RECLAMATION
Managing Water in the West

Final
Boise/Payette Water Storage Assessment Report

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region

July 2006

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Prepared for
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U.S. DEPARTMENT OF THE INTERIOR

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor and trust our responsibilities to Indian tribes and our commitments to island communities.

MISSION OF THE BUREAU OF RECLAMATION

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Executive Summary

Background

Throughout the arid west and southwestern Idaho, rapid urbanization of land previously used for agricultural purposes (including cropland, pasture, and dairies) has created water management challenges. Comprehensive water supply and water management incorporates multiple elements including optimizing existing supplies, conjunctively managing surface water and groundwater, developing water conservation strategies, and identifying additional potential supplies to meet increasing demand. The broad issue of water supply and water management is certainly not new to the Boise and Payette River basins, which together contain nearly 40 percent of Idaho's population. Recent prolonged drought conditions, in combination with urban growth, motivated local water users' request that Reclamation conduct this assessment as a first step in the process of evaluating additional water storage opportunities in these two basins. An assessment is generally a preliminary survey of problems and needs that utilizes existing information to explore conceptual solutions to water resources issues in specific areas. This assessment focuses primarily on new or enhanced storage capabilities, including new on-stream and off-stream reservoir storage facilities, and retrofitting of existing reservoir facilities.

This assessment is just one activity and one aspect of the many activities that multiple agencies are conducting to address water supply and water management issues in the Boise and Payette River basins. A broad-based stakeholder working group (SWG) was convened to participate in the assessment effort. More than 60 invitations to participate were sent to a broad spectrum of local water users and interested parties including Federal partners, State partners, and local partners; irrigation interests; flood control districts; and environmental groups. Participants provided review and commentary throughout each stage in the assessment, culminating with review of this report.

The stakeholder working group also identified a number of non-physical or administrative water storage opportunities that did not fit into the defined scope of this assessment. These opportunities include water conservation (including upgrading delivery canals), modifying existing reservoir minimum pool operations (for example, at Cascade Reservoir), and expanding authorization at existing storage facilities to include other water uses. These opportunities were not evaluated in this assessment because they are outside the scope of the effort, but they could be pursued by other agencies and stakeholders or could be considered in separate or future Reclamation studies.

Assessment Area

Reclamation's Boise Project (which includes both the Boise and Payette River basins) includes six reservoirs, two diversion dams, three Federal powerplants, seven pumping plants, 720 miles of main canals, more than 1,300 miles of smaller canals, and 650 miles of drains (there are also other facilities operated by other government agencies and private entities). Irrigation is generally the primary purpose of all authorized Reclamation facilities in the Boise Project, and flood control, recreation, or fish and wildlife enhancement are viewed as project functions or benefits that are national in scope and were generally added through legislation.

The Boise Project has an active capacity to store and distribute 1.95 million acre-feet of water. Estimated demand volumes over a 50-year planning horizon were used in this assessment to define conceptual storage needs. Those storage needs are then used to develop volume criteria to help assess potential storage opportunities. Three types of water uses were considered:

1. Consumptive Uses (domestic, commercial, municipal, and industrial [DCM&I], Irrigation)
2. Flood Control Capacity
3. Flow Augmentation

Demand projections (and thus estimated additional supply volumes) are presented with ranges of uncertainty because they reflect long-range planning-level estimates that would need to continue to be refined in subsequent appraisal/feasibility analysis. This assessment suggests that between 62,470 and 386,430 acre-feet (AF)/year of additional surface water storage might be needed between both basins. The relationship between where the water will be needed, and when future demands will need to be met, will ultimately control the decision of how much water can or should be supplied by surface water facilities.

Assessment Process

Following the development of conceptual storage needs, more than 200 potential storage sites that had been previously identified were assessed. The comprehensive list of potential storage sites was narrowed down to a manageable number for more detailed evaluation in three steps:

- Compile and summarize existing written documents via a Literature Report. Query stakeholders on other non-published pertinent information.
- Screen initial list of 200+ sites to a smaller list of 56 potential sites.
- Rank smaller list of potential sites to determine areas that best represent opportunities for new storage.

A comprehensive literature review was conducted to assemble the most complete list of historic studies and reports that have provided recommendations for potential water storage opportunities within the Boise and Payette River basins. The literature review assembled 53 documents that dated back to 1938, produced by a wide range of entities and organizations. In addition to reviewing available documentation and literature, members of the stakeholder working group were also encouraged to provide any additional pertinent information that may have been unpublished or otherwise known.

Because an assessment study generally relies on existing information, identified data gaps were related directly to the sheer number of sites evaluated and the current lack of specificity of a potential site. Despite a relatively robust library of existing literature and current stakeholder input, data gaps on benefits associated with potential new storage included information related to fisheries, recreational uses, tourism effects, water quality, wetland mitigation, and hydropower.

More than 200+ new and existing storage sites were identified and initially screened to determine a subset of sites that would most likely meet assessment objectives. The initial screening process was based on four “exclusionary” screening criteria that were used to identify new or existing sites that should not be carried forward for more detailed analysis. These criteria include:

- *Hydrology/Refill Capacity.* A preliminary yield potential of the site (i.e., the percentage of years it would re-fill under long-term average hydrologic conditions) helped to determine whether a site could reliably refill.
- *Special Designations.* Sites located on reaches with special designations such as Wild and Scenic Rivers may be more difficult to develop.
- *Endangered Species/Bull Trout Habitat.* Sites located with reaches that support critical bull trout life stages (such as spawning) may be more difficult to develop.
- *Minimum Storage Volume.* Given the large uncertainty with estimated water supply storage needs, a minimum of 50,000 AF of storage required of all potential new storage sites (existing retrofitting opportunities were not screened against this criterion).

Based on this screening process, a total of 56 sites in both basins were carried forward to the ranking process. The smaller and more refined list of potential storage opportunities was evaluated further and ranked to identify the water storage opportunities with the most potential for success and to make recommendations on which opportunities should be carried forward to an appraisal/feasibility analysis. The ranking of potential candidate site screening followed three lines of analysis:

- *Refined hydrologic analysis*: Reclamation’s MODSIM model was used to determine the overall quantities of water available for new storage in each basin given current operating limitations (for example, water contracts, water rights, existing regulatory or administrative minimum flows, and other relevant aspects/realities of current operations).
- *Socio-economic and environmental constraints analysis*: Candidate reservoir sites were compared in terms of their relative potential impact on such socio-economic and environmental factors as infrastructure, recreation, and biological resources.
- *Needs analysis*: The results of hydrologic and constraints analysis were reviewed critically to ensure that final potential candidate sites were capable of meeting a full range of defined needs and achieving a wide range of benefits.

Results

The results of the screening and ranking process indicated that viable potential water storage sites tend to cluster in discrete reaches and subbasins. To be more useful in future studies, these clusters are identified as “areas of opportunity.” Eight “areas of opportunity” are pockets in each of the basins where excess natural water supplies may be available for storage and where, at an assessment-level analysis, there are apparently fewer potential socio-economic and environmental effects relative to other areas within each basin (see Section 3.3). The “areas of opportunity” each contain several of the most promising sites and represent a starting point for future analyses.

Recognizing that the top candidates in each basin are located within a few broad reaches (because these areas represent that balance between providing downstream use benefits and minimizing impacts), "areas of opportunity" are delineated so that future analysis is not limited to potential candidate sites that were previously identified in the literature.

Each of the eight "areas of opportunity" is characterized by the source water that would either be retained within an on-stream facility, or diverted to an off-stream facility. Hence, each "area of opportunity" actually encompasses two components: source water and specific storage sites that would have the greatest potential for success. In addition to the "areas of opportunity" for new storage sites, a few existing retrofitting opportunities have the potential to be carried forward to an appraisal/feasibility analysis. Identified "areas of opportunity" are shown in Figure ES-1 (located at the end of the Executive Summary).

"Areas of opportunity" in the Boise River basin include the following.

- *Lower South Fork Boise.* Water could be diverted from the Lower South Fork Boise River into an off-stream storage facility. Approximately 50,000 to 60,000 AF could be stored and delivered reliably 90 percent of the time to water users for uses such as DCM&I, irrigation, flow augmentation, and potentially limited flood control capacity depending on the configuration of the off-stream diversion structure and conveyance. Any development would need to further analyze impacts to important bull trout wintering habitat and avoid diversion from the State-designated Natural River section of the reach.

- *North Fork/Middle Fork Boise.* Water could be either stored in an on-stream facility or diverted from the North Fork/Middle Fork Boise River to an off-stream storage facility. Approximately 50,000 AF could be stored and delivered reliably 90 percent of the time to water users for uses such as DCM&I, irrigation, flood control capacity, and flow augmentation. Any development would need to further analyze impacts to important bull trout wintering habitat and avoid diversion from the State-designated Natural River section of the reach.

- *Raising Lucky Peak, Arrowrock, or Anderson Ranch Dams.* Various entities have evaluated raising the height of these dams to create an additional 6,300 AF (Lucky Peak/Arrowrock) to 29,000 AF (Anderson Ranch) of storage capacity. Retrofitting existing facilities meets all uses, including DCM&I, irrigation, flood control capacity, and flow augmentation. Any increased footprint resulting from dam raising would need to further analyze impacts to important bull trout habitat and State-designated Natural River reaches.

"Areas of opportunity" in the Payette River basin include the following.

- *Lower South Fork Payette.* Water could be diverted from the Lower South Fork Payette River into an off-stream storage facility located either within the Payette River basin or via a transbasin transfer to the Boise River basin. Between 150,000 AF and 225,000 AF could be stored and delivered reliably 90 percent of the time to water users for uses such as DCM&I, irrigation, and flow augmentation, and potentially flood control capacity depending on the configuration of the off-stream diversion structure and conveyance. Any development would need to further analyze impacts to downstream flows at Letha and the State-designated Recreational River section of the reach.

- *Lower North Fork Payette.* Water could be diverted from the Lower North Fork Payette River into an off-stream storage facility in Squaw Creek or Scriver Creek/Middle Fork Payette. Approximately 300,000 AF could be stored and delivered reliably 90 percent of the time to water users for uses such as DCM&I, irrigation, flow augmentation, and potentially limited flood control capacity depending on the configuration of the off-stream diversion structure and conveyance. Any development would need to further analyze impacts to the State-designated Recreational River section of the reach.
- *Mainstem Payette.* Water could be diverted from the Lower Mainstem Payette River into an off-stream storage facility in Dry Buck Creek, Lower Squaw Creek or Upper Shafer Creek. Approximately 300,000 AF could be stored and delivered reliably 90 percent of the time to water users for uses such as DCM&I, irrigation, flow augmentation, and potentially limited flood control capacity depending on the configuration of the off-stream diversion structure and conveyance. Any development would need to further analyze impacts to Black Canyon Reservoir and the State-designated Recreational River section of the reach.
- *Lower Payette.* Water could be diverted from the Lower Payette River into an off-stream storage facility. Approximately 300,000 to 400,000 AF could be stored and delivered reliably 90 percent of the time to uses including primarily flow augmentation (little to no use for DCM&I or irrigation water this low in the Payette River basin). There may be limited flood control capacity depending on the configuration of an off-stream diversion structure and conveyance. There are no State- or Federal- designated reaches within this area that would preclude diversion and/or storage.
- *Dredging Cascade Reservoir.* Reclamation has identified potentially dredging 50,000 AF of sediments in Cascade Reservoir to create more active capacity. Retrofitting existing facilities meets all uses, including DCM&I, irrigation, flood control capacity, and flow augmentation. This would not have any effect on the reservoir footprint, and there are no State- or Federal-designated reaches that would be affected.

The distribution of these areas is weighted toward the Payette River basin because this basin has a relatively lower incidence of potential socio-economic and environmental concerns. However, the majority of projected water uses are located in the Boise River basin. Therefore, “areas of opportunity” that received relatively lower scores in the Boise River basin (as compared to “areas of opportunity” in the Payette River basin) were retained and are recommended for consideration in future appraisal/feasibility analysis.

Within each of these eight “areas of opportunity,” there is some flexibility in how future storage sites might be configured using a combination of diversion structures, on-stream or off-stream storage facilities, and water release rules that would work with existing reservoir operations. Some combination of physical structures or inter-basin exchanges may provide the greatest flexibility in meeting future water needs in both basins.

Next Steps

This report completes an assessment of storage opportunities in the Boise and Payette River basins. The next step in the Federal planning process for a water storage project typically includes a more in-depth analysis of identified opportunities (in this case, the identified eight "areas of opportunity"). More detailed analysis is called an appraisal study, and an appraisal study includes an in-depth inventory of water and land resources in a chosen "area of opportunity;" the formulation of alternative plans; the evaluation of the effects of the alternatives; a comparison of alternatives; and the selection of a recommended action based on the comparison of alternatives.

If the appraisal study recommends a viable solution with a Federal role, then that alternative could be evaluated at the next step, which is a feasibility study. Feasibility studies normally integrate constructability with compliance under a number of legislative and regulatory constraints, such as the National Environmental Policy Act, U.S. Fish and Wildlife Service (USFWS) Coordination Act, Endangered Species Act, National Historic Preservation Act, and other related executive orders, environmental, and cultural resource laws.

Feasibility studies cannot be initiated until specifically authorized by Congress and require a 50 percent cost share from future beneficiaries of the project. Reclamation recognizes that given the necessary involvement of Congress in authorizing the project and necessary partnerships for funding future phases of this work, broad-based stakeholder support is required. Federal water resource planning should be responsive to State and local concerns and should provide the opportunity for State and local agencies to participate in the planning process. It is recognized that water projects that are local, regional, State, or even interstate in scope do not necessarily have a large Federal role. State and local entities are free to initiate planning and implementation of water projects without Federal participation.

Figure ES-1. Identified "Areas of Opportunity"

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Acronyms and Abbreviations

AF	acre-feet
ASR	aquifer storage and recovery
BLM	Bureau of Land Management
BPBOC	Boise Project Board of Control
CDC	Conservation Data Center
cfs	cubic feet per second
COMPASS	Community Planning Association of Ada and Canyon Counties
CSU	Colorado State University
CWA	Clean Water Act
DCM&I	Domestic, commercial, municipal, and industrial
DEM	Digital Elevation Model
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
GIS	Geographic Information Systems
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDWR	Idaho Department of Water Resources
IWRB	Idaho Water Resources Board
IWRRI	Idaho Water Resources Research Institute
MAF	million acre-feet
NEPA	National Environmental Policy Act
NMID	Nampa & Meridian Irrigation District
Reclamation	U.S. Bureau of Reclamation
SWG	Stakeholder Working Group
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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1. Introduction

1.1 Assessment Purpose

The arid west was developed, in large part, because of the ability to effectively manage a scarce water supply. In many ways, the culture and way of life in the arid west is defined by water: *How much water do we have? Where is the water? How and why are we using that water?*

Within southwestern Idaho, these questions are becoming even more important to ask and answer as demands on a finite water supply continue to increase. Historically, water management consisted of conveying available surface water, and later on groundwater, to dry lands so that agricultural crops could be irrigated. As the amount of irrigated land and the demand to provide water to that land increased, management shifted to incorporate storage of wetter off-season (winter and spring) surface flows so that stored water was available to agricultural lands during the drier summers. Water management evolved to include flood control, because as the population grew and inhabited more riparian corridors, property damage from uncontrollable spring flows increased. The growing population also meant more demand for non-agricultural water supplies, and placed additional pressure on the available water supply.

Throughout the arid west, including southwestern Idaho, rapid urbanization of land previously used for agricultural purposes (including cropland, pasture, and dairies) has created water management challenges. In 2002, participants at the Treasure Valley Water Summit identified a primary water management goal to be "a sustainable supply of high quality water for domestic, commercial, municipal, and industrial (DCM&I) and irrigation users for the foreseeable future without causing unintended adverse impacts to the basin hydrology" (COMPASS, 2002). This goal reinforces the critical need for long-term planning for water supply and water management.

Comprehensive water supply and water management incorporates multiple elements including optimizing existing supplies, conjunctively managing surface water and groundwater, developing water conservation strategies, and identifying additional potential supplies to meet increasing demand. In Idaho, multiple agencies are charged with managing different aspects of our water resources. Local cities and counties are charged with, among other things, developing floodplain management strategies and land use/growth management plans. Irrigation districts and canal companies manage water delivery to, and drainage from, agricultural lands. The Idaho Department of Water Resources (IDWR) and the Idaho Water Resources Board (IWRB) have many responsibilities including administration and management of water rights, water supply outlook estimation, coordination of the national flood insurance program, and development of the comprehensive State water plan and subsequent basin plans. The Idaho Department of Environmental Quality (IDEQ) is charged with managing the water quality of our streams. The U.S. Army Corps of Engineers (USACE) is charged with flood control management. In Idaho, the U.S. Bureau of Reclamation (Reclamation) manages the storage and delivery of surface water, and is authorized to manage and coordinate programs that develop innovative water management tools and partnerships to meet the growing demand for water.

At the request of local water users, Reclamation agreed to identify and assess potential new surface water supply storage opportunities within the Boise and Payette River basins, as one component of an overall water supply and water management process. This assessment focuses primarily on new or enhanced storage capabilities, including new on-stream and off-stream reservoir storage facilities[1], and retrofitting of existing reservoir facilities.

1.1.1 Background

The broad issue of water supply and water management is certainly not new to the Boise and Payette River basins, which together contain nearly 40 percent of Idaho's population (U.S. Census, 2000). Recent prolonged drought conditions, in combination with urban growth, motivated local water users and Congressman Butch Otter to meet in 2003 and 2004 to discuss the potential need, support, and opportunities for additional water storage. These meetings resulted in a confirmed desire by local water users to pursue water storage opportunities in the Boise and Payette River basins.

Historic water storage studies were conducted for a variety of reasons ranging from supporting economic development, to conceptualizing specific reservoir sites. The Snake River basin comprehensive water storage study conducted by Reclamation and USACE in 1994 is the most recent of more than 50 published documents (dating back to 1938) that address one or more elements of water supply and storage within the two basins.[2] Many things have changed over the years, including increased urbanization, shifting water uses and needs, adjudication of water rights, habitat considerations, recreational uses, power generation, and evolving socio-economic and environmental values. The local water users and Congressman Otter recognized that many things have changed since those past studies were completed and a more current assessment of water storage opportunities was needed.

In 2005, the State legislature passed a resolution (House Concurrent Resolution No. 25) supporting the study of additional water supplies for Idaho, setting the stage for local and State support for the study. Idaho Water Users Association formally agreed to be a study sponsor and requested that Reclamation conduct studies on potential water storage sites in the Boise and Payette River basins. Reclamation agreed to conduct this assessment as a first step in the process of evaluating additional water storage opportunities in these two basins. Invitations to participate in this assessment process were sent to 60 potentially interested parties, of which 25 expressed a direct desire to participate. More information on the development and participation of the Stakeholder Working Group (SWG) is provided in Section 1.2.

1.1.2 Reclamation's Authority to do this Assessment

Authorization to conduct assessments is provided under the Reclamation Act of 1902 (June 17, 1902) 32 Stat 388, and those Acts amendatory thereof and supplementary thereto. The 1902 Act and supplementary Acts authorize Reclamation to manage and coordinate those Idaho Investigations programs that develop innovative water management tools and

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[1] An on-stream site is defined as any site within a drainage-way that has sufficient year-round flow to fill at a specified frequency from waters within the drainage. An off-stream site is defined as being located on or adjacent to a drainage-way and requiring intra- or transbasin sources to fill at a specified frequency.

[2] These documents also formed the baseline for this assessment, as discussed in Chapter 3.

partnerships to meet the growing demand for water in the American West. The Idaho Investigations program mission is to work with its partners to conduct innovative studies to address regional water resource issues while addressing the goals in the Department of Interior's and Reclamation's Strategic Plans.

The Federal water resource planning process involves several levels of planning, starting with an assessment and then moving to appraisal/feasibility analysis. An assessment study is generally a preliminary survey of problems and needs that utilizes existing information to explore conceptual solutions to water resources issues in specific areas. The assessment helps determine the Federal role and the desirability of potential partner(s) to proceed to appraisal/ feasibility analysis.

Specific authority must be provided by Congress for Reclamation to conduct feasibility studies. At the time of this assessment report publication, Congressman Butch Otter has introduced legislation (H.R. 2563) that would provide broad authority for Reclamation to conduct feasibility studies to address water storage opportunities in the Payette and Boise River basins. Additional information on next steps in the Federal water resources planning process is provided in Chapter 5.

1.1.3 Scope

This assessment is just one activity and one aspect of the many activities that multiple agencies are conducting to address water supply and water management issues in the Boise and Payette River basins. The focus of this assessment is to identify and assess potential new surface water supply storage opportunities within these basins. Other water supply and water management components such as optimizing existing supplies, conjunctively managing surface water and groundwater, and developing water conservation strategies are outside of this assessment's scope.

A broad-based SWG was convened to participate in the assessment effort (see Section 1.2). The SWG identified a number of non-physical or administrative water storage opportunities that did not fit into the defined scope of this assessment. These opportunities include water conservation (including upgrading delivery canals), modifying existing reservoir minimum pool operations (for example, at Cascade Reservoir), and expanding authorization at existing storage facilities to include other water uses. These opportunities will not be evaluated in this assessment because they are outside the scope of the effort, but they could be pursued by other agencies and stakeholders or could be considered in separate or future Reclamation studies.

More than 200 potential new storage sites or options have been identified in the historic literature (as discussed in more detail in Chapter 3). To examine and prioritize current water storage opportunities, this assessment builds upon the historic foundation of information to the extent possible. As defined earlier, an assessment study generally determines the desirability of proceeding to either an appraisal/feasibility analysis by relying primarily on existing data and information.

Even though a large body of information is available, the quality of that information is limited and there are data gaps. Where information was not available, reasonable assumptions were made in the analysis. The best example of this is the development of estimated future water needs (Chapter 2). To generally estimate how much additional storage might be needed over a 50-year planning horizon, existing water demand projections and regional long-range planning assumptions developed by IDWR were extrapolated using very simple methods. Simple methods were used recognizing that demand projections are not the focus of this assessment, and as long-range future demands are developed in more detail by IDWR, this information can and should be incorporated into the comprehensive water management process. Such data gaps will need to be addressed more thoroughly at subsequent levels of investigation.

