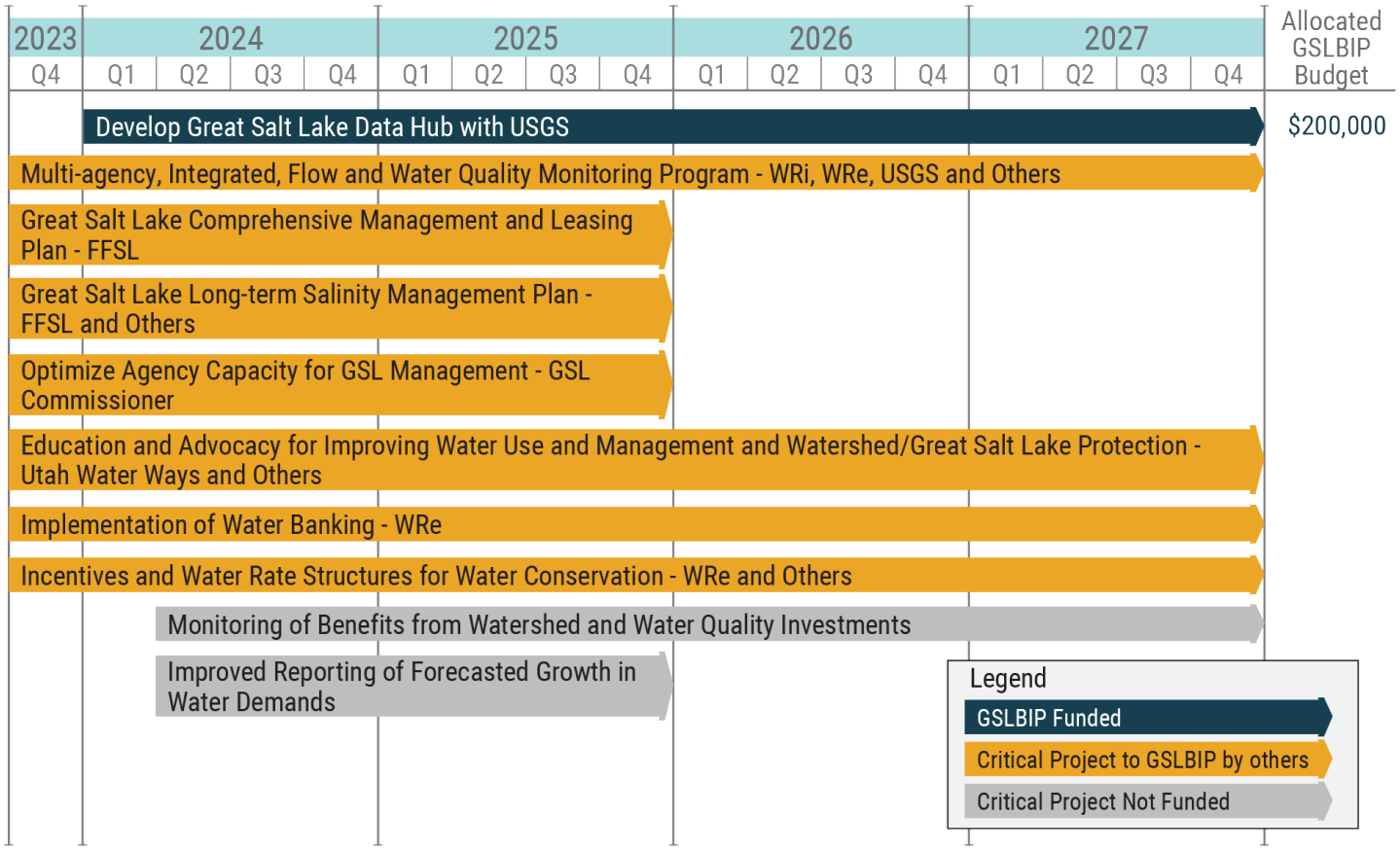


Figure 4-10. Prioritized Studies for Capacity Development



POLICY OPPORTUNITIES

A number of opportunities were identified to enhance existing policy to improve process, inform better decisions and enable better outcomes. These opportunities are summarized in Appendix D and may be considered during and after GSLBIP development.