This assessment builds on the existing body of information over the last 75 years, including most importantly the 1994 Reclamation/USACE report, to develop a consolidated list of potential new water storage sites in the Snake River basin. More than 200 previously identified sites within the Boise and Payette River basins have been consolidated from over 50 past reports. These sites have been evaluated in this assessment process based on three primary criteria:

- Volume—Which sites are large enough to meet possible future water demands?
- Hydrologic Feasibility—Which sites can reliably refill based on existing facility operations, current water rights and water delivery commitments, and current stream flow targets?
- Socio-economic and Environmental Constraints—Which sites are located in areas that have the lowest impact (relative to other potential sites) on socio-economically and/or environmentally important factors (for example, infrastructure and/or protected rivers)?

Project objectives are as follows:

1. Contribute to long-range regional water management planning activities by identifying new water storage.
2. Begin with the broadest possible base of historic and current information so that appropriate storage opportunities can be considered.
3. Develop a process that logically and defensibly consolidates identified opportunities to a manageable number, by relying on a common set of hydrologic criteria coupled with an assessment of impacts on socio-economically or environmentally important factors.
4. Incorporate stakeholder input in identifying relevant historic information, providing accurate current information, understanding diverse perspectives (particularly associated with the socio-economic or environmental factors), and gaining some level of consensus.

1.1.4 Report Organization

This report is organized as follows:

- Executive Summary—Provides an overview of the assessment methods and conclusions.
- Chapter 1—Presents the background information necessary to understand the scope of this assessment, including its limitations.

- Chapter 2—Discusses estimated future water needs.
- Chapter 3—Summarizes how potential storage sites were identified, how screening criteria were selected and developed, and how potential storage sites were screened against these criteria.
- Chapter 4—Evaluates areas identified as having the highest potential for future water storage and discusses the conclusions of this assessment and potential path forward for further analysis.
- Chapter 5—Describes the next steps in moving forward with a specific recommendation for further analysis in the Federal water resource planning process.
- Chapter 6—Provides references cited in this assessment.

Report appendixes also provide important back-up information as follows:

- Appendix A—Provides a list of SWG participants.
- Appendix B—Presents SWG meeting agendas, presentation materials, and summary notes.
- Appendix C—Presents an overview of conservation estimates from adjacent arid states.
- Appendix D—Includes a Literature Report that summarizes existing documents and information.
- Appendix E—Summarizes information relating to the hydrologic modeling that helped support this assessment.
- Appendix F—Records stakeholder input on the relative importance of various socio-economic and environmental factors.
- Appendix G—Summarizes the scoring of specific sites against identified socio-economic and environmental factors.
- Appendix H—Summarizes the approach and assumptions used to develop assessment construction cost estimates.
- Appendix I—Provides a list of definitions used for technical terms in this assessment.
- Appendix J—Provides a break-down of land uses that would be affected by potential storage sites.

1.2 Stakeholder Working Group

A broad-based SWG was formed to participate in the assessment effort. Over 60 invitations to participate were sent on July 13, 2005, to a broad spectrum of local water users and interested parties including Federal partners, State partners, and local partners; irrigation interests; flood control districts; and environmental groups. Participants were invited to be a part of this effort based on their long-standing expertise and historic knowledge of regional water resources including regulatory, environmental, water use, and infrastructure issues. Of those invited, 25 agencies and entities were represented in regular SWG meetings, and another five requested to be kept up to date via a general mailing list. The initial meeting was held on August 23, 2005, and the final meeting was held on March 14, 2006.

SWG participants provided review and commentary throughout each stage in the assessment, culminating with review of this report. The SWG met six times during the assessment effort. Stakeholder agencies and organizations comprising the SWG included the following (see Appendix A for a list of the individuals representing these stakeholders).

Federal Agencies:

- U.S. Bureau of Reclamation
- U.S. Army Corps of Engineers
- U.S. Bureau of Land Management
- U.S. Environmental Protection Agency
- U.S. Geological Survey

State Agencies:

- Idaho Department of Fish and Game
- Idaho Department of Water Resources
- Idaho Water Resources Board

Local Agencies, Districts, and Other Organizations:

- Boise Project Board of Control
- Canyon County Planning and Zoning Commission
- City of Boise
- Congressman Otter's Office
- Holladay Engineering Company (representing multiple cities and districts)
- Idaho Farm Bureau Federation
- Idaho Rivers United
- Idaho Water Users Association
- J.R. Simplot Company
- Nampa & Meridian Irrigation District
- Payette County
- Pioneer Irrigation District
- Settlers Irrigation District
- Senator Crapo's Office
- Trout Unlimited
- United Water Idaho
- Water District 63, Boise
- Water District 65, Payette

SWG meeting agendas and summary notes were made available on Reclamation's project Web site throughout the process, and are included in Appendix B.

1.3 Assessment Area

The Boise and Payette River basins are in the southwest area of Idaho (Figure 1-1). The two basins are complex watersheds in terms of their development histories and current management goals. These basins are among the fastest growing areas in Idaho and are experiencing increased pressure to find water supplies to meet growing demands. The growth and the historical Federal presence in both the Boise and Payette River basins, through the development of the Boise Project, made this watershed an excellent candidate for evaluating future water storage opportunities. Figure 1-1 presents the boundaries of Reclamation's Boise Project, which consists of the Arrowrock and Payette Divisions (Reclamation, 2005a).

A summary of general factors in the assessment area is provided in this section, and includes overviews of socio-economic issues, hydrologic characteristics, management of the existing water storage system, and instream flow issues.

1.3.1 Socio-economic Description

The Boise River basin is the most diverse socio-economic area of Idaho and includes the State capitol, as well as the larger Treasure Valley metropolitan area. The Payette River basin contains a number of growing towns that cater to recreational tourism, with a strong agricultural land use base. Additional water will be required to meet competing needs associated with a growing population and high rates of urbanization, coupled with the need to sustain agricultural production.

Both basins represent high growth areas of the State. Between 1970 and 2000, the population of Ada and Canyon Counties increased from 175,000 to 400,000, representing a growth rate of 7.6 percent annually (IDWR, 2001). Within the Payette River basin, Boise, Gem, Payette, and Valley Counties grew at an average rate of 6.6 percent annually between 1970 and 1996 (this rate declined to 4.4 percent between 1990 and 1996 [IDWR, 1999]). Such rapid growth places increasing pressure on existing water supplies and continued population growth will mean that additional water supplies will be necessary, as discussed in more detail in Chapter 2.

The most recent water use numbers for the Boise River basin are from 2000, and the most recent water use numbers for the Payette River basin are from 1996. In 2000, annual DCM&I water usage in the lower Boise River basin was 121,000 acre-feet (AF) (IDWR, 2001). Irrigation consumption in the Boise River basin in 2000 was estimated at 1,156,700 AF of surface water and 53,000 AF of groundwater (McGown, 2004). Irrigation uses include both agricultural consumption, as well as urban landscaping consumption. Thus, the combined consumptive use in the Boise River basin in 2000 was 1.3 million acre-feet (MAF).

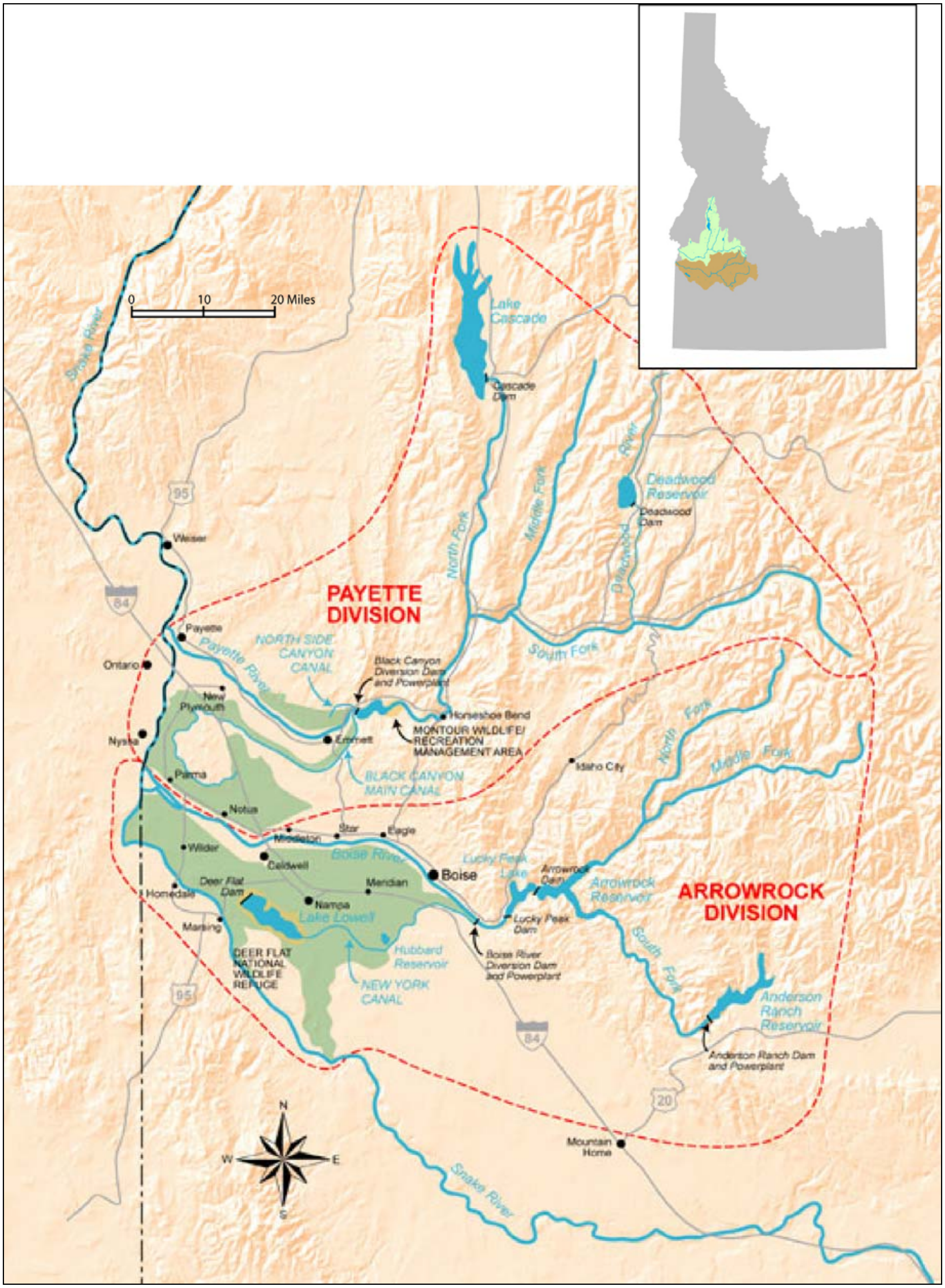

Figure 1-1. Boise Project: Boise and Payette River Basins
Source: Reclamation, 2005a

Similarly, in 1996 annual DCM&I water usage in the Payette River basin was 31,900 AF (IDWR, 1999). Irrigation consumption was estimated at 1,150,000 AF of surface water and 52,000 AF of groundwater (IDWR, 1999). Within the Payette River basin, crops over the last 10 years have generally moved to higher-value crops that require higher levels of irrigation (potatoes and sugar beets). The combined consumptive use in the Payette River basin in 1996 was 1.2 MAF.

Projected DCM&I and irrigation demands are discussed in more detail in Chapter 2.

1.3.2 Physical Hydrology

The Boise River originates as three forks—the North Fork, Middle Fork, and South Fork—to the east and northeast of the City of Boise (see Figure 1-1 for the locations of the major river forks in both basins). Surface water flows of the three forks are generally west and southwest to where they join to form the mainstem, approximately 20 miles east of the City of Boise. Mores Creek (and its major tributary, Grimes Creek) flows generally south, drains an area to the west of the three forks of the Boise River, and flows into Lucky Peak Reservoir. The Boise River continues west through the City of Boise and past the edge of the City of Caldwell to join the Snake River.

The Payette River also originates as three forks—the North Fork, Middle Fork, and South Fork. Surface water flows in the North and Middle Forks are generally south, and the Middle Fork joins the South Fork, which flows west, just downstream from Garden Valley. Downstream from the confluence, the South Fork is generally referred to as the mainstem, which is joined by the North Fork upstream from Banks. The mainstem flows southwest to Horseshoe Bend and through Black Canyon, joining the Snake River downstream from the town of Payette.

Figure 1-2 presents the annual precipitation within both basins (IDWR, 2005). This figure shows that while the majority of rainfall (more than 25 inches per year) occurs within the higher elevations, the population centers and large-scale agricultural uses are in relatively lower elevations with less rainfall (less than 25 inches per year). Thus, there is currently sufficient water leaving the basins, but additional storage is necessary to capture and make use of it. For example, the upper Boise River watershed produces about 2 MAF of water into the lower Boise River watershed in an average year, of which about 1 MAF leaves the lower Boise River at its mouth near Parma.

Available precipitation data also show that the Payette River basin (4,100 square miles), which is a larger basin relative to the adjacent Boise River basin (3,300 square miles), is dominated by higher precipitation. On an inch-per-square-mile basis, the Payette River basin receives nearly double the volume of precipitation compared to the Boise River basin.

This translates into higher runoff on an annual basis in the Payette River basin. Figure 1-3 shows the estimated natural[3] runoff patterns for both basins.

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[3] Natural flows for the Boise River basin incorporated gage data from Featherville (USGS 13186000) and Twin Springs (USGS 13185000). Natural flows for the Payette River basin incorporated gage data from South Fork Lowman (USGS 13237920).

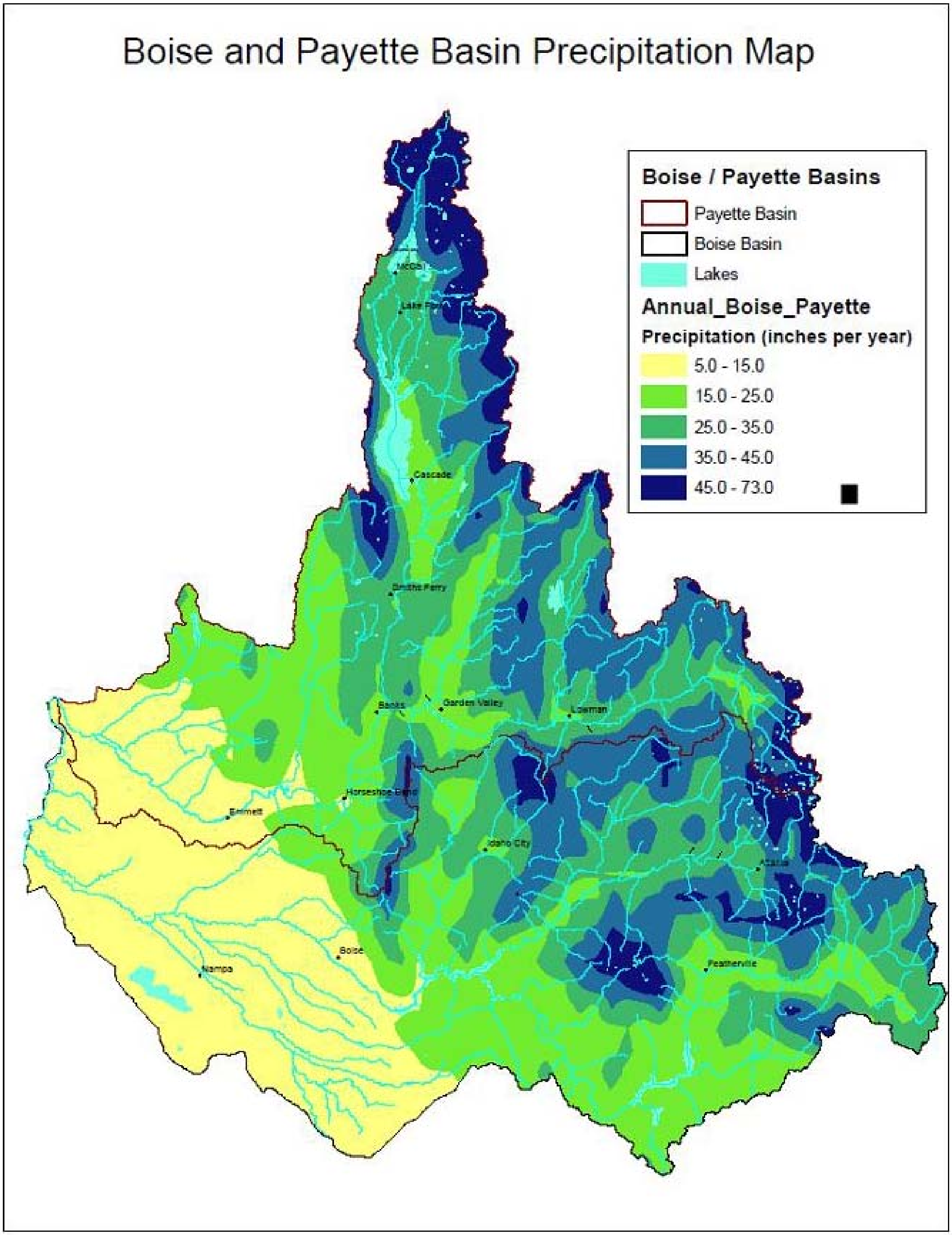


Figure 1-2. Annual Precipitation
Source: IDWR, 2005

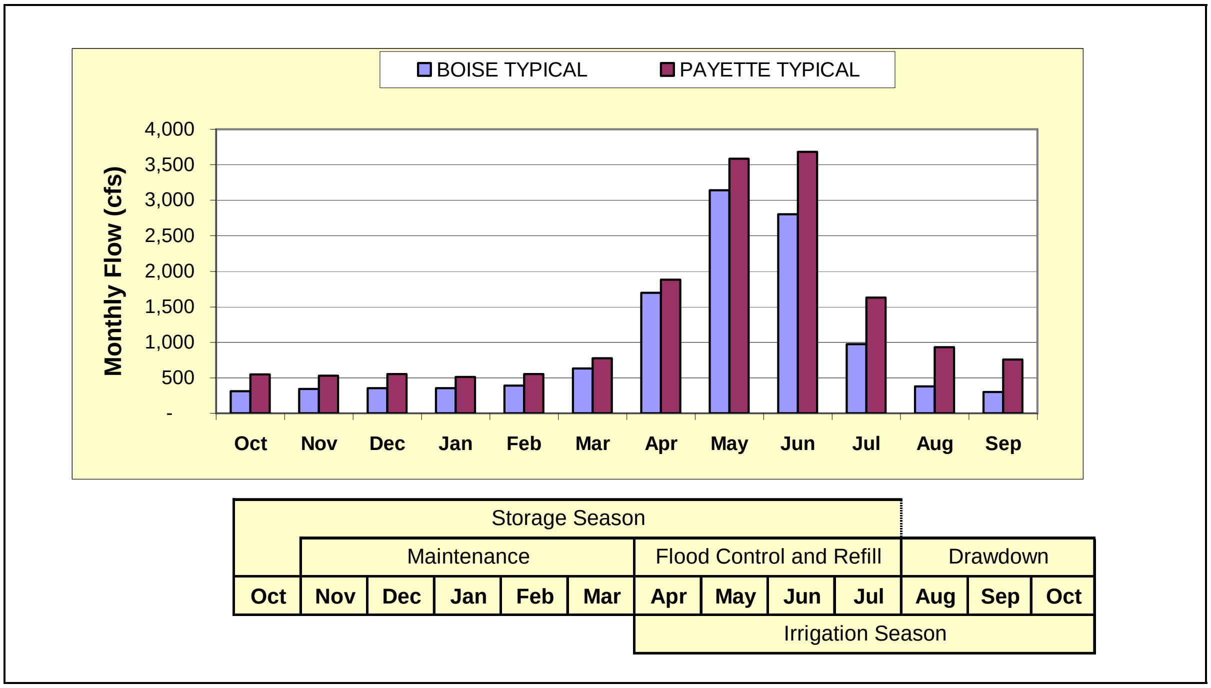


Figure 1-3. Estimated Annual Runoff Patterns
Sources: USGS, 2004; Reclamation, 1997

Gage records (see Footnote 3) indicate that 37 percent greater runoff is observed in the Payette River basin relative to the Boise River basin. Based on these records, between 65 and 70 percent of this runoff occurs in the April-July spring flood season, when snowpack in the upper elevations melts as daily temperatures increase. Infrequent rain-on-snow events, where rainfall melts existing snow cover, can also cause widespread regional flooding such as the January 1997 flood event that affected both basins.

Storage for downstream uses of the runoff occurs between October and July, although storage during the April-July period must be balanced with flood control. Drawdown typically occurs between August and October, depending on the water year condition. Operational issues associated with multiple uses of the existing storage facilities are discussed in more detail in the following section.

These runoff volumes and patterns are based on historic data and do not consider potential future volume or pattern changes due to possible climate change impact. Throughout the Pacific Northwest, warmer temperatures are predicted to result in progressively smaller snowpack and earlier runoff (Climate Impacts Group, 2006). If such regional predictions occur within the Boise and Payette River basins, smaller snowpack and earlier runoff may impact current water storage patterns and may lead to the need for additional water storage.

1.3.3 Existing Regulation Development and Operations Overview

Large-scale organized irrigation came to the lower Boise River in the 1860s and 1870s, long before Reclamation was established. By that period, the greatest need was for a water storage system to supplement river flows during the later summer months when irrigation demands exceeded natural river supplies.

The Boise Project began in 1906 by extending the New York Canal 40 miles to convey water from the Boise River Diversion Dam to Lake Lowell. In the Payette River basin, Black Canyon Diversion Dam was constructed in 1924 as the first diversion from the Payette River. Since then, the Boise Project has evolved to provide full irrigation water supply to approximately 224,000 acres and a supplemental supply to some 173,000 acres. While the majority of lands within each basin are irrigated with water from that basin, a limited amount of land (7,000 acres) is irrigated by water that is diverted from both basins.

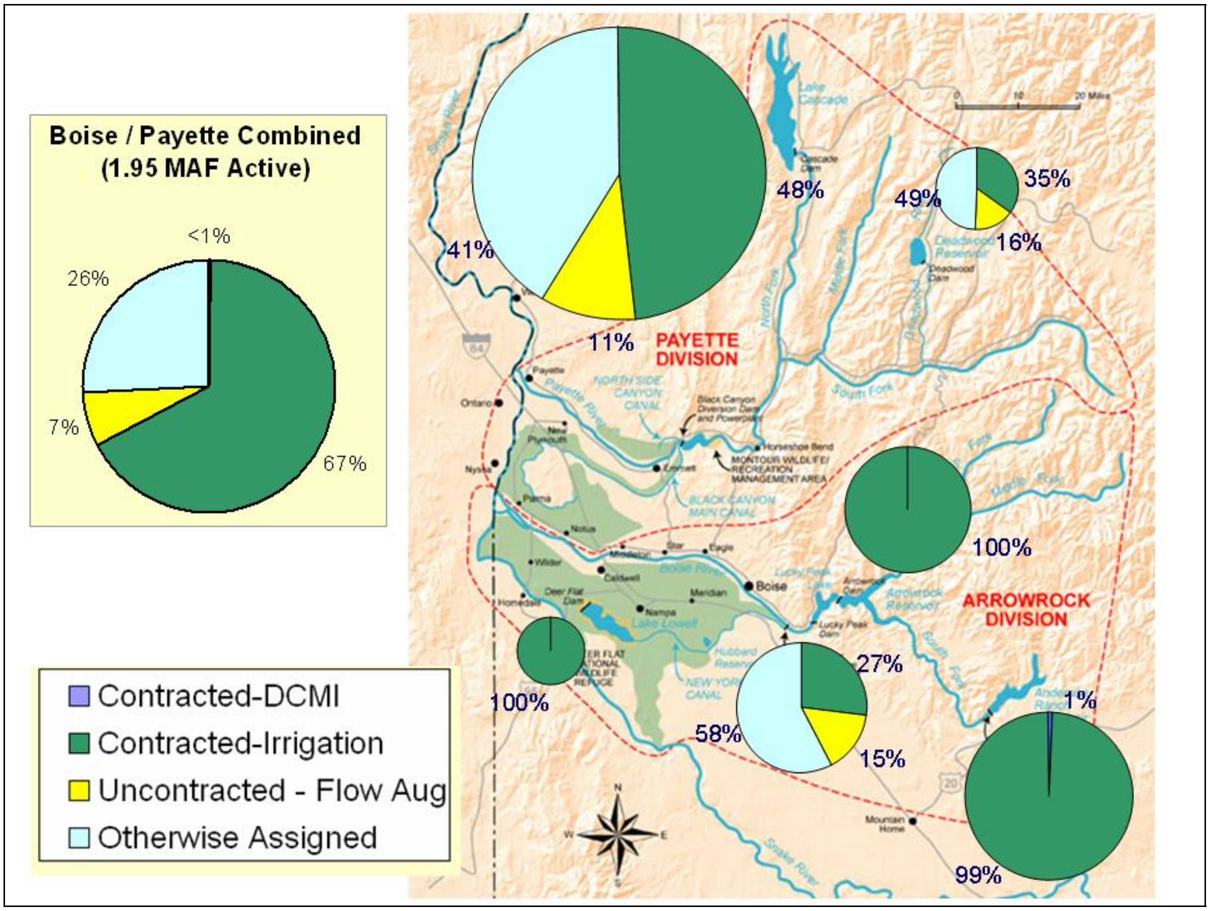
As shown in Figure 1-1, Reclamation's Boise Project includes six reservoirs (Anderson Ranch Reservoir, Arrowrock Reservoir, Lake Lowell, Deadwood Reservoir, Cascade Reservoir, and Black Canyon Reservoir), two diversion dams (Boise River Diversion Dam and Black Canyon Diversion Dam), three Federal powerplants (Anderson Ranch, Boise River Diversion Dam, and Black Canyon), seven pumping plants, 720 miles of main canals, more than 1,300 miles of smaller canals, and 650 miles of drains. There are also other facilities operated by other government agencies (for example, USACE operates Lucky Peak Reservoir for flood control in the lower Boise River valley) and private entities (for example, Idaho Power Company operates a powerhouse at Cascade Reservoir).

For existing Federal facilities, the Secretary of the Interior, under provisions of the Reclamation Act of June 17, 1902 (32 Stat. 388), authorized construction of the original Boise Project (now the Arrowrock Division) on March 27, 1905; Arrowrock Dam on January 6, 1911; and Black Canyon Dam on June 26, 1922. The President, under Section 4 of the Act of June 25, 1910 (36 Stat. 836), and subsection B, Section 4 of the Act of December 5, 1924 (48 Stat. 701), approved Deadwood Dam and Reservoir on October 19, 1928, and Payette Division on December 19, 1935. Finally, the Secretary of the Interior, under the Reclamation Project Act of 1939 (53 Stat. 1187), authorized Anderson Ranch Dam and Reservoir on June 25, 1940. Lucky Peak Dam, constructed by USACE in 1946, was authorized in 1944 under the Flood Control Act of 1944 for flood control and irrigation purposes.

The original authorizing legislation is an important consideration because it states the authorized project purpose and determines the uses of storage water and the limits within which that Federal facility can be operated. The original authorized purpose of each storage facility of the Boise Project is: Arrowrock Dam—irrigation; Anderson Ranch Dam—irrigation, power, flood control, conservation of fish, and recreation; Black Canyon Dam—irrigation and power; Cascade Dam—irrigation and power; Deadwood Dam—irrigation and downstream power; and Deer Flat Dam (Lake Lowell)—irrigation. The Federal Water Project Recreation Act of 1965 (P.L. 89-72) provided further authorities by authorizing recreation and fish and wildlife enhancement as a function at all existing reservoirs.

In summary, irrigation is generally the primary purpose of all authorized Reclamation facilities in the Boise Project, and flood control, recreation, or fish and wildlife enhancement are viewed as project functions or benefits that are national in scope and were generally added through legislation.

The Boise Project can store and distribute 1.95 MAF of water. The Boise Project is operated to meet contract obligations, flood control, and instream resources. Figure 1-4 shows the current allocation of active storage volumes for the entire Boise Project as well as for each facility (storage volume for each facility is shown to scale).



Note: Legend terms are also used in Table 1-1.

Figure 1-4. Current Water Allocation
Source: Reclamation, 1997

Table 1-1 (Reclamation, 1997) provides a summary of the uses, different storage components, and current allocations for each Federal storage reservoir in the Boise Project (including Lucky Peak, which is operated by the USACE). Black Canyon Reservoir is not included in this table because Reclamation does not store water in this run-of-river facility. Although only Federal facilities are included in Table 1-1, several other significant non-Federal reservoirs are present in both basins (for example, Payette Lake, Little Payette Lake, and Little Camas Reservoirs).

In the Boise River basin all three reservoir facilities (Anderson Ranch, Arrowrock, and Lucky Peak) are operated in a coordinated manner, with coordination of irrigation operations with the Water District 63 Watermaster and coordination of flood control operations with the USACE. To the extent possible, as a matter of practice, water is stored high in the system for operational flexibility. During the irrigation season, Lucky Peak is held at or near full pool through the summer, and Arrowrock and Anderson Ranch Reservoirs are drafted for irrigation and uncontracted water is released for flow augmentation. In the fall, Lucky Peak is drafted to meet late-season irrigation needs. Storage water that is not used is credited as carryover into the next year or may be placed into a Boise River rental pool for rental by other water users in the current year.

Table 1-1. Federal Reservoir Use, Storage Component, and Current Allocation Summary

Facility	AUTHORIZATION			ACTIVE STORAGE VOLUME (AF)				
	Irrigation	Flood	Power	TOTAL ACTIVE VOLUME	Contracted-DCM&I	Contracted-Irrigation	Uncontracted - Flow Augmentation[a]	Uncontracted - Otherwise Assigned[b]
Anderson Ranch	X	X	X (Federal)	423,200	4,800	418,000	-	400
Arrowrock	X			286,600	-	286,600	-	-
Lucky Peak	X	X	X (Private)	264,370	-	71,018	40,932	152,420
Lake Lowell	X			159,400		159,400		-
Boise Sum				**1,133,570**	**4,800**	**935,018**	**40,932**	**152,820**
Deadwood	X		X (Federal)	161,900	-	56,600	25,400	79,900
Cascade	X		X (Private)	653,200	-	313,700	69,600	269,900
Payette Sum				**815,100**	-	**370,300**	**95,000**	**349,800**
Boise/Payette Sum				**1,948,670**	**4,800**	**1,305,318**	**135,932**	**502,620**

[a] This volume represents uncontracted water that is used for salmon flow augmentation in the summer.
[b] This volume represents uncontracted water that is used to meet other uses, such as winter instream flows, dam safety mitigation, and evaporative losses.

NOTE: Black Canyon is not included in this table because it does not store water as a run-of-river facility.

In the Payette River basin, Deadwood and Cascade Reservoirs (as well as the diversion dam at Black Canyon) are also operated in a coordinated manner. Generally, Cascade and Deadwood Reservoirs are operated in parallel to keep the refill capabilities of the two reservoirs equal. Deadwood Dam provides a regulated flow for the powerplant at Black Canyon Diversion Dam and for irrigation in the Payette Division and Emmett Irrigation District. Reclamation attempts to keep Cascade Reservoir at relatively constant levels given the shoreline development and recreational uses of the reservoir. Generally, irrigation demands are met by first releasing water from Deadwood, usually in July and August, and in the late fall season irrigation demand and flow augmentation uses are met first by releases from Cascade Dam (IDWR, 1999).

In addition to surface water supplies, water users in both basins also rely on groundwater. In recent years, increasing population and droughts have led to localized declines in shallow groundwater levels in the Boise River basin. In 2000, 175,000 AF of groundwater was pumped in the Boise River basin, of which 30 percent was used for irrigation (53,000 AF) and 70 percent was used for DCM&I (122,000 AF [IDWR, 2000]). In addition, United Water draws 80 percent of the water it supplies for DCM&I from the deeper regional aquifer (Rhead, 2004b). Analysis suggests that groundwater levels in the deeper aquifer are relatively stable, in contrast with shallow water table levels that appear to be locally declining in areas where residential development is replacing flood-irrigated farmland (IWRRI, 2004).

In the Payette River basin, 52,000 AF of groundwater was diverted for application to agricultural lands, primarily from the lower Payette River valley (IDWR, 1999). Levels have typically remained stable since the 1960s, although marginal groundwater quality has limited the widespread withdrawal of groundwater.

Hydropower is also generated by a number of Federal facilities within both basins. Table 1-2 summarizes existing hydropower development at Federal facilities.

Table 1-2. Existing Federal Facility Hydropower Development

Facility	Location	Capacity (MW)	Owner
Boise River Basin			
Anderson Ranch Dam	South Fork Boise	40	Reclamation
Lucky Peak Dam	Mainstem Boise	103.2	Boise Project Board of Control (Seattle City Light)
Diversion Dam	Lower Boise	3.5	Reclamation
Payette River Basin			
Deadwood	Deadwood River	--	Reclamation (Provides storage for Black Canyon power generation)
Cascade	North Fork Payette	12.8	Idaho Power Company
Horseshoe Bend	Mainstem Payette	9.5	Horseshoe Bend Hydroelectric Company
Black Canyon	Mainstem Payette	10.2	Reclamation

Sources: Reclamation, 1997; IDWR, 1999.

1.3.4 Instream Flows and Flow Augmentation

Some surface water in both basins is stored and released for minimum instream flows and flow augmentation.

IDWR administers the State minimum stream flow program, as authorized by the Idaho Legislature in 1978, to preserve stream flows and lake elevations for public health, safety, and welfare. IDWR defines minimum stream flows as “the amount of flow necessary to preserve desired stream values, including fish and wildlife habitat, aquatic life, navigation and transportation, recreation, water quality, and aesthetic beauty” (IDWR, 2006). In some cases water rights are established to meet minimum stream flow targets. These water rights are approved by the legislature and are held by the IWRB in trust for Idaho citizens. Most of these water rights have relatively recent priority dates and are junior to other more senior water rights in both basins.

In addition to legal minimum stream flow water rights, minimum stream flow targets have also been established and are attempted to be met if water conditions allow; these minimum targets are not protected. Stream flow water rights and stream flow targets in both basins are summarized in Table 1-3.

Table 1-3. Minimum Instream Flows and Targets

	Flow (cfs)	Period	Type (Priority Date)
Boise River Basin			
Downstream from Anderson Ranch (South Fork Boise)	300	Sep 15-Mar 31	Minimum target
	600	Apr 1-whenever higher releases dictated by irrigation demand or flood control	Minimum target
East Fork Montezuma (Montezuma, Middle Fork Boise)	0.1	Year-round	Licensed water right (Nov-96)
Crooked River (Middle Fork Boise)	150	May 1-Jun 30	Licensed water right (Nov-96)
	34	Jul 1-Apr 30	Licensed water right (Nov-96)
Yuba River (Middle Fork Boise)	200	May 1-Jun 30	Licensed water right (Nov-96)
	44	Jul 1-Apr 30	Licensed water right (Nov-96)
North Fork Elk Creek (Mores, Boise)	5	Year-round	Licensed water right (Nov-96)
	230	Jul 1-Apr 30	Licensed water right (Nov-96)
Middle Fork Boise (RM 16.3 to North Fork)	1,000	May 1-Jun 30	Licensed water right (Nov-96)
	230	Jul 1-Apr 30	Licensed water right (Nov-96)
Downstream from Lucky Peak (Glenwood, Lower Boise)	150	Winter	Minimum target

Table 1-3. Minimum Instream Flows and Targets (continued)

	Flow (cfs)	Period	Type (Priority Date)
Payette River Basin			
Downstream from Deadwood (South Fork Payette)	50	Winter	Minimum target
Sawtooth Wilderness to Deadwood River confluence	1,100	Apr 19-Jul 15	Licensed water right (Apr-85)
	212	Jul 16-Apr 18	Licensed water right (Apr-85)
Deadwood to Oxbow	1,100	Apr 15-Aug 31	Licensed water right (Apr-85)
	337	Sep 1-Apr 14	Licensed water right (Apr-85)
Downstream from Deadwood Confluence (South Fork Payette)	700-763	Apr 15-Aug 31	Licensed water right (May-89)
Downstream from Deadwood Confluence to Oxbow Reach (South Fork Payette)	337	Year-round (400 cfs Fri-Sun, Apr 15-Aug 31)	Licensed water right (Apr-85)
Deadwood to Middle Fork Payette	1,100	Apr 15-Aug 31	Licensed water right (Apr-85)
	337	Sep 1-Apr 14	Licensed water right (Apr-85)
Middle Fork Payette to Banks	1,350	Apr 15-Aug 31	Licensed (Apr-85)
	407	Sep 1-Apr 14	Licensed (Apr-85)
Downstream from Cascade (North Fork Payette)	200	Winter	Minimum target, meets Idaho Power natural flow right
North Fork Payette (Cabarton to Smith's Ferry)	1,400	Jun 18-Oct 12	Licensed water right (Dec-87)
	106-294	Oct 13-Mar 15	Licensed water right (Dec-87, Apr-88)
	100-500	March 15-June 17	Licensed water right (Dec-87, Apr-88)
North Fork Payette (Smith's Ferry to Banks)	1,800	May 1-June 30	Licensed water right (Apr-88)
	1,300	July 1-July 31	Licensed water right (Apr-88)
	1,800	Aug 1-Sept 1	Licensed water right (Apr-88)
	400	Sept 2-April 30	Licensed water right (May-89)
Letha (Payette)	150	Year-Round	Minimum target

Since 1992, Reclamation has attempted to provide up to 427,000 AF/year in salmon flow augmentation water to the Lower Snake and Columbia Rivers. Following the acceptance of the Nez Perce Agreement in 2005, the target water salmon flow augmentation volume for Reclamation is 487,000 AF/year. These Snake River basin augmentation flows are derived in part from the Boise Project, and in part from other upper Snake River projects. Augmentation flows are released primarily for juvenile salmon migration between April 20 and August 31, and Reclamation generally assumes the majority of flows are needed in July and August after natural flows recede.

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2. Estimated Water Needs

2.1 Basis and Limits

The focus of this assessment is to identify and assess potential new surface water supply storage opportunities within the Boise and Payette River basins. As defined in Chapter 1, an assessment study is a preliminary study of problems and needs that uses existing data and information to explore conceptual solutions to water resource issues within specific areas.

This chapter relies on available current and projected water use information for the Boise and Payette River basins. The current and projected water use information was initially developed for a 25-year planning horizon. For the purposes of this assessment, following consultations with the SWG, several assumptions were made to extend the projections to a 50-year planning horizon. A 50-year planning horizon was chosen for this assessment because shorter planning horizons would almost certainly be outdated by the time any future storage facility could be designed, permitted, and constructed.

Estimated demand volumes are used in this assessment to define conceptual storage needs. Those storage needs are then used to develop volume criteria to help assess potential storage opportunities. Extending existing water use projections beyond the 25-year planning horizon inherently adds uncertainty to the estimated future demands. However, margins of error associated with future projections are already inherently large in an assessment. Further refinement of these estimated needs would be warranted in subsequent and more detailed appraisal/feasibility analysis.

Three types of water uses were considered in estimating additional demands[4]:

- *Consumptive Uses (DCM&I, Irrigation)*. As defined in Idaho Code § 42-202B, consumptive uses are "that portion of the annual volume of water diverted under a water right that is transpired by growing vegetation, evaporated from soils, converted to nonrecoverable water vapor, incorporated into products, or otherwise does not return to the waters of the State." In non-legal terms, consumptive uses generally decrease the amount of water available for another use, such as municipal/industrial and/or irrigation uses (some water that is diverted for a consumptive use can be available for another use via return flows and seepage to groundwater).
- *Flood Control Capacity*. Flood control capacity is the storage capacity used to regulate flood inflows to reduce flood damage downstream. Depending on the design and operation of a storage reservoir, this volume may be additive (that is, flood space would need to be added to any storage volume required for consumptive uses), or non-additive (that is, flood space could include storage volume that is also used for consumptive uses).
- *Flow Augmentation*. In this assessment, flow augmentation was also considered when estimating additional demands. Flow augmentation is authorized under the special provisions of Idaho Code § 42-1763B and water released for flow augmentation is not available for other uses.

[4] Other water uses, such as non-consumptive recreational releases, were not considered at this assessment-level analysis.

These uses are discussed in more detail below. Throughout this discussion, demand projections (and thus estimated additional supply volumes) are presented with associated ranges of uncertainty. Again, ranges of uncertainty reflect the broad and generalized approach inherent in an assessment. Data gaps that contribute to uncertainty are also discussed below.

2.2 Consumptive Uses

As defined in Idaho Code § 42-202B, consumptive uses are “that portion of the annual volume of water diverted under a water right that is transpired by growing vegetation, evaporated from soils, converted to nonrecoverable water vapor, incorporated into products, or otherwise does not return to the waters of the State.” In non-legal terms, consumptive uses generally decrease the amount of water available for another use, such as municipal/industrial and/or irrigation uses (some water that is diverted for a consumptive use can be available for another use via return flows and seepage to groundwater).

2.2.1 DCM&I Uses

DCM&I uses include all uses associated with domestic, commercial, municipal, and industrial uses. Available information used to form the basis of estimated additional DCM&I demands included two primary sources:

- Within the Boise River basin, IDWR (2001) completed a 25-year projection of DCM&I demands in response to concerns about significant population growth. This assessment was completed in partnership with the Community Planning Association of Ada and Canyon Counties (COMPASS) and the U.S. Geological Survey (USGS), and was funded by Reclamation.
- Within the Payette River basin, IDWR (1999) completed a Payette River comprehensive planning document that summarizes 1996 water demands and compared these demands to historic trends.

IDWR (2001) projected future DCM&I demands in the Boise River basin through 2025. These projections suggest that between 76,000 and 96,000 additional AF of water will be needed to accommodate future DCM&I demand projected over a 25-year timeframe.[5] These increasing water use demands are consistent with United Water Idaho projections that the population in Ada County (representing the eastern portion of the lower Boise River basin) alone might exceed 800,000 by 2050 (UWID, 2002).

The demand projections in the IDWR (2001) report were extended to 2050 based on the increasing trend line from 2015 to 2025. Certainly, extrapolating from previous studies adds uncertainty to the 50-year projections. To address this uncertainty, an error of ±10 percent was applied.

Within the Payette River basin, projected annual DCM&I water usage in 2025 is estimated to be near 45,200 AF (IDWR, 1999). Population growth trends observed between 1990 and 1996 were used to predict increasing water demand trends through 2050. Although population growth and water use growth are not always proportional, the uncertainty associated with this assumption has only a marginal effect on overall regional water use

[5] These volume estimates do not incorporate any water conservation measures.

projections because only a small percent of the total DCM&I water use occurs within the Payette River basin. To address uncertainty associated with projecting future water use, an error of ±10 percent was applied.

Neither of the existing demand projections (IDWR, 2001; IDWR, 1999) incorporated any water savings related to increased conservation. In response to stakeholder concerns that water conservation should not be ignored as a water management tool, a factor for conservation was incorporated into the water demand projections. A detailed conservation plan and analysis is beyond the scope of this assessment study. However, a conservation factor was developed (based on information contained in Appendix C) and incorporated into estimated demand projections for this assessment.

For the purposes of this assessment, it was assumed that the majority of future DCM&I demands would be met using surface water sources. IDWR and Idaho Water Resources Research Institute (IWRRI) continue to conduct studies to determine the condition and yield of the multiple aquifer systems in the Treasure Valley. United Water has estimated that 40,000 AF of additional DCM&I growth in Ada County could be supplied by groundwater from the Boise River basin (Rhead, 2004a). In addition, despite the rural nature of the Payette River basin, the majority of future DCM&I water needs may have to be met with surface water sources because declining water quality in groundwater is an issue (IDWR, 1999).

A summary of how the total estimated future DCM&I surface water needs was calculated is provided in Equation 1.