SUMMARY

The *Gap Analyses Report* (Appendix G) identified an ambitious list of over 130 potential opportunities to fill gaps in our collective understanding of GSL and its watershed. During Work Plan development, the Project Team, GSLBIP Steering Committee and GSLBIP Advisory Group discussed the feasibility, impact, and potential value of the complete project list and ultimately identified which projects were the most urgent and important to accomplishing the GSLBIP goals (Table 4-1 and Figure 4-11). These studies were targeted based upon their capacity to 1) inform decisions to be made by 2026, 2) build a foundation for the future, and 3) be completed within the prescribed timeline and budget for the GSLBIP. Further investment in additional efforts would add additional value and accelerate implementation of solutions.

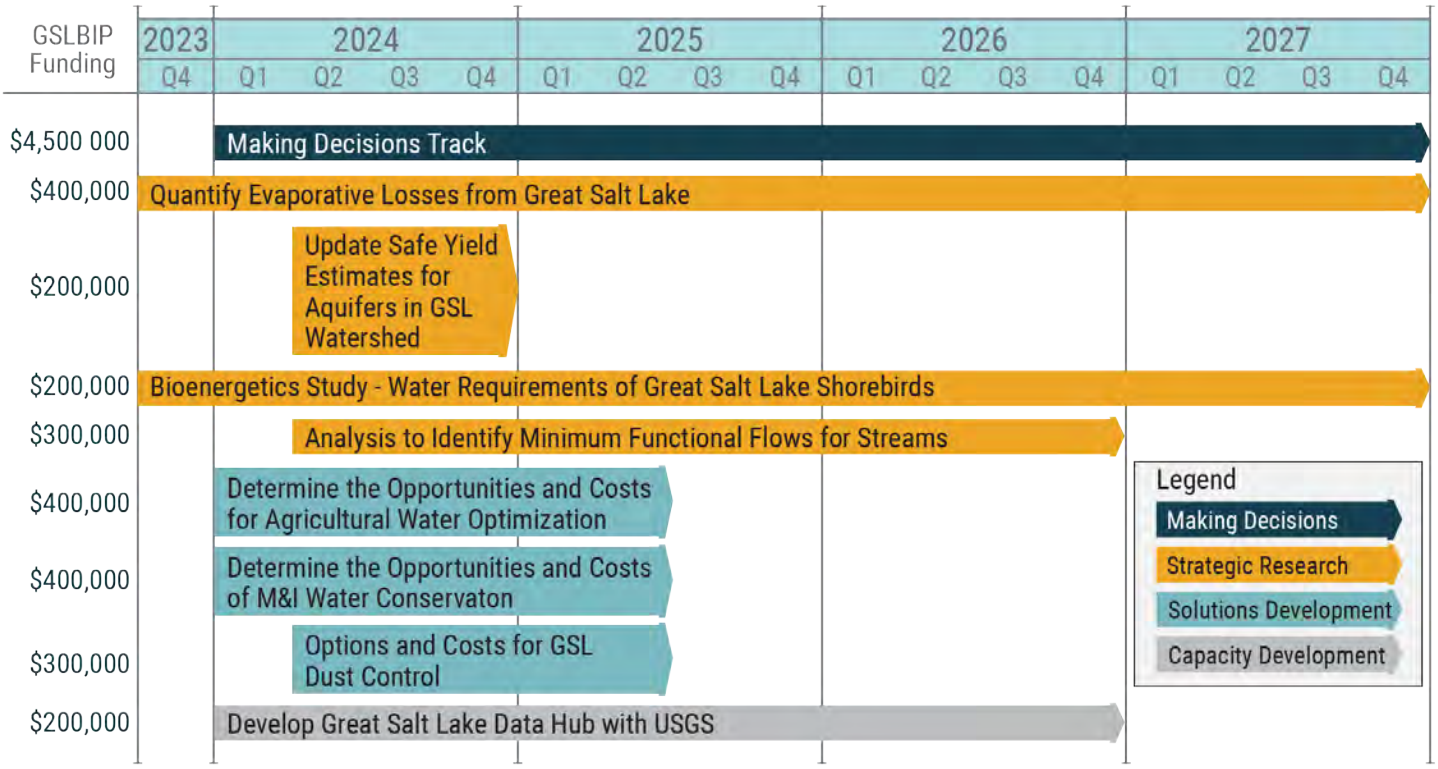
Table 4-1. Cost Summary for Great Salt Lake Basin Integrated Plan Projects