Eqn. 1. Estimated Additional DCM&I Supply From Surface Water =
Minus—Projected Water Demands
Minus—Conservation Savings
Minus—Anticipated Additional Groundwater Supply
Plus or Minus ±10 percent—Uncertainty Factor

Projected DCM&I surface water needs for both basins are shown in Figure 2-1.

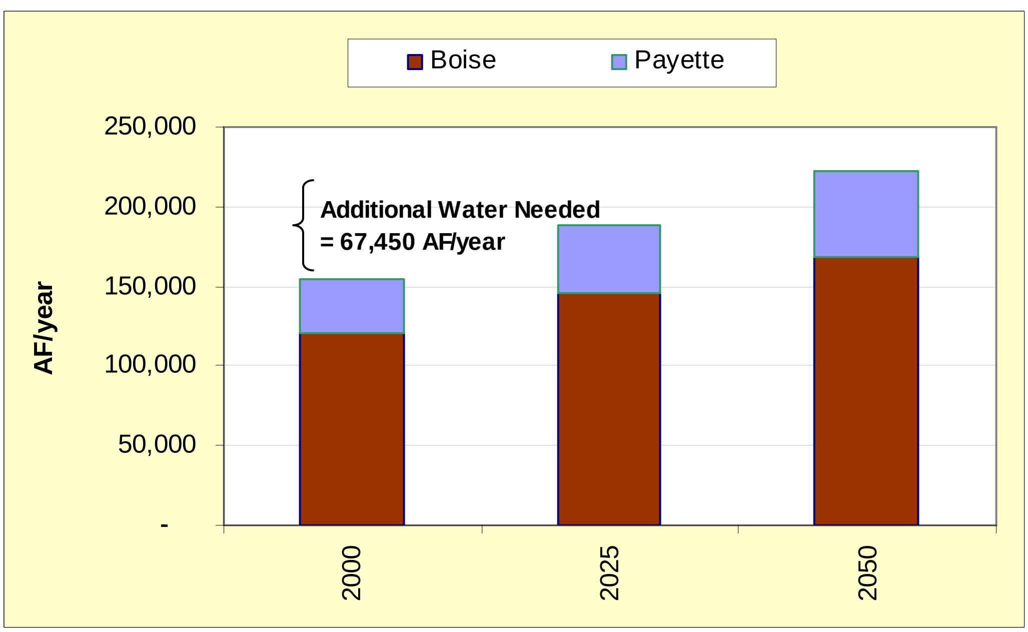

Figure 2-1. Estimated DCM&I Surface Water Needs

Figure 2-1 shows the projected DCM&I surface water needs for both basins over a 50-year planning horizon and takes into consideration conservation savings and anticipated groundwater supply. By 2050, DCM&I needs in both basins might require an additional 67,450 AF of surface water above 2000 levels on an annual basis (as calculated using the elements in Equation 1). Detailed estimates for 2050 are summarized in Table 2-1.

Table 2-1. Estimated Additional DCM&I Surface Water Needs by Basin (at 2050)

Basin	Projected Water Demands above Current Levels	- Conservation Savings	- Volume Supplied by Groundwater	Estimated Additional DCM&I Supply Volume Needed
Boise	124,085	36,760	40,000	47,325
Payette	22,955	2,830	-	20,125
Total	147,040	39,590	40,000	67,450
			-10 percent	***60,705***
			+10 percent	***74,195***

NOTE: These values are estimated water needs above current levels. All values are AF/year.

The majority of projected DCM&I growth occurs within the Boise River basin (~47,325 AF), with a smaller projection in the Payette River basin (~20,125 AF). These estimates are conceptual and associated with a level of uncertainty related to simple trend applications and long-term (50-year) planning horizons. To address this uncertainty, an error of ±10 percent has been applied.

2.2.2 Irrigation Uses

Irrigation uses include both urban/suburban developments and planned communities that rely on irrigation water for landscaping needs, as well as traditional farmlands that rely on irrigation water to grow crops. The Treasure Valley is one of the fastest urbanizing areas in the nation. This urbanization means that agricultural lands are being converted to urban/suburban land uses at a rapid rate. Unpublished data from the Idaho Association of Soil and Conservation Districts (Koberg, 2005) indicates that 10,000 acres of agricultural lands were converted to urban and suburban land uses between 2000 and 2004, most notably to residential developments. This translates to a 2 percent annual land use conversion rate.

The effect of these conversions on consumptive demand for water in the Boise and Payette River basins has not been quantitatively assessed yet. This data gap was addressed using input from local water users and case studies from elsewhere in the arid west that have also been undergoing rapid growth and urbanization.

Within the Boise River basin, since it is projected to experience faster rates of urbanization, the Nampa & Meridian Irrigation District (NMID), delivers irrigation water to approximately 64,000 acres of urban, suburban, and rural lands throughout the lower Boise River basin. In 2006, the Boise Project Board of Control (BPBOC), which is composed predominantly of NMID, provided 2.6 AF/acre to its water users (Idaho Statesman, 2006), which is less than in neighboring arid states (Utah Natural Resources, 2001; Nevada Division of Water Resources, 1999). NMID's experience is that there has been no reduction in water demand for large tracts of developed land that was once irrigated by individual farmers.

In addition to input from local water users such as NMID, other regional case studies were also evaluated. On a statewide basis, Utah and Nevada's water plans assume that an annual loss of agricultural land on the order of 0.2 to 0.3 percent will translate to a 5 to 10 percent reduction in water consumed (Utah Natural Resources, 2001; Nevada Division of Water Resources, 1999). Current water consumption on agricultural lands for these States ranges between 3.0 AF/acre and 4.4 AF/acre.

Within the Payette River basin, agricultural lands are also being converted to urbanized uses, but likely at a much lower rate. The conversion rate has not been quantified in a manner such as the Boise River basin, and whether or not this conversion results in water savings is uncertain. The difference in the Payette River basin is that any need for additional irrigation water may be able to be met by existing storage and instream resources.

Using both local water user input and case studies, for the purposes of this assessment it was assumed that irrigation demand in both basins would remain constant at current levels, with an error of ±2 percent. This error assumption has a large effect on the overall future water demand because current irrigation uses comprise such a large percentage of total water demand (~90 percent). Given that approximately 2.1 MAF of water is used annually for irrigation in both basins (see Chapter 1), ±2 percent of this irrigation volume is estimated at 48,235 AF/year. Thus, irrigation water needs might increase or decrease by 48,235 AF/year.

It is important to reiterate that local empirical data on how water consumption might change as land continues to be urbanized are limited. Water consumption related to specific land uses (for example, irrigated agriculture versus urbanized landscaping) is expected to continue to be monitored. Thus, future irrigation water needs are expected to be reevaluated and refined in future appraisal/feasibility analysis.

2.2.3 Summary of Consumptive Uses

As summarized in Table 2-2, the combination of both DCM&I and irrigation demands in both basins brings future consumptive demand estimates in 2050 to between 12,470 and 122,430 AF/year above current levels. Compared to current consumptive use volumes (2.5 MAF, as explained in Chapter 1), this represents an increase of up to 5 percent above current levels over the 50-year planning horizon.

Table 2-2. Summary of Additional Consumptive Demand Volumes

Water Use Type	Minimum	Maximum
Consumptive		
DCM&I (Section 2.2.1)	60,705	74,195
Irrigation (Section 2.2.2)	-48,235	48,235
Total Consumptive Demands	***12,470***	***122,430***

NOTE: These values are estimated water needs above current levels. All values are AF/year.

2.3 Flood Control Capacity

Flood control capacity is the storage capacity used to regulate flood inflows to reduce flood damage downstream. Within the Boise River basin, USACE and Reclamation developed a coordinated plan for the operation of the three-dam system in consultation with related downstream diversion and storage facilities. Current releases are managed under a revised manual (USACE, 1985) according to climate pattern, runoff, and irrigation demand. This manual is based on the floodplain management plans in effect at that time (USACE, 1985); these plans are in the process of being updated as development continues to occur within the floodplain and floodway areas surrounding the Boise River.

The beginning and ending of the flood control and refill season (typically from April through July) can vary widely with weather conditions and the water supply (Reclamation, 1997). This period represents a basic management conflict that is managed cooperatively between Reclamation, USACE, and water users: USACE is required to manage space in Lucky Peak to provide a flood control pocket for downstream population centers (notably including the Cities of Boise, Eagle, and Caldwell), while Reclamation and downstream water users rely on the spring runoff period to provide a refill volume that can sustain water calls throughout the dry summer period. Additional dedicated storage volume (either in existing reservoirs or in new facilities) could provide the USACE the ability to protect downstream communities from flooding while the reservoirs could continue to be filled to meet summer water demands.

Although the spring runoff rule curve has not been updated since 1985, USACE developed preliminary estimates of future flood control that might be needed in the Boise River basin. Current hydrological models predict that a 100-year regulated event would sustain significant property damage (USACE, 2005). USACE estimates that the additional dedicated space required to reduce flood risk is between 50,000 and 200,000 AF (in concert with an updated floodplain management plan) in the Boise River basin (USACE, 2005). Thus, the higher the volume of flood control storage, the lower the flood risk.

Reclamation manages two storage facilities that provide flood control in the Payette River basin (Deadwood and Cascade Reservoirs) and flood flow releases are coordinated according to an informal agreement using 1996 flood control rule curves (Reclamation, 1997). Because 65 percent of the basin is located below these two control facilities (IDWR, 1999), flood conditions at, and downstream from, Horseshoe Bend can only be controlled to a limited extent by upper watershed facilities (that is, low elevation runoff cannot be stored or controlled by either facility). USACE constructed an extensive levee system downstream from Horseshoe Bend, but these levees are considered temporary and unsuitable for protection for large flood events (IDWR, 1999). Updating flood control requirements for the Payette River basin would need to be considered in future phases of water storage planning. It is presumed that any additional flood storage in the Payette River basin would be beneficial to those communities.

A summary of target flood capacity for the Boise River basin (again, no information is available for the Payette River basin) is summarized in Table 2-3. Depending on the design and operation of a potential new storage reservoir, flood control capacity may be additive (that is, the flood space represents an independent need that would be added to any storage volume required for consumptive uses), or non-additive (that is, would rely on optimizing reservoir operations so that the flood space would also be used for consumptive uses). This assessment assumes that flood control is additive; certainly, this assumption could be refined in future appraisal/feasibility analysis.

Table 2-3. Summary of Target Flood Control Capacity

Water Use Type	Minimum	Maximum
Flood Control Capacity	50,000	200,000

NOTE: Target flood control capacity for the Payette River basin is unknown. All values are AF/year.

2.4 Flow Augmentation

In this assessment, flow augmentation was also considered when estimating additional demands. Flow augmentation is authorized under the special provisions of Idaho Code § 42-1763B and water released for flow augmentation is not available for other uses. Flow augmentation releases can also include benefits related to water quality or recreation.

Since 1992, Reclamation has attempted to provide a quantity of water up to 427,000 AF/year in salmon flow augmentation to the lower Snake and Columbia Rivers. Following the acceptance of the Nez Perce Agreement in 2005, the target volume for Reclamation is 487,000 AF/year. This water comes from multiple sources throughout the upper Snake, Boise, and Payette River basins. Flows are released primarily for juvenile salmon migration between April 20 and August 31, and Reclamation generally assumes the majority of flows would be needed in July and August after natural flows recede and the beginning of releases to meet irrigation calls.

The Boise and Payette River basins represent an important component of the overall 487,000 AF target volume.

At a conceptual level, it may be desirable and beneficial to secure additional water from these basins for flow augmentation in dry years. For the purposes of this assessment, flow augmentation targets reflect Reclamation's desire to secure the ability to provide 200,000 AF under all climate conditions. It was estimated that a minimum of 64,000 AF could achieve this goal. This number represents the difference between the volume that is typically provided during wet years (200,000 AF) and the amount of water that is typically provided in dry years (136,000 AF). Certainly, this projected water need is a "placeholder" and should continue to be evaluated and assessed in subsequent, more detailed studies.

Table 2-4. Summary of Flow Augmentation Volumes

Water Use Type	Minimum	Maximum
Flow Augmentation Flow Volumes	0	64,000

NOTE: All values are AF/year.

2.5 Summary of Estimated Water Needs

The future demand volumes presented in this chapter represent long-range planning-level estimates that need to be refined in subsequent appraisal/feasibility analysis. Table 2-5 presents a summary of volumes by use.

Depending on the design and operation of a potential new storage reservoir, flood control capacity may be additive (that is, flood space represents an independent need that would be added to any storage volume required for consumptive uses), or non-additive (that is, would rely on optimizing reservoir operations so that flood space would also be used for consumptive uses). This assessment assumes that flood control is additive; certainly, this assumption could be refined in future appraisal/feasibility analysis.

Table 2-5. Summary of Estimated Additional Water Needs

Water Use Type	Minimum	Maximum
Consumptive (DCM&I, Irrigation) (Table 2-2)	12,470	122,430
Flow Augmentation (Table 2-4)	0	64,000
Subtotal	12,470	186,430
Flood Control Capacity (Table 2-3)	50,000	200,000
Total Estimated Additional Storage Volumes	**62,470**	**386,430**

NOTE: See Tables 2-2, 2-3, and 2-4 for more information on how these volumes were derived. Flood control reflects information from the Boise River basin only; projected flood control capacity for the Payette River basin is not available. All values are AF/year.

As explained in the beginning of this chapter, estimated demand volumes are used in this assessment to define conceptual storage needs. Those storage needs are then used to develop volume criteria in the next chapter to help assess potential storage opportunities.

This assessment suggests that between 62,470 and 386,430 AF/year of additional surface water storage might be needed between both basins. The high-end estimate reflects the assumption that the maximum total consumptive and flow augmentation uses (186,430 AF) would be additive with flood control capacity (that is, these needs would be independently managed), and the maximum volume of flood control storage (200,000 AF) would be added to the other uses to determine the maximum sizing (386,430 AF) of a storage facility (or facilities).

Again, these volumes represent estimates that rely on uncertainty and data gaps and would need to be refined in potential appraisal/feasibility analysis.

The relationship between where the water will be needed, and when future demands will need to be met, will ultimately control the decision of how much water can or should be supplied by surface water facilities. For example, in the Boise River basin, flood control capacity could be coupled with additional storage, which could then be filled following flood season to provide water for DCM&I, irrigation, and/or flow augmentation needs. Alternatively, in the Payette River basin, flood control capacity high in the system could be offset with additional storage at existing facilities to ultimately provide additional DCM&I or flow augmentation. Because Reclamation operates their facilities in a coordinated manner, a reasonable amount of water storage operational flexibility is possible using existing and potential new storage facilities.

3. Storage Site Identification and Screening

The focus of this assessment is to identify and assess potential new surface water supply storage opportunities within the Boise and Payette River basins. Because historic information was available on more than 200 sites, the comprehensive list of potential storage sites was narrowed down to a manageable number for more detailed evaluation in three steps:

1. Compile and summarize existing written documents via a Literature Report. Query stakeholders on other non-published pertinent information. This information-gathering step is summarized in Section 3.1.
2. Screen initial list of 200+ sites to a smaller list of 56 potential sites. This screening step is summarized in Section 3.2.
3. Rank smaller list of potential sites to determine areas that best represent opportunities for new storage. This ranking step is summarized in Section 3.3.

The process and results of each of these steps are described below.

3.1 Summary of Existing Information

A comprehensive literature review was conducted to assemble the most complete list of historic studies and reports that have provided recommendations for potential water storage opportunities within the Boise and Payette River basins. The majority of documents assembled for the review were provided by Reclamation (Snake River Area Office); USACE (Walla Walla District Office); and IDWR (Boise, Idaho Office Headquarters). Other materials included within the review were obtained from libraries and various private entities.

The literature review assembled 53 documents that dated back to 1938 and were produced by a wide range of entities and organizations. These documents examined a broad range of aspects and potential opportunities for water development within the Boise and Payette River basins. As discussed in Chapter 1, a comprehensive water storage appraisal study conducted by Reclamation and USACE (1994) provided one of the more extensive documents that addressed water supply and storage. The literature review was complied into a separate report entitled *Boise and Payette River Basins: Literature Report for Potential Water Storage Opportunities* (Literature Report). This report can be found in Appendix D.

The Literature Report provides a summary of the potential on-stream, off-stream, existing, and unclassified water development facilities for more than 200 sites. The Literature Report also includes a detailed bibliography and an evaluation of the quality and quantity of information contained within each document reviewed for this assessment.

The documentation for each facility included: 1) the basin for the proposed site; 2) subbasin; 3) the specific location (where available); 4) type of facility; 5) water source; 6) capacity (or range of capacities); 7) source document(s); 8) an estimate of the cost at the time of the report (where available); 9) reasons for not constructing the facility at the time of the report; and 10) other details about the facility (where available).

In addition to reviewing available documentation and literature, members of the SWG were also encouraged to provide any additional pertinent information that may have been unpublished or otherwise known. Members of the SWG identified a number of water storage opportunities, some of which did not fit into the defined scope of this assessment; such as non-physical or administrative water storage opportunities. Other SWG ideas outside the scope of study included water conservation (including upgrading delivery canals), modifying existing reservoir minimum pool operations (for example, at Cascade Reservoir), and expanding authorization at existing storage facilities to include other water uses. These opportunities are outside the scope of this assessment. However, these opportunities could also be pursued by others or considered in separate or future Reclamation studies. Feedback from the SWG is documented in meeting summary notes contained in Appendix B.

Table 3-1 provides a consolidated summary of the sites by type and basin and Figure 3-1 shows the site locations. Table 3-2 and Table 3-3 list each of the sites identified in the literature within the Boise and Payette River basins. These tables include a summary of pertinent information regarding published facility type (for example, on-stream versus off-stream) and published storage capacity. Appendix D provides a description, where available, of the type of dam for new storage sites or the various operational supporting facilities necessary for the site. Appendix D also includes existing facilities upgrade (i.e., retrofitting) recommendations from the literature review.

Tables 3-2 and 3-3 also present the results of the screening process, which are discussed in more detail in Section 3.2.

Table 3-1. Summary of Identified Physical / Mechanical Water Storage Opportunities

Site Type/Source	Definition	Total	Total by Basin	Capacity Range (AF)
On-stream	Any new site within a drainage-way that has sufficient year-round flow to fill at a specified frequency from waters within the drainage.	53	Boise – 29	12,000 to 490,000
			Payette – 24	8,000 to 2,400,000
Off-stream	Any new site located on or adjacent to a drainage-way and requires intra- or transbasin sources to fill at a specified frequency.	94	Boise – 50	21,000 to 1,500,000
			Payette – 37	24,000 to 2,600,000
Unclassified	New sites that had no assigned facility type.	69	Boise – 24	NA
			Payette – 45	13,000 to 20,000
Existing	Presently developed sites that could be retrofitted.	14	Boise – 6	4,060 to 35,000
			Payette – 8	6,300 to 180,000
TOTAL		**223**		

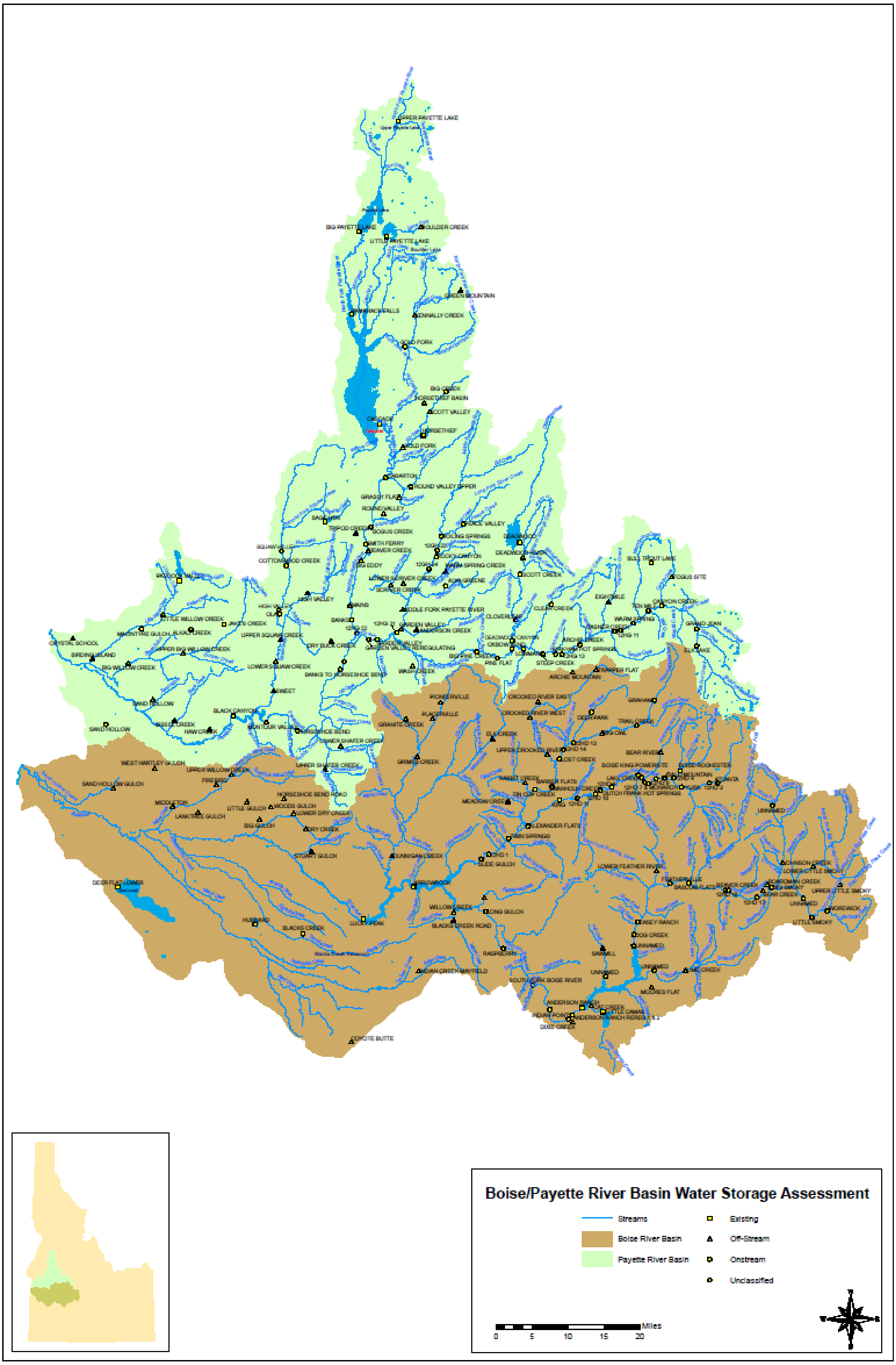

Figure 3-1. Comprehensive Map of New and Existing Potential Water Storage Sites

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Table 3-2. Summary of Identified Sites and Screening Process for Boise River Basin

Site Name	Step 1: Literature Information Summary					Step 2: Screening Results				Step 3: Ranking Recommendation		
	On-stream	Off-stream	Existing	Unclassified	Published Storage Potential (AF)	Hydrology	Special Designation	ESA/ Bull Trout	Minimum Size	Carry Forward?	Eliminate?	Notes
Alexander Flats	X				15-50,000					✓		
Anderson Ranch			X		29,000				?	✓		Retained as a retrofit option.
Anderson Ranch Rereg No 1				X	NA				?		✓	Eliminated because multiple potential retrofitting options carried forward under Anderson Ranch.
Archie Mountain		X			49,000						✓	Eliminated due to inadequate facility size.
Arrowrock			X		6,300				?	✓		Retained as a retrofit option.
Atlanta				X	NA				?		✓	Eliminated due to critical bull trout habitat.
Bald Mountain	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Barber Flats	X				76,000					✓		
Bascum Flats	X				90-122,000						✓	Eliminated due to critical bull trout habitat.
Bear Creek		X			NA				?		✓	Eliminated due to critical bull trout habitat.
Bear River		X			93-95,000						✓	Eliminated due to critical bull trout habitat.
Beaver Creek	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Big Gulch		X			36,000						✓	Eliminated due to inadequate facility size.
Big Owl		X			NA				?		✓	Eliminated due to Natural designation and critical bull trout habitat.
Big Smoky	X				125-258,000						✓	Eliminated due to critical bull trout habitat.
Blacks Creek	X				NA						✓	Eliminated due to poor hydrology and inadequate facility size.
Blacks Creek Road		X			44,000						✓	Eliminated due to inadequate facility size.
Blacks Lake				X	NA				?		✓	Eliminated because only limited information available on potential site.
Boardman Creek		X			NA				?		✓	Eliminated due to critical bull trout habitat.
Boise King Powersite				X	NA				?		✓	Eliminated due to critical bull trout habitat.
Boise-Rochester	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Casey Ranch	X				270,000					✓		
Cat Creek		X			93-95,000					✓		
Chadre		X			24,000	?					✓	Eliminated due to inadequate facility size.
Conswello		X			56,000	?					✓	Eliminated because only limited information (including site location) available.
Coyote Butte		X			260,000					✓		
Crooked River East		X			37,000						✓	Eliminated due to critical bull trout habitat and inadequate facility size.
Crooked River West		X			119,000				?		✓	Eliminated due to critical bull trout habitat.
Deer Flat Lower			X		NA				?		✓	Eliminated due to poor hydrology.
Deer Park	X				NA				?		✓	Eliminated due to poor hydrology and critical bull trout habitat.
Dixie Creek		X			46-47,000						✓	Eliminated due to Natural designation and critical bull trout habitat.
Dog Creek	X				165,000						✓	Eliminated because nearby Casey Ranch carried forward.
Dry Creek		X			53-220,000					✓		
Dunnigan Creek		X			240,000					✓		
Dutch Frank Hot Springs	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Elk Creek		X			41,000						✓	Eliminated due to inadequate facility size.
Featherville	X				34,000						✓	Eliminated due to inadequate facility size.
Firebird		X			67,000					✓		
Graham	X				44,000						✓	Eliminated due to poor hydrology, critical bull trout habitat, and inadequate facility size.
Granite Creek		X			48,000						✓	Eliminated due to inadequate facility size.
Grimes Creek		X			5-1,500,000					✓		
GWP 13				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Horseshoe Bend Road		X			100,000						✓	Eliminated because nearby Dry Creek carried forward.
Hubbard			X		4,060	?					✓	Eliminated due to inadequate facility size.
Indian Creek-Mayfield		X			52,000					✓		
Indian Point	X				20,000						✓	Eliminated due to inadequate facility size.
Johnson Creek	X				180,000						✓	Eliminated due to critical bull trout habitat.
King	X				56,000						✓	Eliminated due to critical bull trout habitat.
Krall Mountain		X			121,000					✓		
Lake Creek	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Lanktree Gulch		X			22,000						✓	Eliminated due to inadequate facility size.
Lime Creek		X			NA				?		✓	Eliminated due to poor hydrology and Natural designation.
Little Camas			X		NA				?		✓	Eliminated due to poor hydrology.
Little Gulch		X			NA						✓	Eliminated due to inadequate facility size.

Table 3-2. Summary of Identified Sites and Screening Process for Boise River Basin (continued)

Site Name	Step 1: Literature Information Summary					Step 2: Screening Results				Step 3: Ranking Recommendation		
	On-stream	Off-stream	Existing	Unclassified	Published Storage Potential (AF)	Hydrology	Special Designation	ESA/ Bull Trout	Minimum Size	Carry Forward?	Eliminate?	Notes
Little Smoky	X				12,000						✓	Eliminated due to critical bull trout habitat and inadequate facility size.
Long Gulch	X				27,000						✓	Eliminated due to Natural designation and inadequate facility size.
Lost Creek	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Lower Crooked River		X			250,000	?					✓	Eliminated because only limited information (including site location) available.
Lower Dry Creek		X			43,000						✓	Eliminated due to inadequate facility size.
Lower Feather River		X			24,000						✓	Eliminated due to inadequate facility size.
Lower Little Smoky Creek		X			76,000	?					✓	Eliminated because only limited information (including site location) available.
Lucky Peak			X		See notes.				?	✓		Retrofit option carried forward with Arrowrock; storage potential of 35,000 AF represents a flood control pocket.
Magello		X			27,000	?					✓	Eliminated due to inadequate facility size.
Meadow Creek		X			44,000						✓	Eliminated due to inadequate facility size.
Middleton		X			29,000						✓	Eliminated due to inadequate facility size.
Monarch	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Moores Flat		X			52-55,000					✓		
North Fork Boise River				X	NA	?					✓	Eliminated because only limited information (including site location) available.
Pioneerville		X			58,000					✓		
Placerville		X			21,000						✓	Eliminated due to inadequate facility size.
Rabbit Creek		X			152,000					✓		
Raspberry	X				145-160,000						✓	Eliminated due to poor hydrology.
Sand Hollow Gulch		X			39-42,000						✓	Eliminated due to poor hydrology and inadequate facility size.
Sawmill		X			NA				?		✓	Eliminated due to poor hydrology.
Sebree		X			30,000						✓	Eliminated due to inadequate facility size.
Slide Gulch	X				NA				?		✓	Eliminated because only limited information available on potential site.
South Fork Boise River	X				113,000					✓		
Stuart Gulch		X			37,000						✓	Eliminated due to inadequate facility size.
Swanholm Creek	X				NA				?		✓	Eliminated due to critical bull trout habitat.
Trail Creek				X	NA				?		✓	Eliminated due to Natural designation and critical bull trout habitat.
Trapper Flat		X			178,000						✓	Eliminated due to critical bull trout habitat.
Trinity Mountain		X			104,000	?					✓	Eliminated because only limited information (including site location) available.
Twin Springs	X				170-490,000					✓		
Unnamed				X	NA				?		✓	Eliminated due to poor hydrology.
Unnamed				X	NA				?		✓	Eliminated because only limited information available on potential site.
Unnamed				X	NA				?		✓	Eliminated because only limited information available on potential site.
Unnamed				X	NA				?		✓	Eliminated due to critical bull trout habitat.
Unnamed				X	NA				?		✓	Eliminated due to poor hydrology.
Upper Crooked River		X			49,000						✓	Eliminated due to critical bull trout habitat and inadequate facility size.
Upper Feather River		X			70,000	?					✓	Eliminated because only limited information (including site location) available.
Upper Little Smoky Creek		X			87,000	?					✓	Eliminated because only limited information (including site location) available.
Upper Willow Creek		X			31,000						✓	Eliminated due to inadequate facility size.
West Hartley Gulch		X			31,000						✓	Eliminated due to inadequate facility size.
Willow Creek		X			46,000						✓	Eliminated due to inadequate facility size.
Woods Gulch		X			26,000						✓	Eliminated due to inadequate facility size.
Worewick	X				12,000						✓	Eliminated due to critical bull trout habitat and inadequate facility size.
Yuba	X				90,000						✓	Eliminated due to poor hydrology.
12HD 1				X	NA				?		✓	Consolidated with nearby site.
12HD 3				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 4				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 6				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 7				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 9				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 10				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 11				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 13				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 14				X	NA				?		✓	Eliminated due to critical bull trout habitat.

Table 3-2. Summary of Identified Sites and Screening Process for Boise River Basin (continued)

Site Name	Step 1: Literature Information Summary					Step 2: Screening Results				Step 3: Ranking Recommendation		
	On-stream	Off-stream	Existing	Unclassified	Published Storage Potential (AF)	Hydrology	Special Designation	ESA/ Bull Trout	Minimum Size	Carry Forward?	Eliminate?	Notes
12HD 17				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HD 18				X	NA				?		✓	Eliminated due to critical bull trout habitat.
SUM	29	50	6	24	- -	- -	- -	- -	- -	19	90	- -

Hydrology		Will Not Fill 50% of the Time
		Will Fill 50% of the Time or Off-Stream Site
		Will Fill 80% of the Time
	?	Site Location Unknown
Special Designation		Federal Protection (Wilderness Area) and State-Protected Natural Streams
		State Protected Recreational Streams and Proposed Wild and Scenic
		No Designations
ESA/ Bull Trout		Existing Populations of Bull Trout
		Proposed Habitat, Migratory Habitat, or Populations Unknown
		No Known Populations
Minimum Size		< 50,000 AF
		> 50,000 AF
	?	Size Unknown or Not Applicable

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Table 3-3. Summary of Identified Sites and Screening Process for Payette River Basin

	Step 1: Literature Information Summary					Step 2: Screening Results				Step 3: Ranking Recommendation		
Site Name	On-stream	Off-stream	Existing	Unclassified	Published Storage Potential (AF)	Hydrology	Special Designation	ESA/ Bull Trout	Minimum Size	Carry Forward?	Eliminate?	Notes
Alkali Creek	X				NA				?		✓	Eliminated due to poor hydrology.
Alva Greene				X	NA				?		✓	Eliminated due to poor hydrology.
Anderson Creek		X			51,000					✓		
Archie Creek	X				140,000					✓		
Banks				X	NA				?		✓	Eliminated because only limited information available.
Banks Lower				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Banks to Horseshoe Bend				X	NA				?		✓	Eliminated because only limited information available.
Beaver Creek		X			NA				?		✓	Eliminated because only limited information available.
Big Creek		X			400,000						✓	Eliminated due to poor hydrology.
Big Creek				X	20,000						✓	Eliminated due to poor hydrology and inadequate facility size.
Big Eddy				X	NA				?		✓	Eliminated because only limited information available.
Big Falls				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Big Pine Creek	X				110,000					✓		
Big Payette Lake			X		30,000				?	✓		
Big Willow Creek		X			310-313,000					✓		
Birding Island		X			175,000					✓		
Bissel Creek		X			153,500-200,000					✓		
Black Bear				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Black Canyon			X		180,000					✓		
Bogus Creek	X				33,000						✓	Eliminated due to inadequate facility size.
Boiling Springs	X				70,000					✓		
Boulder Creek		X			93,000						✓	Eliminated due to poor hydrology.
Box Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Browns Pond		X			92,000	?					✓	Eliminated because only limited information available on potential site.
Brush Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Bull Trout Lake	X				NA						✓	Eliminated due to poor hydrology, critical bull trout habitat, and inadequate facility size.
Cabarton	X				66-1,400,000					✓		
Canyon Creek	X				33,000						✓	Eliminated due to poor hydrology and inadequate facility size.
Cascade			X		50,000					✓		
Casner	X				142,000						✓	Eliminated due to critical bull trout habitat.
Clear Creek				X	NA				?		✓	Eliminated due to poor hydrology.
Cloverleaf		X			NA				?		✓	Eliminated because only limited information (including site location) available.
Cottonwood Creek	X				50,000					✓		
Crystal School		X			91,000						✓	Eliminated due to poor hydrology.
Dead Horse Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Deadwood Canyon				X	NA				?	✓		
Deadwood Reservoir			X		NA				?		✓	Eliminated due to critical bull trout habitat.
Deadwood River				X	NA				?		✓	Eliminated due to critical bull trout habitat.
Deer Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Dry Buck Creek		X			380,000					✓		
Eightmile				X	NA				?		✓	Eliminated due to poor hydrology and critical bull trout habitat.
Elk Lake				X	NA				?		✓	Eliminated due to Natural designation and critical bull trout habitat.
Fall Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Ferncroft				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Fisher Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Fogus Site				X	NA				?		✓	Eliminated due to poor hydrology and critical bull trout habitat.
Garden Valley	X				1,330-2,400,000						✓	Eliminated due to poor hydrology.
Garden Valley		X			576,000						✓	Eliminated due to poor hydrology.
Garden Valley Reregulating	X				8,000						✓	Eliminated due to inadequate facility size.

Table 3-3. Summary of Identified Sites and Screening Process for Payette River Basin (continued)

	Step 1: Literature Information Summary					Step 2: Screening Results				Step 3: Ranking Recommendation		
Site Name	On-stream	Off-stream	Existing	Unclassified	Published Storage Potential (AF)	Hydrology	Special Designation	ESA/ Bull Trout	Minimum Size	Carry Forward?	Eliminate?	Notes
Gold Fork	X				80,000					✓		
Gold Fork		X			930,000					✓		
Grand Jean	X				88-90,000						✓	Eliminated due to critical bull trout habitat.
Grassy Flat		X			32,000						✓	Eliminated due to inadequate facility size.
Green Mountain		X			24,000						✓	Eliminated due to inadequate facility size.
Grimes Pass				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Haw Creek		X			33-35,000						✓	Eliminated due to inadequate facility size.
High Valley		X			1,760,000					✓		
High Valley				X	NA				?		✓	Eliminated because only limited information (including site location) available.
Horseshoe Bend	X				480,000					✓		
Horsethief		X			75,000						✓	Eliminated due to poor hydrology.
Horsethief Basin			X		NA				?		✓	Eliminated due to poor hydrology.
Jake's Creek				X	NA				?		✓	Eliminated due to poor hydrology.
Jug Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Kennally Creek		X			330-351,000						✓	Eliminated due to poor hydrology.
Kirkham Hot Springs				X	NA				?		✓	Eliminated because only limited information (including site location) available.
Little Payette Lake			X		16,500					✓		
Little Willow Creek		X			85,000					✓		
Louie Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Lower Scriver Creek		X			44,000						✓	Eliminated due to inadequate facility size.
Lower Shafer Creek		X			34,000						✓	Eliminated due to inadequate facility size.
Lower Squaw Creek		X			550,000					✓		
Lowman				X	NA				?		✓	Eliminated because only limited information (including site location) available.
Macintyre Gulch	X				NA						✓	Eliminated due to poor hydrology and inadequate facility size.
Mains				X	NA				?		✓	Eliminated because only limited information (including site location) available.
Middle Fork Payette River		X			1,600,000					✓		
Montour Valley	X				32,000						✓	Eliminated due to inadequate facility size.
North Fork				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Ola	X				50-93,000					✓		
Oxbow Bend	X				60,000					✓		
Paddock Valley			X		6,300				?	✓		Retained as retrofit option despite low refill potential.
Peace Valley				X	13,000						✓	Eliminated due to poor hydrology and inadequate facility size.
Pidgeon Flat		X			490,000	?					✓	Eliminated because only limited information available on potential site.
Pine Flat				X	NA				?		✓	Eliminated because only limited information (including site location) available.
Rocky Canyon	X				23,000						✓	Eliminated due to inadequate facility size.
Round Valley		X			430,000					✓		
Round Valley Upper				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Sand Hollow	X				39,000						✓	Eliminated due to poor hydrology and inadequate facility size.
Sand Hollow		X			68-145,000					✓		
Scott Creek				X	NA				?		✓	Eliminated due to critical bull trout habitat.
Scott Valley	X				18,000	?					✓	Eliminated due to inadequate facility size.
Scott Valley		X			131,000						✓	Eliminated due to poor hydrology.
Scriver Creek		X			NA				?	✓		
Shafer Creek				X	NA	?			?		✓	Eliminated because only limited information (including site location) available.
Slick Rock		X			35,000	?					✓	Eliminated due to inadequate facility size.
Smith Ferry	X				95,000					✓		
Squaw Valley				X	NA				?		✓	Eliminated because only limited information (including site location) available.
Steep Creek				X	NA				?		✓	Eliminated because only limited information (including site location) available.
Sweet		X			148,000						✓	
Tamarack Falls	X				20,000						✓	Eliminated due to inadequate facility size.
Ten Mile				X	NA				?		✓	Eliminated due to critical bull trout habitat.
Tripod Creek		X			54-57,000					✓		

Table 3-3. Summary of Identified Sites and Screening Process for Payette River Basin (continued)

	Step 1: Literature Information Summary					Step 2: Screening Results				Step 3: Ranking Recommendation		
Site Name	On-stream	Off-stream	Existing	Unclassified	Published Storage Potential (AF)	Hydrology	Special Designation	ESA/ Bull Trout	Minimum Size	Carry Forward?	Eliminate?	Notes
Upper Big Willow Creek		X			160-350,000					✓		
Upper Payette Lake			X		37-98,000					✓		
Upper Shafer Creek		X			93,000					✓		
Upper Squaw Creek		X			2,600,000					✓		
Warm Spring				X	NA				?		✓	Eliminated due to critical bull trout habitat.
Warm Spring Creek		X			61,500					✓		
Wash Creek		X			55,000					✓		
12HG 11				X	NA				?		✓	Eliminated due to critical bull trout habitat.
12HG 13				X	NA				?		✓	Eliminated because only limited information (including site location) available.
12HG 21				X	NA				?		✓	Eliminated because only limited information (including site location) available.
12HG 22				X	NA				?		✓	Eliminated because only limited information (including site location) available.
12GH 23				X	NA				?		✓	Eliminated because only limited information (including site location) available.
12GH 24				X	NA				?		✓	Eliminated because only limited information (including site location) available.
SUM	24	37	8	45	- -	- -	- -	- -	- -	37	77	- -

Hydrology		Will Not Fill 50% of the Time
		Will Fill 50% of the Time or Off-Stream Site
		Will Fill 80% of the Time
	?	Site Location Unknown
Special Designation		Federal Protection (Wilderness Area) and State-Protected Natural Streams
		State Protected Recreational Streams and Proposed Wild and Scenic
		No Designations
ESA/ Bull Trout		Existing Populations of Bull Trout
		Proposed Habitat, Migratory Habitat, or Populations Unknown
		No Known Populations
Minimum Size		< 50,000 AF
		> 50,000 AF
	?	Size Unknown or Not Applicable

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3.1.1 New Storage

Table 3-2 lists the 200+ potential new storage sites identified within the assessment area. The available information on each site varied widely. While most of the sites had limited or no description of the operational supporting facilities, a limited number had detailed descriptions that included pumping, canals, tunnels, and piping conveyance opportunities.

The capacities of the new storage sites commonly varied by site or by publication, or were not provided at all. However, through the review process it became apparent that most of the storage volumes identified in the literature generally were not associated with any technical justification. The capacities identified in the literature review were ultimately replaced with more realistic and technically supported capacities based on hydrologic volumes derived from a modeling exercise using Reclamation's MODSIM model (described in Section 3.3).

3.1.2 Retrofitting Existing Facilities

Within the Boise and Payette River basins there are several existing Federal and private storage sites (see Chapter 1). Following is a list of retrofitting opportunities at existing facilities that were identified and evaluated in this assessment.

- *Raise Lucky Peak Dam*. Various entities have evaluated raising Lucky Peak Dam or modifying reservoir operations to create an additional 35,000 AF of flood control storage; however, Arrowrock Dam creates upstream inundation limitations. This was evaluated in 1994 (Reclamation/USACE, 1994) but not pursued because costs at that time were considered to be prohibitive. As the value of water increases, additional evaluations could be considered in the future.
- *Raise Arrowrock Dam*. Reclamation (2005c) has evaluated using an additional 2 feet of freeboard, which would yield an additional storage capacity of 6,300 AF. Additional evaluations could be considered in the future.
- *Raise Anderson Ranch Dam*. Reclamation (2005c) developed preliminary estimates associated with raising the Anderson Ranch Dam crest 6 to 16 feet (the larger dam raise would provide additional flood control). Additional storage capacity was estimated at 29,000 AF for a cost of between $18 and $27 million. Using another 6 feet of freeboard was also considered. Additional evaluations could be considered in the future.
- *Improve Hubbard Dam*. Hubbard Reservoir currently operates as a re-regulating facility for nearby irrigation water deliveries and as an emergency short-term storage for dewatering the New York Canal during periods when the downstream canal might fail. With an active capacity of 4,000 AF and nearby commercial and residential developments, realistic opportunities for improving the reservoir capacity appear to be limited.
- *Dredge Cascade Reservoir*. Another option that has been discussed is dredging Cascade Reservoir to create an additional 50,000 AF of active capacity in the reservoir. Dredging would not affect the overall footprint of the reservoir, nor have long-term impacts on shoreline improvements. More detailed evaluation beyond existing limited analysis (Reclamation, 2005c) of this concept is needed to better understand its potential.
- *Black Canyon*. Previous studies have estimated that an additional 180,000 AF of storage might be available if Black Canyon Dam were raised so that the facility could be

operated to store water (Reclamation currently operates it as a run-of-river facility). This option could be evaluated in more detail in the future.