Project Title	Estimated GSLBIP Funding Contribution[a]
Great Salt Lake Basin Integrated Plan Work Plan Development (completed)	$700,000
Great Salt Lake Stormwater Study (completed)	$500,000
Modeling and Scenario Planning[b]	$4,500,000
Quantification of Evaporative Losses from Great Salt Lake	$400,000
Update of Safe Yield Estimates from Aquifers	$200,000
Bioenergetics Study: Water Requirements of Great Salt Lake Shorebirds	$200,000
Analysis to Identify Minimum Functional Flows for Streams	$300,000
Opportunities and Costs for Agricultural Water Optimization	$400,000
Opportunities and Costs of Municipal and Industrial Water Conservation	$400,000
Options and Costs for Great Salt Lake Dust Control	$300,000
Great Salt Lake Data Hub Development	$200,000
TOTAL	$8,100,000

[a] Estimated GSLBIP funding contribution does not include external funding amount. Appendix J, *Project Fact Sheets*, provide more information on matching funds from project partners.

[b] Appendix H, *Scoping Plan for the Water Resources Planning Tool*, provides additional schedule details

Figure 4-11. Studies Roadmap of the Work Plan for the Great Salt Lake Basin Integrated Plan



5 NEXT STEPS

Implementing the GSLBIP is a daunting task; an IWA has never been completed at this scale in Utah. Water supply challenges faced throughout the watershed, and especially at GSL, could not be more urgent. Developing and implementing the GSLBIP could not be more important. The GSLBIP will need to overcome significant social, political, and technical challenges that will require an unprecedented level of trust, cooperation, and spirit throughout the watershed. Therein is the key for success: connection, a shared understanding and a commitment to a shared outcome. This Work Plan provides a roadmap to action; a path to a GSLBIP that will provide GSL's watershed with every opportunity to succeed. However, durable outcomes and long-term success will largely depend upon one thing—the GSL watershed moving forward together with a new view of water and community. It can be done.

A STORY OF ONE LAKE, ONE COMMUNITY

The GSL community was not always able to tackle and overcome extremely challenging issues. As recently as 15 years ago, lake stakeholders often thought and acted independently. Conflict was common, resolution was infrequent. Increasing challenges, passionate leadership, and a common desire to protect the lake, however, brought lake stakeholders together as one community. One community that revolved around the idea of one lake. They had different interests, opinions, and agendas, but they agreed that they only had one lake. A view of one lake forged one community. That one community is what in turn is preserving one lake.

A VIEW FOR ONE WATER, ONE COMMUNITY

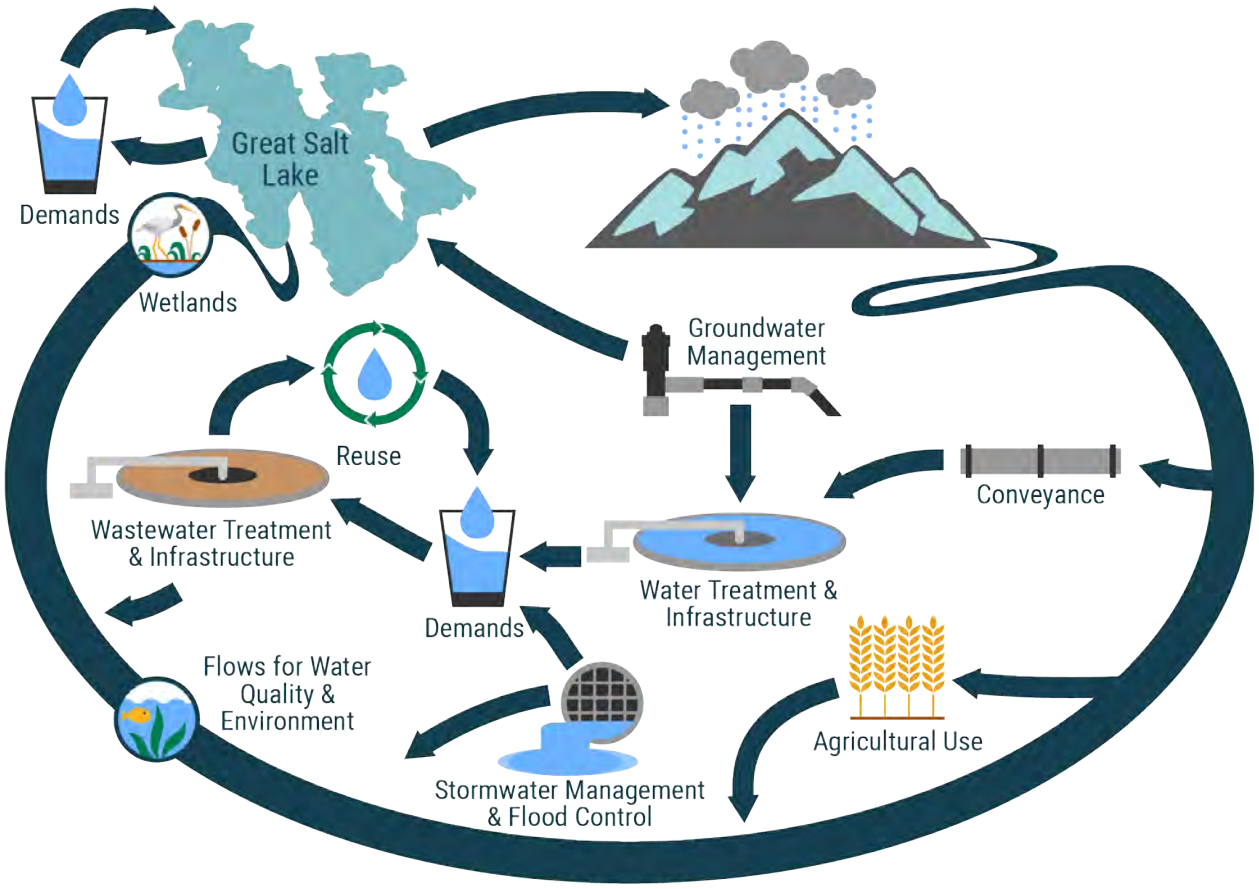
The GSL watershed is a closed basin. Everyone who lives, works, and plays within this watershed relies upon the same, precious one water. We must begin to think about our watershed as a community, considering where our water comes from and where it goes. The water we use was once used or passed through someone's system upstream. The water we drain, flush, or return is inevitably used by someone or something downstream. We all use and rely upon one water (Figure 5-1). That one water is what makes us one community. It will take one community to preserve one water for future generations.

The intent of this Work Plan is to create that opportunity.

MOVING FORWARD

Over 150 individuals contributed to this Work Plan and has resulted in significant interest and momentum throughout the GSL watershed to implement it. This momentum must be maintained through implementation even as the draft Work Plan is reviewed by the public. Active planning must be balanced with no regrets actions. Monies are available, there is a social and political will to act, and time is of the essence. No regrets actions can be considered and taken (refer to Appendices D and E). Outreach and engagement efforts with the community have already begun as this Work Plan is rolled out to the public and work begins (refer to Appendix C, *Communications and Outreach Plan*). WRe and Reclamation are already mobilizing staff, leveraging partnerships, and contemplating contracts to begin work in January 2024 (refer to Appendices H, I, and J). This Work Plan provides a roadmap for the GSLBIP; the State of Utah is already moving forward to a resilient water supply.

Figure 5-1. Great Salt Lake One Water



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Jacobs Engineering Group
The Langdon Group
Clyde Snow & Sessions
Hansen Allen & Luce

Great Salt Lake Basin
Integrated Plan

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