- *Payette Lake*. Previous studies have estimated that an additional 30,000 AF of storage might be available if the current facility were expanded. Although Little Payette Lake and Upper Payette Lake were included in previous literature discussions as retrofit options, both were discounted from further review due to geological instability concerns. This option could be evaluated in more detail in the future.

- *Implement Aquifer Storage and Recovery (ASR).* ASR reflects a management approach where excess surface water (during high-flow periods) is stored underground in a suitable aquifer and recovered during low-flow periods as needed. Water utilities throughout the west are relying more on ASR as a means to provide additional water to meet peak daily or short-term emergency demands, or to provide additional base volumes of water during periods of drought. Other advantages of installing ASR systems include potentially increased instream flows during periods of low summer flow, increased conservation of water due to lower evaporation, and decreased infrastructure costs. Disadvantages of ASR systems include the potential disruption of return springs and flows, damage to riparian and wetland vegetation, potential loss of legal control of the water, and potentially being unable to deliver water to downstream water users. Currently, an ASR approach is most feasible in a closed hydrogeologic system because there is no mechanism in current State law that guarantees injected water will be available later.

  Micron Technologies installed an ASR system in the 1990s to provide thermal energy storage so that water temperatures stay consistent for chip manufacturing purposes. United Water Idaho has also explored the use of ASR, recognizing the seasonal benefits even though the water must be pumped twice (once for injection during high flow and again for recovery during low flow) and requires membrane treatment (Rhead, 2004b).

  The IWRRI investigated the influence of canal seepage on aquifer recharge in the vicinity of the New York Canal, where it is estimated that between 12 and 20 percent of the surface water that flows through the canal seeps into the underlying surface aquifer (IWRRI, 2002). Losses and gains in this area of the basin correlate strongly with local stratigraphy, and aquifer recharge is limited to the surface (within a few hundred feet) aquifer, not deeper regional aquifers.

  The BPBOC is carefully monitoring various ASR discussions, including the relationship between ASR and stormwater drainage. Within their service area, the main issue is that drains collect the majority of water during storm periods, so delivery canals that would be used for ASR do not receive water during storm events. Once water enters the drain, the BPBOC cannot use that water before it leaves the district. Another compounding issue is that these drains supply water to downstream irrigation districts, and diversion of drain water into an ASR system potentially removes that water from meeting downstream water rights. The timing and design of an ASR system in the Boise River basin would need to include a detailed analysis of water use patterns and downstream reuse patterns, which is beyond the scope of this assessment. More detailed evaluation would be needed if this opportunity were carried forward into appraisal/feasibility analysis.

  Within the Payette River basin, there may be limited potential for ASR in the Fruitland area as groundwater levels in this area have dropped 20 to 30 feet in the last 30 years (Holladay, pers. comm., 2005).

3.1.3 Data Gaps

As defined in Chapter 1, an assessment study is generally a preliminary survey of problems and needs that relies on existing information to explore conceptual solutions to water resources issues in specific areas.

In an assessment, it is not possible to quantify benefits within a given area. Identified data gaps are related directly to the sheer number of sites evaluated and the current lack of specificity of a potential site. For example, quantifying benefits to fisheries depends on site-specific habitat preferences of native and non-native species within a given reach that cannot be assessed until a specific reservoir site is selected. Despite a relatively robust library of existing literature and current stakeholder input, data gaps certainly exist and are discussed in qualitative terms below.

- *Fisheries*. Effects on downstream, in-facility, and upstream fishery resources cannot be quantified within an assessment. While effects on downstream and upstream fishery resources would be required to be evaluated in detail in potential future analysis, Idaho does support a number of reservoir trophy fisheries, and certainly existing reservoirs provide a suitable habitat for many warm-water and cool-water species. Within southeast Idaho, these species include bass (largemouth and smallmouth), bluegill, black crappie, perch, and catfish (bullhead and channel) (Idaho Rod and Reel, 2005).
- *Recreation.* Effects on downstream and in-facility recreational uses cannot be quantified within an assessment. Many reservoirs in southwest Idaho provide flat-water recreational facilities that are heavily used. Boaters and leisure trip users are common to the existing reservoir facilities in the region, and overnight camping sites are often booked months in advance.
- *Tourism/Destinations*. Effects on other recreational factors cannot be quantified within an assessment. Lakeshore facilities along reservoirs are increasingly being developed as a major destination for weekend and business travel. For example, Tamarack Resort near Lake Cascade attracts regional visitors, as well as those seeking a weekend getaway from the Treasure Valley. As the regional interest in these types of destination areas increases, pressure on resorts such as Tamarack and the surrounding business environment will also likely increase.
- *Water Quality*. Effects on downstream and in-facility water quality cannot be quantified within an assessment. Water quality within the reservoir body itself can be quite variable, ranging from oligotrophic to eutrophic conditions. Downstream from reservoirs, depending on the outlet configuration, elevated summer temperatures can be mitigated by deeper, colder reservoir releases.
- *Wetland Mitigation*. Effects on downstream, in-facility, and upstream wetland resources cannot be quantified within an assessment. Creating a reservoir can increase the shoreline area, which can result in additional wetland acreage. Effective mitigation planning can result in additional forested and scrub-shrub wetlands, as well as emergent wetlands that replace palustrine wetlands lost as part of inundation.
- *Hydropower*. Benefits to hydropower production cannot be quantified within an assessment. Certainly, potential hydropower could be a benefit that could be

incorporated into the design of a new facility. Information on hydropower production within the literature is outdated and would need to be updated in future analysis.

3.2 Screening Process

The 200+ new and existing storage sites identified in the Literature Review (Appendix D) were initially screened to identify a subset of sites that would most likely meet assessment objectives. The initial screening process was based on four "exclusionary" screening criteria that were used to identify new or existing sites that should not be carried forward for more detailed analysis. These criteria were discussed by the SWG for this screening. The four criteria include:

- *Hydrology/Refill Capacity*. This criterion addresses the preliminary yield potential of the site (i.e., the percentage of years it would refill under long-term average hydrologic conditions). This criterion was considered primary because if the site cannot reliably refill, then water user contracts cannot be developed or met.
- *Special Designation*. This criterion addresses special designations such as Wild and Scenic Rivers that potentially represent a major impediment to project success. This criterion was considered primary because if the site is located within a specially designated reach, the possibility of site development diminishes greatly.
- *Endangered Species/Bull Trout Habitat*. This criterion addresses Endangered Species Act (ESA)/bull trout habitat that potentially represents a major impediment to project success. This criterion was considered primary because if the site is located within a reach that supports critical bull trout life stages such as spawning, the possibility of site development diminishes greatly.
- *Minimum Storage Volume*. Acceptable new candidate sites (that would be carried forward into the ranking process) should be based on a minimum storage capacity that would contribute significantly to meeting storage needs (as estimated in Chapter 2). Given the large uncertainty with estimated water supply storage needs, a minimum of 50,000 AF of storage was applied to new sites; retrofitting of existing reservoirs was exempted from this minimum.

The results of these four screening criteria are presented in Table 3-2 and Table 3-3 for the Boise and Payette River basins, respectively, and are discussed in more detail in the following sections.

3.2.1 Hydrologic/Refill Capacity

The preliminary hydrologic/refill capacity analysis was based on USGS stream statistics obtained from the online StreamStats tool. Equations used to estimate stream flow statistics for ungaged sites were developed through a process known as regionalization. This process involves use of regression analysis to relate stream flow statistics computed for a group of selected stream gaging stations to basin characteristics measured for the stations (USGS, 2005). Estimates provided by StreamStats assume natural (unregulated) flow conditions at the site. At this level of analysis, StreamStats does not reflect activities such as dam regulation, water withdrawals, seepage, and return flows that are common to the Boise and Payette River basins, all of which can substantially affect the timing, magnitude, or duration of flows at a selected site. Because of these limitations, it is important to recognize that at this level of analysis the data are indicative of the hydrologic potential of a location and not the actual discharge that is available to store and divert for downstream uses.[6]

At each site, monthly stream flows that are exceeded 80 percent and 50 percent of the time were determined using StreamStats. Refill potential for on-stream and off-stream sites was evaluated at the on-stream dam or diversion site location. Based on these exceedance flows, if the published site capacity could not refill reliably, the site may have been eliminated from further consideration as described below. (Where no published capacity information was available, a minimum capacity of 50,000 AF was assumed.) The terms R50 and R80 represent the probability that a given facility will refill 50 or 80 percent of the time, respectively. In practical terms, the R50 and R80 are tied to minimum storage volumes (Section 3.2.4) because it is easier to refill a smaller facility more reliably. In the ranking process, this hydrologic/refill analysis is refined further on those sites carried forward (Section 3.3.1).

In this screening process, hydrology/refill capacity was assessed using the following three categories.

- Definitely Carry Forward for Ranking.
  R80 (refill 80 percent or more of years) represents a good/acceptable condition.

- Possibly Carry Forward for Ranking.
  R80–R50 (refill between 50 percent and 80 percent of years for on-stream sites or where inter-basin transfer possible) represents a moderate condition that may or may not be acceptable depending on the other criteria.

- Do Not Carry Forward for Ranking.
  <R50 (cannot refill 50 percent or more of years) represents a poor/unacceptable condition.

Because the number of off-stream sites posed challenges in estimating how much flow would be available, off-stream sites were carried forward only if they passed the other three screening criteria.

The results of this hydrologic/refill capacity analysis are as follows.

- For sites within the Boise River basin, 45 percent were in the good/acceptable category; 46 percent were in the moderate/may or may not be acceptable category; and 9 percent were in the poor/unacceptable category. The majority of sites that were considered unacceptable were located in the higher elevations where not enough drainage area was available to provide sufficient runoff volumes.

- For sites within the Payette River basin, 38 percent were in the good/acceptable category; 46 percent were in the moderate/may or may not be acceptable category; and 16 percent were in the poor/unacceptable category. Similarly, the majority of sites that were considered unacceptable were located in the higher elevations where not enough drainage area was available to provide sufficient runoff volumes.

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[6] A more in-depth level of analysis that considers human activities, dam management, and other factors affecting hydrology in both basins is achieved using MODSIM in the ranking process as described in Section 3.3. MODSIM was used on a more limited number of sites that "passed" the screening process.

Table 3-2 and Table 3-3 provide a summary of the results of this analysis for the Boise and Payette River basins, respectively.

3.2.2 Special Designations

Site locations were examined to determine if they fell within river reaches designated as special status at either the Federal or State level. To determine the status and location of special designation rivers and streams within the Boise and Payette River basins, U.S. Forest Service (USFS) Boise National Forest electronic databases, Idaho Department of Fish and Game (IDFG), Idaho Conservation Data Center (CDC), Idaho Department of Parks and Recreation, IDWR, and Reclamation were accessed for available information.

At the Federal level, such status includes Wild and Scenic Rivers and rivers within Designated Wilderness Areas. Currently, there are no Federally designated Wild and Scenic River segments within the assessment area.

At the State level, management of protected rivers falls under The Idaho Comprehensive Water Planning and Protected Rivers Act of 1988 (Idaho Code, Section 42-1734A et seq.), which established a Statewide review of all Idaho rivers. The IDWR administers the program for the IWRB. Each State-protected river has a list of prohibited activities that may differ depending on its resource values. Although the IWRB recommends river designation and prohibitions based on whether the value of preserving a waterway outweighs the value of development[7], the IWRB cannot permanently designate a protected river until the legislature approves the designation and its prohibitions. The final, ratified protected river segment and policy becomes part of the Idaho Comprehensive State Water Plan.

A State-protected river can be classified as Natural or Recreational. A Natural-designated river has minimal human-created development in or along the river, while a Recreational-designated river can have substantial human-created development along the river. On Natural-designated Rivers, IDWR prohibits all of the following:

- Construction or expansion of dams or impoundments
- Construction of hydropower projects
- Construction of water diversion works
- Dredge or placer mining (except recreational dredge mining when not specifically prohibited)
- Alterations of the streambed
- Mineral or sand and gravel extraction within the streambed

On Recreational-designated rivers the IDWB may choose which of the above to prohibit. The first two prohibitions could affect the acceptability of potential storage sites identified in this assessment.

[7] No provision of this program can limit, restrict, or conflict with approved water rights or vested property rights that exist on the designation date. Protected river designations cannot affect licensed hydropower projects that have already generated electricity.

The IWRB recognizes the need to maintain flexibility in the Comprehensive State Water Planning process to meet the changing needs of the public. Basin plans are “flexible” to the extent they can be changed, and this process would be public. Any changes would need to be adopted by the IWRB and the legislature. Consistent with the flexibility provided in the Comprehensive State Water Planning process, potential sites that were located within reaches with special designations were not necessarily eliminated in the screening process, as described below.

In this assessment process, special designated waters were assessed using the following three categories.

- Definitely Carry Forward for Ranking.
  No Federal or State designation is present at the site. This represents a good/acceptable condition.

- Possibly Carry Forward for Ranking.
  State-designated Recreational or proposed Federal designation is present at the site. This represents a moderate condition that may or may not be acceptable depending on the other criteria.

- Do Not Carry Forward for Ranking.
  Federal-designated and State-designated Natural River is present at the site. This represents a poor/unacceptable condition.

The results of this special designated waters analysis indicate the following.

- For sites within the Boise River basin, 49 percent were in the good/acceptable category; 45 percent were in the moderate/may or may not be acceptable category; and 6 percent were in the poor/unacceptable category.

- For sites within the Payette River basin, 48 percent were in the good/acceptable category; and 52 percent were in the moderate/may or may not be acceptable category. No sites were in the poor/unacceptable category.

Table 3-2 and Table 3-3 provide a summary of the results of this analysis for the Boise and Payette River basins, respectively.

3.2.3 ESA/Bull Trout Habitat

This factor addresses ESA/bull trout habitat that potentially represents a major impediment to project success. Bull trout is currently the only Federally listed ESA fish within the Boise and Payette River basins. ESA/habitat information was collected from Reclamation, U.S. Fish and Wildlife Service (USFWS), and USFS. Knowledgeable fisheries staff provided current information on the distribution of bull trout populations and offered a current understanding of the relationship of the species distributions and life-histories to potential storage sites.

The SWG determined that the mere presence of ESA-listed species should not eliminate sites from further analysis. Rather, potential sites located in areas within known resident populations and known critical spawning and rearing habitat were excluded from further analysis. In contrast, migratory or over-wintering habitats, as well as areas with potential but unconfirmed populations, were not necessarily eliminated from further analysis. This division of the life history needs strikes a balance by: 1) providing a preliminary filter that incorporates ESA concerns, given knowledge of the species and its habitat, and 2) providing a range of reasonable alternatives to carry forward for further review.

In this assessment process, ESA-listed bull trout issues were assessed using the following three categories.

- Definitely Carry Forward for Ranking.
  No potential, proposed, or occupied habitat present at the site. This represents a good/acceptable condition.

- Possibly Carry Forward for Ranking.
  Potential or proposed habitat or presence/status unknown at the site. This represents a moderate condition that may or may not be acceptable depending on the other criteria.

- Do Not Carry Forward for Ranking.
  Known resident populations with known critical rearing or spawning habitat or occupied habitat present at the site. This represents a poor/unacceptable condition.

The results of the bull trout habitat analysis indicate the following.

- For sites within the Boise River basin, 28 percent were in the good/acceptable category; 33 percent were in the moderate/may or may not be acceptable category; and 39 percent were in the poor/unacceptable category. Many of the sites located in known populations or occupied habitat were also sites with insufficient hydrologic/refill capacity because bull trout spawning occurs in higher elevation streams that do not have a great deal of drainage area.

- For sites within the Payette River basin, 48 percent were in the good/acceptable category; 42 percent were in the moderate/may or may not be acceptable category; and 10 percent were in the poor/unacceptable category.

Table 3-2 and Table 3-3 provide a summary of the results of this analysis for the Boise and Payette River basins, respectively.

3.2.4 Minimum Storage Volume

Only new sites with the potential to contribute significantly to meeting storage needs (as defined in Chapter 2) should be carried forward into the ranking process.

In this assessment process, minimum volume was assessed using the following two categories.

- Definitely Carry Forward for Ranking.
  A minimum published volume of 50,000 AF or greater represents a good/acceptable condition.

- Do Not Carry Forward for Ranking.
  A minimum published volume of less than 50,000 AF represents a poor/unacceptable condition.

The minimum of 50,000 AF applies to new sites; existing reservoirs are exempted from this minimum storage volume criteria recognizing that an option of assembling 50,000 AF or more volume from actions at two or more existing reservoirs warrants further analysis. Sites in the “unknown” category (with an unspecified capacity) were assumed to represent a poor/unacceptable condition and were not carried forward for ranking unless they met all of the other three screening criteria.

The results of this analysis indicate the following.

- For sites within the Boise River basin, 30 percent were in the good/acceptable category; 34 percent were in the poor/unacceptable category; and 36 percent of the sites had no capacity information available.
- For sites within the Payette River basin, 39 percent were in the good/acceptable category; 23 percent were in the poor/unacceptable category; and 37 percent of the sites had no capacity information available.

Table 3-2 and Table 3-3 provide a summary of the results of this analysis for the Boise and Payette River basins, respectively.

3.2.5 Conclusions of the Screening Process

In addition to the “exclusionary” criteria summarized previously, several sites identified in the literature review were “consolidated.” Multiple sites located near each other on a single tributary were consolidated to reduce the number of sites being assessed on any given tributary and to reduce redundancy. For example, on most tributaries in the two basins, several (sometimes greater than 10) potential sites have been identified in previous studies. The basic “rules” used in the consolidation process include the following:

- Two or more sites that were located close together, with equal screening characteristics, were consolidated into one.
- Sites identified only as low-head hydropower potential that were located near another, similar on-stream site were consolidated into one site.
- Sites listed in source documents but with no location specified and no additional data for clarification were excluded or consolidated with another site on that tributary.

Application of the exclusionary criteria and consolidation rules yielded a total of 56 sites that were carried forward in the ranking process. These 56 sites break down as follows:

- 15 New On-stream Sites (5 Boise; 10 Payette)
- 30 New Off-stream Sites (11 Boise; 19 Payette)
- 10 Existing Reservoirs (3 Boise; 7 Payette)
- 1 Unclassified Reservoir (1 Payette)

Table 3-2 and Table 3-3 show 200+ potential on-stream, off-stream, existing, and unclassified water storage opportunities identified in the literature review and stakeholder input process and the results of the initial screening process. Those sites that were carried forward to the ranking process, which is discussed in more detail in the following section, are also identified.

3.3 Ranking Process

The screening process described in the previous section resulted in narrowing down a list of more than 200 storage opportunities that had been previously identified either in the literature or via stakeholder input. The smaller and more refined list of 56 potential storage opportunities was evaluated further and ranked as described in this section. The purpose of the ranking was to identify the water storage opportunities with the most potential for success and to make recommendations on which opportunities should be carried forward to an appraisal/feasibility analysis.

The ranking of potential candidate site screening followed three lines of analysis:

- *Refined hydrologic analysis*: Reclamation's MODSIM model was used to determine the overall quantities of water available for new storage in each basin and the proportion of that water that could be captured by potential candidate sites. MODSIM represented a more refined hydrologic analysis because it incorporated the management of existing reservoirs, water contracts, water rights, existing regulatory or administrative minimum flows, and other relevant aspects/realities of current operations. Important assumptions used in the MODSIM analysis included: 1) no adverse impact of existing water rights or contracts, and 2) maintenance of minimum flow targets, whether statutory, policy-driven, or established as general goals.
- *Socio-economic and environmental constraints analysis*: Candidate reservoir sites were compared in terms of their relative potential impact on such socio-economic and environmental factors as infrastructure, recreation, and biological resources. The intent of this analysis was to identify (and rank higher) those candidate locations that had relatively fewer socio-economic and environmental constraints to reservoir siting and development.
- *Needs analysis*: The results of hydrologic and constraints analysis were reviewed critically to ensure that final potential candidate sites were capable of meeting a full range of defined needs and achieving a wide range of benefits. For example, some relatively lower scoring sites in the Boise River basin (as determined by rank in the constraints analysis) were retained because of the potential to meet downstream needs such as DCM&I growth and flood control outweighs their relatively lower constraints score.

These analyses are described in more detail in the following sections.

3.3.1 Refined Hydrologic Analysis

A refined hydrologic analysis based on Reclamation's MODSIM model was conducted on the sites that were carried forward from the screening process. The refined analysis went beyond the StreamStats approach used in the screening process to include operating limitations associated with existing reservoirs (and their return flow estimates), water contracts, water rights, existing regulatory or administrative minimum flows, and other relevant aspects/realities of current operations. These existing operations were considered as "givens" in this analysis. That is, this modeling exercise assumed that any new storage could not negatively impact or affect existing system elements. More detailed discussion of the MODSIM set-up, assumptions, and sensitivity analysis is included in Appendix E.

The MODSIM model assisted in identifying high-yield areas of both basins. This is an important consideration because sites recommended for further analysis must be able to capture and store enough water to meet estimated needs. Another advantage of MODSIM is the ability to model desired storage volume targets, which can then be used to determine varying facility volumes and footprint sizes. Facility sizing information based on the MODSIM modeling was also used in evaluating socio-economic and environmental constraints.

Figure 3-2 shows one type of MODSIM output: the probability that a potential site (Example A for illustrative purposes) would be able to fill to a certain volume (which is dependent on the basin yield).

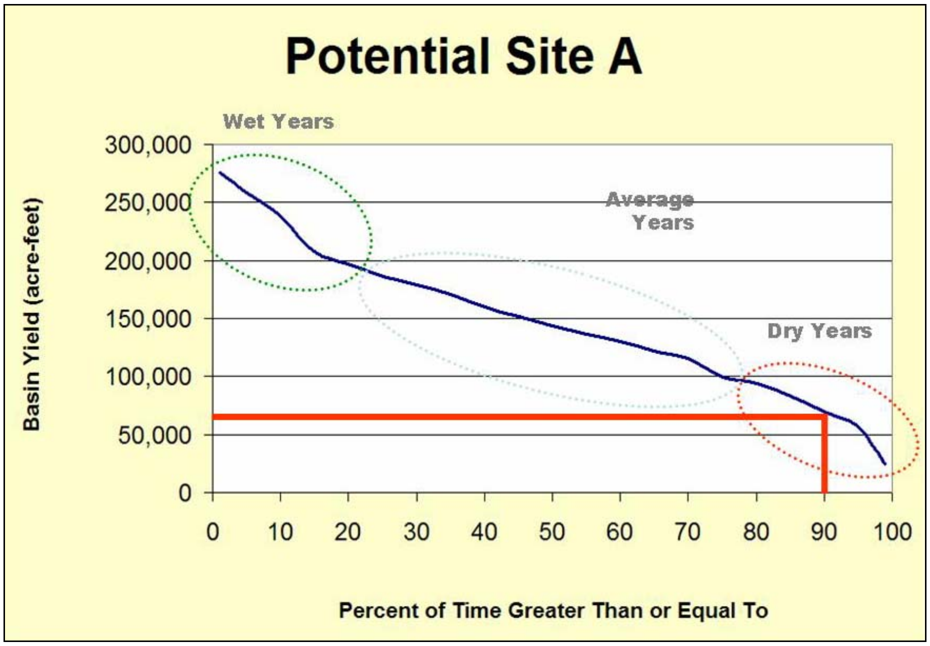

Figure 3-2. MODSIM Probability Curve for Example Site A

This graph shows the annual volume of basin yield, which represents water that can be diverted or stored at varying levels of reliability. For example, the volume of water that can be diverted or stored at least 90 percent of the time (thick red line) is 65,000 AF, which represents a storage volume that could be met even during most dry years. This volume is lower than the volume that could be diverted or stored 50 percent of the time (140,000 AF), which represents average year conditions. To determine the maximum size of a potential storage site, the 90th percentile value was chosen to be conservative under the assumption that water users would expect water deliveries to achieve that level of reliability. While the 90th percentile value provides a conservative view of potential basin yield, the 50th percentile (average) value can just as easily be determined from the MODSIM output.

Certain sites were chosen within each major subbasin or fork to be representative of a group of potential storage sites within the same general location or reach. MODSIM was run for that site and probability curves were developed to be representative of that location or reach. For example, within the North Fork Payette, the Tripod Creek site was modeled and chosen to be representative of basin yields for nearby sites such as Cabarton, Round Valley, and Smith Ferry. Table 3-5 at the end of this chapter summarizes the results of the ranking process, including the MODSIM analysis, and shows the match between representative MODSIM sites and potential storage sites.

In the Boise River basin, five representative sites were modeled in MODSIM (Dry Creek, Rabbit Creek, Casey Ranch, South Fork Boise, and Twin Springs). Figure 3-3 shows the total annual delivery for each of those sites. Figure 3-3 shows that, within the Boise River basin, Dry Creek has the best refill potential (for example, it may be able to reliably deliver 50,000 AF approximately 95 percent of the time based on withdrawals from the lower Boise

River). Upstream sites such as Rabbit Creek and Twin Springs all have higher refill volumes (100,000 AF), but can reliably deliver that higher volume only 80 percent of the time.

In the Payette River basin, eight representative sites were modeled in MODSIM (Big Pine Creek, Firebird, Bissell Creek, Upper Shafer, Boiling Springs, Upper Squaw Creek, Cabarton, and Wash Creek). Figure 3-4 shows that, within the Payette River basin, annual deliveries are relatively higher (between 150,000 and 400,000 AF) than in the Boise River basin, but reliable delivery of these volumes is consistently only about 80 percent of the time. This means that in dry years, a site within the Payette River basin may not be able to capture higher volumes.

Importantly, these graphs portray total annual delivery, not total annual storage capacity. Total annual delivery is composed of both natural flows that can be diverted for use without being stored, and stored flows. This means that possible storage volumes are not synonymous with total annual delivery shown in these figures.[8]

The constraints analysis was based on a high level of reliability (90 percent) in an effort to be conservative and to test potential storage sites and volumes under demanding scenarios (e.g., DCM&I and/or base irrigation supply). Under this assumption, the sites that can store a higher volume of water offer greater operational flexibility (unless the larger size is outweighed by the socio-economic and environmental impacts associated with a larger reservoir footprint). Determination of the most appropriate reliability level will ultimately depend on the demand/use scenario pursued; this consideration is certainly relevant in appraisal/feasibility analysis.

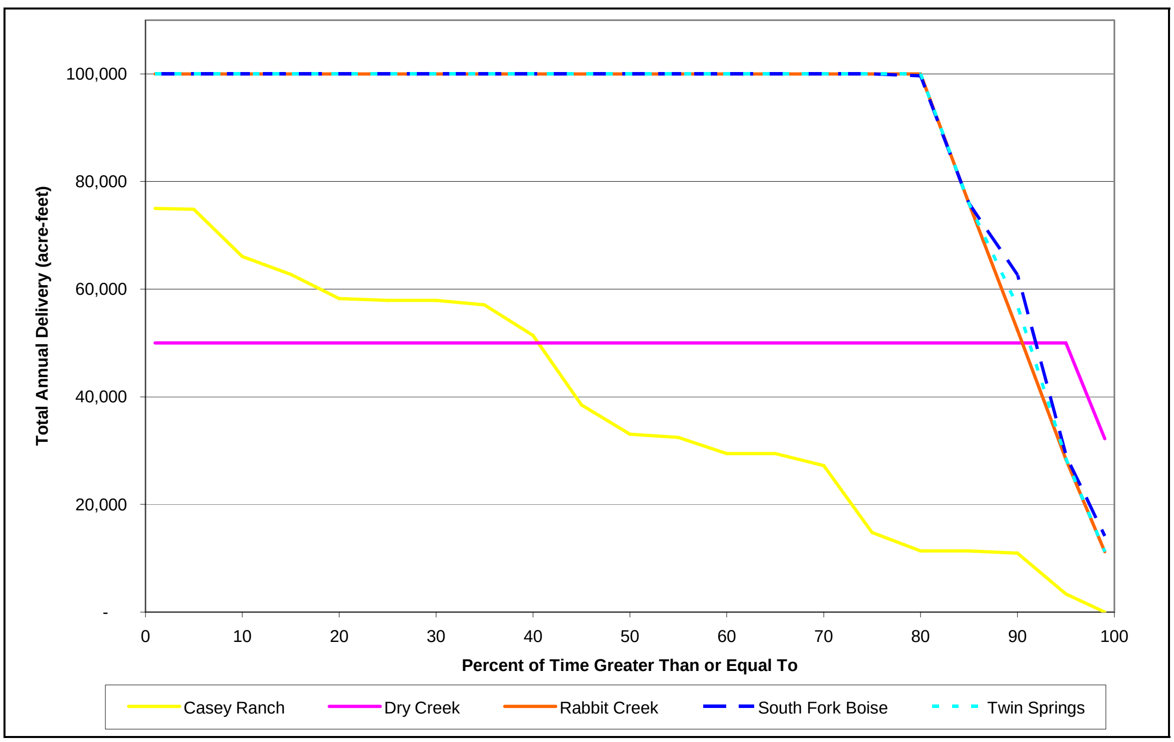

Figure 3-3. Annual Deliveries (Natural and Stored Flows) within the Boise River Basin

[8] The ultimate sizing of a new or retrofitted existing site would also be dependent on downstream flood control storage requirements.

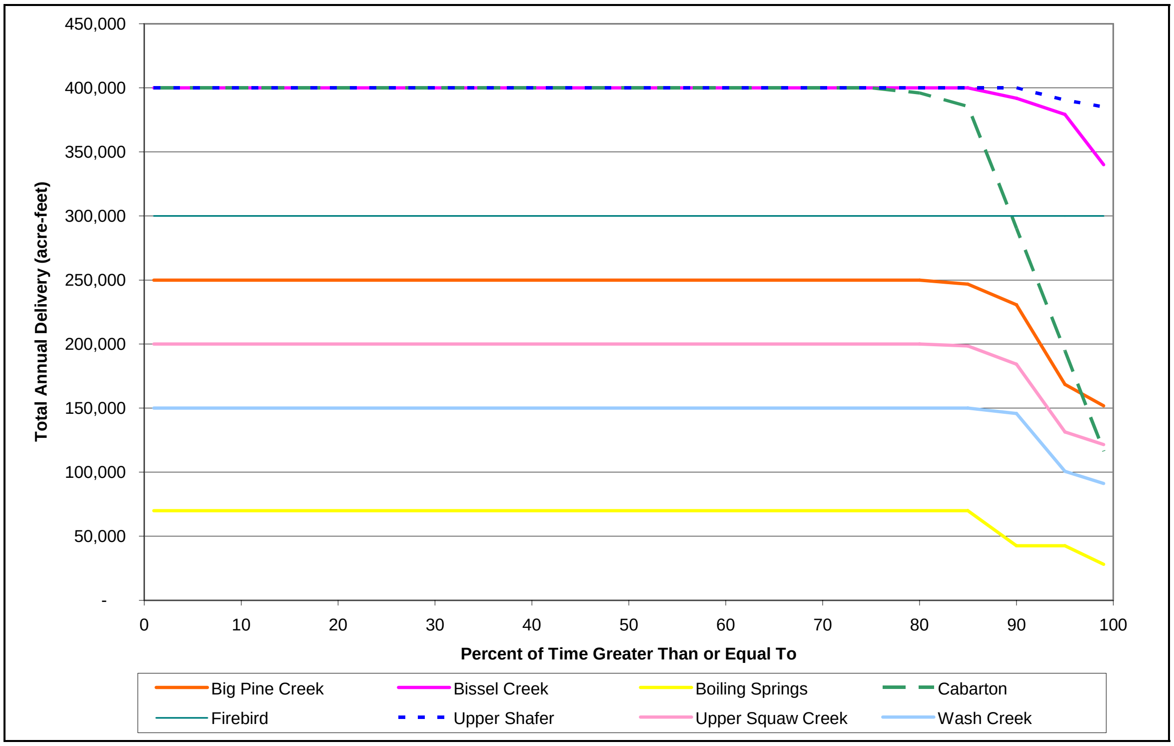

Figure 3-4. Annual Deliveries (Natural and Stored Flows) within the Payette River Basin

3.3.2 Socio-economic and Environmental Constraints Analysis

Following the hydrologic analysis, the next step in the ranking process was to compare candidate reservoir sites in terms of their relative potential impacts on factors such as infrastructure, recreation, and biological resources. The intent of this analysis was to identify those candidate locations that had the least socio-economic and environmental constraints to reservoir siting and development.

This analysis was conducted in three steps:

1. Delineate potential candidate site footprint.
2. Identify and quantify the constraints associated with each potential candidate site.
3. Compare each potential candidate site to develop raw scores and weighted stakeholder value scores.

These steps are described in the following sections.

Potential Candidate Site Footprint Delineation

Based on the results of the MODSIM analysis, an estimate of the reservoir (pool) footprint associated with each potential candidate site was mapped using a 10-meter digital elevation model (DEM) produced by the USGS. For each candidate reservoir site, generalized pool footprints were mapped in increments of 50,000 AF of storage volume. Figure 3-5 provides an example of the footprint delineation at Anderson Creek. Dam site locations for candidate new reservoirs were identified in large part from previous studies. In cases where no conceptual location had previously been mapped, local terrain conditions were assessed to determine a likely site.

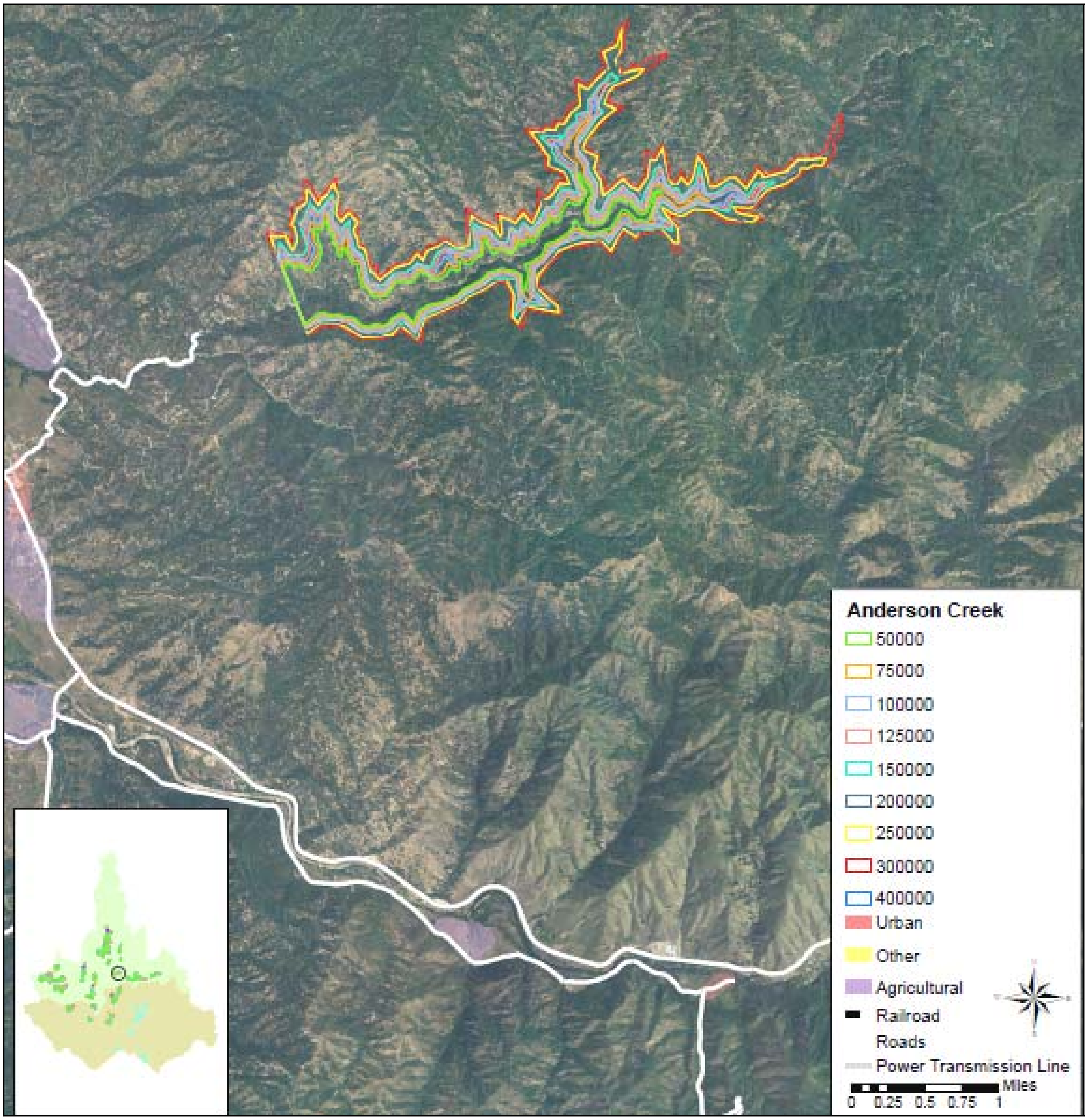

Figure 3-5. Example Footprint Delineation at Anderson Creek

The maximum pool size at any given site was based on either: 1) the maximum basin yield available for storage in the watershed (according to the MODSIM analysis), or 2) general site conditions, whichever was most limiting. The maximum pool footprints are based on the maximum volume that could reliably be diverted and stored 90 percent of the time. The maximum pool in the Payette River basin ranged from 50,000 AF to 300,000 AF and the maximum pool footprint for sites in the Boise River basin ranged from 50,000 AF to 100,000 AF.

Using Geographic Information Systems (GIS), the pool footprints for all potential candidate sites were overlaid onto available infrastructure, recreation, and biological resource, land ownership, and land use data. Based on the pool footprints, the relative impacts for various factors were quantified and reported in the following terms (as appropriate given the constraint):

- Acres per 10,000 AF of storage for land ownership, lands uses, and species habitats
- Miles per 10,000 AF of storage for roads, transmission lines, recreational segments, and aquatic habitats
- Instances per 10,000 AF of storage for existing recreation sites

How these units of measurement were used to develop a score to rank potential candidate sites is explained in more detail below.

Identification and Quantification of Socio-economic and Environmental Constraints
Criteria used in the ranking consisted of both socio-economic factors and environmental factors as shown in Table 3-4.

Table 3-4. Constraints Analysis Criteria

Categories	Factors	Criteria
Socio-economic	Existing Land Use	Residential uses
		Other developed uses (C/M/I)
		Irrigated/developed agriculture
	Recreation	Recreation site(s)
		Noted fishing reach
	Infrastructure	Roads/highways or railroads
		Other (e.g., transmission lines, telecom facilities)
Environmental	Federal Endangered Species	Bull Trout migratory, over-wintering, or proposed critical habitat[1]
	Sensitive Species[2]	Aquatic species habitat
		Terrestrial species habitat
	Protected Management Status: Federal	Candidate Wild and Scenic Reach or Wilderness Study Area
		Designated Roadless Area, Research Natural Area, or Area of Critical Environmental Concern
	Protected Management Status: State	Designated Recreation River (included streams noted for boating recreation)

NOTES:
[1]Sites with resident populations or critical spawning habitat were eliminated during initial screening
[2]Candidate ESA species or State Species of Special Concern

Each of these factors, including their data sources, is discussed below.

Socio-economic Factors
Based on a review of available data (at the scale of this assessment) and discussion with the SWG, the following socio-economic criteria were evaluated:

- Existing Land Uses
  - Residential uses—towns and cities
  - Other developed uses—commercial/municipal/industrial (C/M/I), mines, airports, gravel pits, and golf courses
  - Irrigated/developed agriculture—row crops, irrigated pasture and hay fields, dry farm crops, and fallow fields

  Source: Idaho Gap Analysis—This Statewide dataset provides planning-level data for urban land, other developed land, and agriculturally developed land.

- Recreation
  - Recreation sites—direct impacts to boat ramps, campgrounds, community parks, and State parks
  - Noted fishing reaches—river reaches that have special rules/regulations intended to protect priority fishing reaches (e.g., no bait, barbless hooks, catch/release)

  Source: GIS databases from USFS, IDPR, and IDFG.

- Infrastructure
  - Roads/highways or railroads—would require re-routing
  - Other (power transmission lines, telecom facilities)—would require re-routing

  Sources: Road/highway GIS data from Idaho Transportation Department, Railroad GIS data from University of Idaho library, and power transmission data from GIS depot.

Environmental Factors
Based on a review of available data (at the scale of this assessment) and discussion with the SWG, the following criteria were evaluated:

- Endangered Species
  - Removes Federally listed ESA bull trout habitat (migratory, over-wintering, or proposed critical).[9]

  Sources: Reclamation, USFS, and IDFG agency personnel and published reports.

- Sensitive Species
  - Removes species habitat of State Species of Special Concern. For aquatic species, this parameter includes areas suspected of containing pure strains of native redband rainbow trout. For terrestrial species, this parameter includes areas identified as known or potential habitat of State and Federally listed species.

  Sources: IDFG is currently investigating the genetic distribution of redband rainbow trout; information from Reclamation, IDFG, and USFS provided areas suspected of containing pure strains of redband rainbow trout. Terrestrial species are from the CDC.

[9] This parameter includes areas typically lower in the basins that are downstream of known, local resident populations or that are within spawning and rearing sites of migratory fish.

- Protected Management Status: Federal
  - Candidate Wild and Scenic River
  - Designated Roadless Area
  - Research Natural Area

  Sources: CDC and USFS databases.

- Protected Management Status: State-Designated Natural and Recreation Rivers
  - At present, the State has assigned a protective designation to Recreational Rivers allowing only minimal development. Rivers designated as Natural are currently prohibited from development.

  Sources: State, CDC, and USFS databases.

Comparison and Scoring of Constraints

Raw Scoring Process

In order to enable valid, equal comparison of candidate sites against one another, the results of the "per 10,000 AF" measurements were translated into a common "language." This was accomplished for each criterion by determining the range of impacts encountered among all sites, and interpreting this range for each site as shown below.

Level of Impact/Extent of Constraint	Constraint/Impact Score
- In top third of range	1
- In middle third of range	2
- In bottom third of range	3
- Constraint not encountered	4

The following simple example illustrates this translation. Assuming the range of impacts on residential land use (among all candidate reservoir opportunities) is a minimum of 0 to a maximum of 100 acres per 10,000 AF of storage, the impact score for this criterion would be derived as shown below.

For each candidate site:	Constraint/Impact Score
- 67 to 100 acres of impact/10,000 AF	1
- 34 to 66 acres of impact/10,000 AF	2
- 1 to 33 acres of impact/10,000 AF	3
- 0 acre of impact/10,000 AF	4

This method allows comparison of sites in a simple, straightforward manner, both on a criterion-by-criterion basis and in terms of overall performance on all criteria (that is, by summing individual criterion scores to obtain a total constraint/impact score). Overall, the sites with the highest scores are the most attractive because they evidence the fewest constraints.

	Constraint/Impact Score				
	Criterion 1	**Criterion 2**	**Criterion 3**	**Criterion 4**	**Total**
Site 1	1	2	4	2	9
Site 2	4	4	3	4	15
Site 3	3	4	3	3	13
Site 4	2	1	3	3	9
Site 5	2	1	3	2	8

These raw scores provided a view of the "best/least constrained" sites, assuming all the criteria were of equal importance.

Weighted Scoring Process

Raw scores were then weighted to reflect varied SWG points of view regarding which of the criteria are most important to decision-making. Stakeholders were asked to assign relative importance using the following process:

- Rate the importance of each Factor (see Table 3-4) (e.g., land ownership, existing land uses, recreation, etc.) on a scale of 1 to 3, with 1 being least important and 3 being most important.
- Rate the importance of each Criteria (see Table 3-4) (e.g., urban uses, road/highway/railroads, species habitat, etc.) on a scale of 1 to 3, with 1 being least important and 3 being most important.
- Using 100 points, assign part to each constraint Category (see Table 3-4) (e.g., Socio-economic and Environmental) with a higher allocation indicating greater importance.

A total of 15 SWG responses was received and the results were analyzed to establish an average set of importance values for the criteria. These values were then used as multipliers with the constraint/impact scores described previously. Thus, a second weighted score was achieved based on relative importance input.

The complete list of importance values derived from SWG input is included as Appendix F. However, it is relevant to note that of the 15 responses received, six generally assigned higher importance to socio-economic criteria, six reflected a higher priority to environmental criteria, and three assigned equal importance to both categories.

In order to obtain an indication of which candidate reservoir sites offer the fewest/least extensive potential constraints, total scores were summed for each site. An example summary sheet of the surface storage site evaluation and comparison process is provided in Figure 3-6. Complete scores are provided in Appendix G.

Boise/Payette Basin Storage Assessment

Surface Storage Site Evaluation and Comparison Process

Level 2 Analysis Worksheet -

High 1/3 ○
Mid 1/3 ◑
Low 1/3 ◕
None ●

Factors	Criteria	Level 2 Data	Level 2 Analysis: Result Summary Score (Result 1 to 4, Least to Most Suitable)					Relative Importance
Land Acquisition								
Land Ownership	Private vs. Public Ownership	Acres private/10,000 AF storage	●	4	X	1	=	4
Socioeconomic Factors								
Existing Land Use	Displaces urban uses	Acres /10,000 AF storage	●	4	X	3.1	=	12
	Displaces other developed uses		●	4	X	2.7	=	11
	Displaces irrigated agriculture		●	4	X	3.1	=	12
Recreation	Displaces recreation site(s)	Number of sites /10,000 AF	○	1	X	1.5	=	2
	Eliminates noted fishing reach	Miles /10,000 AF	○	1	X	1.8	=	2
Infrastructure	Displaces road/highway/railroads	Miles /10,000 AF	○	1	X	2.1	=	2
	Displaces transmission line	Miles /10,000 AF	●	4	X	1.9	=	8
		Socioeconomic Factors Score:		19				49
Environmental Factors								
Federal ESA Species	Removes Bull Trout habitat (migratory, over-wintering or proposed critical)	Miles /10,000 AF	●	4	X	3.3	=	13
State Species of Special Concern	Removes species habitat (Redband Trout)	Miles /10,000 AF	○	1	X	3.0	=	3
State and Federally Listed Terrestrial Species Habitat	Removes species habitat	Acres /10,000 AF	◕	3	X	3.0	=	9
Protected Land/River Status: Federal	Candidate Wild & Scenic	Acres /10,000 AF	○	1	X	3.0	=	3
	Located in one of the following: ☑ Designated Roadless Area ☐ Research Natural Area		○	1	X	3.0	=	3
Protected Land/River Status: State	Designated Recreation River	Miles /10,000 AF	○	1	X	3.1	=	3
		Environmental Factors Score:		11				34
		Total Score:		30				83

Figure 3-6. Example Constraints Sheet Showing Raw and Weighted Scores

3.3.3 Needs Analysis

Recognizing that potential candidate sites should be capable of meeting a full range of defined needs and achieving a wide range of benefits, the results of hydrologic and constraints analysis were reviewed critically. The highest scoring potential candidate sites were assessed to determine whether they provided the required benefits (for example, being located in an area that could provide adequate irrigation storage or flood control).

Notably, the majority of sites that scored the highest (both on a raw scoring basis and a weighted scoring basis) were located in the Payette River basin. This is because the Payette River basin generally has fewer infrastructure concerns and fewer potential site locations that are in environmentally sensitive areas. Given the varied uses that might be met with future water storage facilities in both basins, potential sites within the Boise River basin needed to be retained for further analysis, even though they scored relatively lower in general than potential sites within the Payette River basin.

In addition to carrying forward sites to meet specific basin needs, land ownership was also calculated to present the relative effects of a storage site on private or public lands. Members of the SWG disagreed as to whether potential candidate sites were more or less desirable depending on the affected land uses (public vs. private). To avoid biasing the list of potential candidate sites in favor of purely public or purely private lands, this information is simply summarized in Appendix J to be used in future phases of analysis. The information summarized in Appendix J shows the percentage of Federal, State, and private land that would be inundated by a new reservoir at selected sites recommended for further analysis.

3.3.4 Results of the Ranking Process

Table 3-5 provides a summary of how each site scored in the ranking process. Detailed scores are presented in Appendix G for varying reservoir storage volumes (and footprints).

To reiterate, an initial list of 200+ sites was narrowed in the screening step to provide a refined list of sites that could be evaluated in more depth as part of the ranking step. There are a few sites that were carried forward to the ranking step, but for which no scores were calculated (shown as n/a in Table 3-5). A footprint for these sites was not calculated (and no scores assigned) if initial MODSIM results indicated poor refill potential (Casey Ranch, Cat Creek, Moores Flat, Cottonwood Creek, Gold Fork [on-stream], and Ola), or if site topography would not fit a minimum storage volume of 50,000 AF (Coyote Butte and High Valley). Gold Fork (off-stream) was also not scored because a new reservoir footprint would overlap with the existing Horsethief Reservoir.

The results of the screening and ranking process indicate that viable potential water storage sites tend to cluster in discrete reaches and subbasins. To be more useful in future studies, a decision was made to define these clusters as “areas of opportunity” and to recommend they be used as starting points for future analysis. Recognizing that the top candidates in each basin are located within a few broad reaches (because these areas represent that balance between providing downstream use benefits and minimizing impacts), “areas of opportunity” are defined so that future analysis is not limited to potential candidate sites that were previously identified in the literature. Thus, these “areas of opportunity” represent areas that have the greatest potential for meeting future demands, while minimizing impact to contemporary socio-economic and environmental values. These areas are described in more detail in Chapter 4.

Table 3-5. Summary of Ranking Process for Sites in Both Basins

		Ranking Results					Recommendation		
		Refined Hydrologic Analysis		Constraints Analysis (Weighted Scores)					
Site Name	**Type**	**Representative MODSIM Site**	**Potential Storage Capacity (AF, 90% Reliability)**	**Socio-economic Score**	**Environmental Score**	**Total Score**	**Include in "Area of Opportunity"?**	**Eliminate?**	**Notes**
BOISE RIVER BASIN									
Alexander Flats	On-stream	Rabbit Creek/ Twin Springs	50,000	49	34	83	✓		North Fork/Middle Fork Boise
Anderson Ranch	Existing	Casey Ranch	10,000	33	36	69	✓		Lucky Peak, Arrowrock, or Anderson Ranch
Arrowrock	Existing	Twin Springs/ South Fork Boise	50,000-60,000	61	27	88	✓		Lucky Peak, Arrowrock, or Anderson Ranch
Barber Flats	On-stream	Rabbit Creek	50,000	59	49	108	✓		North Fork/Middle Fork Boise
Casey Ranch	On-stream	Casey Ranch	10,000	n/a	n/a	n/a		✓	No score because poor refill potential
Cat Creek	Off-stream	Casey Ranch	10,000	n/a	n/a	n/a		✓	No score because poor refill potential
Coyote Butte	Off-stream	South Fork Boise	60,000	n/a	n/a	n/a		✓	No score because topography would not fit a minimum storage volume of 50,000 AF
Dry Creek	Off-stream	Dry Creek	50,000	59	74	133		✓	Withdrawals from Lower Boise River not practical
Dunnigan Creek	Off-stream	Wash Creek/Big Pine Creek	150,000-225,000	59	56-59	114-117	✓		Lower South Fork Payette
Firebird	Off-stream	Firebird	300,000	49-51	74	123-125	✓		Mainstem Payette (although ability to deliver to downstream users is limited)
Grimes Creek	Off-stream	Wash Creek/Big Pine Creek	150,000-225,000	41-59	56	97-114	✓		Lower South Fork Payette
Indian Creek-Mayfield	Off-stream	South Fork Boise	60,000	53	74	127	✓		Lower South Fork Boise
Krall Mountain	Off-stream	South Fork Boise	60,000	56	59	115	✓		Lower South Fork Boise
Lucky Peak	Existing	Twin Springs/ South Fork Boise	50,000-60,000	50	53	103	✓		Lucky Peak, Arrowrock, or Anderson Ranch

Table 3-5. Summary of Ranking Process for Sites in Both Basins (Continued)

		Ranking Results					Recommendation		
		Refined Hydrologic Analysis		Constraints Analysis (Weighted Scores)					
Site Name	Type	Representative MODSIM Site	Potential Storage Capacity (AF, 90% Reliability)	Socio-economic Score	Environmental Score	Total Score	Include in "Area of Opportunity"?	Eliminate?	Notes
Moores Flat	Off-stream	Casey Ranch	10,000	n/a	n/a	n/a		✓	No score because poor refill potential
Pioneerville	Off-stream	Wash Creek/Big Pine Creek	150,000-225,000	37-45	56-62	96-107		✓	Relatively lower score compared to nearby Grimes Creek
Rabbit Creek	Off-stream	Rabbit Creek	50,000	61	58	119	✓		North Fork/Middle Fork Boise
South Fork Boise River	On-stream	South Fork Boise	60,000	49	18	67		✓	Low environmental score
Twin Springs	On-stream	Twin Springs	50,000	49	21	70	✓		North Fork/Middle Fork Boise
PAYETTE RIVER BASIN									
Anderson Creek	Off-stream	Wash Creek/Big Pine Creek	150,000-225,000	65	59-62	123-126	✓		Lower South Fork Payette
Archie Creek	On-stream	Wash Creek/Big Pine Creek	150,000-225,000	59-61	24-33	83-92		✓	Low environmental score
Big Pine Creek	On-stream	Wash Creek/Big Pine Creek	150,000-225,000	47-59	24	71-83		✓	Low environmental score
Big Payette Lake	Existing	n/a	n/a	41	56	97		✓	Cascade Reservoir represents a more feasible retrofit opportunity
Big Willow Creek	Off-stream	Bissel Creek	400,000	59-65	59-65	117-129	✓		Lower Payette
Birding Island	Off-stream	Bissel Creek	400,000	51	56-59	107-110		✓	Relatively lower score compared to nearby Bissel Creek
Bissel Creek	Off-stream	Bissel Creek	400,000	48-50	65-68	114-117	✓		Lower Payette
Black Canyon	Existing	Upper Shafer Creek/ Bissel Creek	400,000	39	71	110		✓	Cascade Reservoir represents a more feasible retrofit opportunity
Boiling Springs	On-stream	Boiling Springs	50,000	60	28	88		✓	Relatively low storage potential relative to environmental impacts
Cabarton	On-stream	Cabarton	300,000	22-40	46-49	68-86		✓	Low socio-economic (recreation) score

Table 3-5. Summary of Ranking Process for Sites in Both Basins (Continued)

		Ranking Results					Recommendation		
		Refined Hydrologic Analysis		Constraints Analysis (Weighted Scores)					
Site Name	Type	Representative MODSIM Site	Potential Storage Capacity (AF, 90% Reliability)	Socio-economic Score	Environmental Score	Total Score	Include in "Area of Opportunity"?	Eliminate?	Notes
Cascade	Existing	n/a	n/a	n/a	n/a	n/a	✓		Cascade Reservoir
Cottonwood Creek	On-stream	Cabarton/ Upper Squaw	180,000-300,000	n/a	n/a	n/a		✓	No score because poor refill potential
Deadwood Canyon	Un-classified	Wash Creek/Big Pine Creek	150,000-225,000	65	31	96		✓	Low environmental score
Deadwood Reservoir	Existing	n/a	n/a	61	50	110		✓	Cascade Reservoir represents a more feasible retrofit opportunity
Dry Buck Creek	Off-stream	Cabarton/ Upper Squaw	180,000-300,000	59-61	74	132-134	✓		Mainstem Payette
Gold Fork	On-stream	Cabarton	300,000	n/a	n/a	n/a		✓	No score because poor refill potential
Gold Fork	Off-stream	Cabarton	300,000	n/a	n/a	n/a		✓	No score because a new reservoir footprint would overlap with the existing Horsethief Reservoir
High Valley	Off-stream	Cabarton/ Upper Squaw	180,000-300,000	n/a	n/a	n/a		✓	No score because topography would not fit a minimum storage volume of 50,000 AF
Horseshoe Bend	On-stream	Upper Shafer Creek	400,000	35	58-71	91-106		✓	Low socio-economic (infrastructure impacts) score
Little Payette Lake	Existing	n/a	n/a	54	65	119		✓	Cascade Reservoir represents a more feasible retrofit opportunity
Little Willow Creek	Off-stream	n/a	n/a	53	62	115		✓	Ability to deliver to downstream users limited
Lower Squaw Creek	Off-stream	Cabarton/ Upper Squaw	180,000-300,000	46-55	62-68	107-123	✓		Lower North Fork Payette/ Mainstem Payette
Middle Fork Payette River	Off-stream	Boiling Springs	50,000	45-50	34-46	81-90		✓	Low environmental score
Ola	On-stream	Cabarton/ Upper Squaw	180,000-300,000	n/a	n/a	n/a		✓	No score because poor refill potential

Table 3-5. Summary of Ranking Process for Sites in Both Basins (Continued)

		Ranking Results					Recommendation		
		Refined Hydrologic Analysis		Constraints Analysis (Weighted Scores)					
Site Name	Type	Representative MODSIM Site	Potential Storage Capacity (AF, 90% Reliability)	Socio-economic Score	Environmental Score	Total Score	Include in "Area of Opportunity"?	Eliminate?	Notes
Oxbow Bend	On-stream	Wash Creek/Big Pine Creek	150,000-225,000	45	18-24	63-69		✓	Low environmental score
Paddock Valley	Existing	n/a	n/a	56	74	129		✓	Facility too small and ability to deliver to downstream users limited
Round Valley	Off-stream	Cabarton	300,000	44-46	65	108-110		✓	Low socio-economic score
Sand Hollow	Off-stream	Bissel Creek	400,000	50-53	65-68	114-121	✓		Lower Payette
Scriver Creek	Off-stream	Cabarton	300,000	65	59-68	123-132	✓		Lower North Fork Payette
Smith Ferry	On-stream	Cabarton	300,000	22-39	46-49	68-88		✓	Low socio-economic score
Tripod Creek	Off-stream	Cabarton	300,000	55	65-74	120-129	✓		Lower North Fork Payette
Upper Big Willow Creek	Off-stream	n/a	n/a	56	56-59	111-114		✓	Ability to deliver water to downstream uses limited
Upper Payette Lake	Existing	n/a	n/a	51	49	100		✓	Cascade Reservoir represents a more feasible retrofit opportunity
Upper Shafer Creek	Off-stream	Upper Shafer Creek	400,000	54-57	65-68	119-124	✓		Mainstem Payette
Upper Squaw Creek	Off-stream	Cabarton/ Upper Squaw	180,000-300,000	36-46	68	104-113	✓		Lower North Fork Payette
Warm Spring Creek	Off-stream	Boiling Springs	50,000	65	53	117		✓	Relatively low storage potential relative to environmental impacts
Wash Creek	Off-stream	Wash Creek/Big Pine Creek	150,000-225,000	65	65-68	129-132	✓		Lower South Fork Payette

NOTES: Sites with a range of scores were evaluated under varying storage volumes (and footprints); variable scores reflect varying footprint sizes and their effects on the socio-economic and environmental criteria. These scores are presented in more detail in Appendix G.

4. Potential "Areas of Opportunity"

4.1 Identification of "Areas of Opportunity"

The original intent of the assessment was to narrow down the exhaustive list of all possible storage opportunities into a few that could be carried forward into an appraisal/feasibility analysis. Relying on existing information, current stakeholder input, and a ranking process, the results of the assessment showed that viable potential water storage sites tend to cluster in discrete reaches and subbasins. These clusters have been delineated as "areas of opportunity." The "areas of opportunity" approach represents a flexible, yet technically defensible, framework for further analysis.

These "areas of opportunity" are pockets in each of the basins where excess natural water supplies may be available for storage and where, at an assessment-level analysis, there are apparently fewer potential socio-economic and environmental effects relative to other areas within each basin (see Section 3.3). The "areas of opportunity" each contain several of the most promising sites and represent a starting point for future analysis.

Each "area of opportunity" is characterized by the source water that would either be retained within an on-stream facility, or diverted to an off-stream facility. Hence, each "area of opportunity" actually encompasses two components: source water and specific storage sites that would have the greatest potential of success (Figure 4-1).

- Source water yields in the Boise River basin may be up to 50,000 AF, while in the Payette River basin source water yields may provide up to 300,000 to 400,000 AF. These volumes are based on the important assumption that the available water that would be stored could be provided reliably 90 percent of the time to water users.

- Eight "areas of opportunity" are identified, largely based on the screening and ranking of specific potential storage sites identified in the literature review. It is recognized that future analysis in any of these areas would continue to evaluate impacts of site-specific alternatives on socio-economic and environmental values to a greater depth (for example, reaches with special designations).

In Figure 4-1, sites with relatively high scores are identified with red text, while sites with somewhat lower scores that are retained within an "area of opportunity" are identified with black text. "Areas of opportunity" are identified with yellow hatch marks. Potential conveyance/water transmission pipelines from a source diversion point to an off-stream storage facility are identified with red lines; no detailed siting information was used to establish these potential lines except for the shortest linear distance between a potential diversion location and the identified storage site. Conveyance/water transmission pipelines that extend outside the yellow hatched "area of opportunity" reflect the fact that some of the sites are located some distance away from a potential diversion point within the identified reach.

"Areas of opportunity" include the following.

- *Lower South Fork Boise*
- *North Fork/Middle Fork Boise*

- *Lower South Fork Payette*
- *Lower North Fork Payette*
- *Mainstem Payette*
- *Lower Payette*

The distribution of these areas is weighted toward the Payette River basin because this basin has a relatively lower incidence of potential socio-economic and environmental concerns. However, the majority of projected water uses are located in the Boise River basin (see Chapter 2). Therefore, "areas of opportunity" that received relatively lower scores in the Boise River basin (as compared to "areas of opportunity" in the Payette River basin) were retained and are recommended for consideration in future appraisal/feasibility analysis. The relative opportunities and challenges associated with specific "areas of opportunity" in both basins are discussed in more detail in the following section.

Two potential new sites with relatively high ranking scores were not considered further: Dry Creek and Paddock Valley. Dry Creek represents an off-stream facility that would be filled with water diverted from the lower Boise River. This site was not considered further because consumptive uses (DCM&I and irrigation), as well as flood control in this basin are located upstream from this location. Paddock Valley was also not considered further because the total estimated volume from retrofitting this existing facility was only 6,300 AF.

In addition to "areas of opportunity" for new storage sites, a few existing retrofitting opportunities have potential to be carried forward to an appraisal/feasibility analysis. These retrofitting "areas of opportunity" include the following.

- *Raising Lucky Peak, Arrowrock, or Anderson Ranch Dams*
- *Dredging Cascade Reservoir*

Within each of these eight "areas of opportunity," there is some flexibility in how future storage sites might be configured using a combination of diversion structures, on-stream or off-stream storage facilities, and water release rules that would work with existing reservoir operations. Some combination of physical structures or inter-basin exchanges may provide the greatest flexibility in meeting future water needs in both basins. These flexibilities can be explored in the next level of study.

Each "area of opportunity" is discussed in the following sections.

Figure 4-1. Identified "Areas of Opportunity"

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4.2 Comparison of Technical Attributes

A comparison of the technical attributes of each "area of opportunity" is described and discussed in more detail in the following section. The information includes the following elements.

- *Figure*. More detailed maps associated with each "area of opportunity" are presented.
- *Description*. Each "area of opportunity" encompasses two components: source water and specific storage sites. These specific storage sites represent those sites that were identified in the literature (see Appendix D for references on a site-specific basis), and "passed" both the screening and ranking processes. Specific storage sites to be evaluated in appraisal/feasibility analysis may not be limited to these sites and may include new storage sites within the "area of opportunity." "Areas of opportunity" are identified with yellow hatch marks. Potential conveyance/water transmission pipelines from a source diversion point to an off-stream storage facility are identified with red lines; no detailed siting information was used to establish these potential lines except for the shortest linear distance between a potential diversion location and the identified storage site. Conveyance/water transmission pipelines that extend outside the yellow hatched "area of opportunity" reflect the fact that some of the sites are located some distance away from a potential diversion point within the identified reach. Also, the term "hydrologic divide" in this description refers to the natural topographic divide that might separate a diversion point from an off-stream storage site in an adjacent drainage.
- *Maximum hydrologic potential*. As described in Chapter 3, this annual volume represents the available water that could be used to meet future demands reliably 90 percent of the time. MODSIM results for each "area of opportunity" are shown in Figure 3-3 (Boise River basin sites) and Figure 3-4 (Payette River basin sites). Importantly, Figures 3-3 and 3-4 show total annual delivery (composed of both natural flows that can be diverted for use without being stored and stored flows) and, conceptually, possible storage volumes are not synonymous with total annual delivery. However, total annual delivery in this discussion was assumed to be the same as the maximum hydrologic potential because this volume represents the upper boundary of what could be stored. For simplicity in this discussion, the MODSIM-modeled hydrologic potential for all "areas of opportunity" are rounded to the nearest 50,000-AF increment. Depending on how a facility is designed and operated, additional space could also be made available for flood control capacity.
- *Feasible uses*. Uses include DCM&I, irrigation, flood control capacity, and flow augmentation. Each of these uses is described in more detail in Chapter 2.
- *Cost considerations*. Assessment cost estimates reflecting only field (direct) construction costs were prepared for potential new storage opportunities. Rough field construction cost estimates of project features were compiled using other past and current reservoir development costs and interpolated for our site conditions. These costs are developed to compare relative differences between "areas of opportunity" and do not reflect site-specific cost estimates of any particular site evaluated in this study. As project details are further developed in appraisal/feasibility analysis, the site-specific accuracy and dependability of the cost estimates would increase. Non-field costs related to permitting, environmental documentation, or mitigation are unknown at this time, but

total costs for project implementation would be larger than the estimated field construction costs presented in this section. Detailed information regarding how the costs were developed is contained in Appendix H.

The conceptual cost estimates are presented only to provide relative construction costs. Cost estimates are shown in a range to reflect the limited site-specific information available during the assessment. The lower-end costs are associated with on-stream facilities that do not require pump stations or pipelines, or off-stream facilities that are located relatively near to their source water. Many of the higher-end costs associated with inter-basin and/or transbasin transfers are related to high pump station costs associated with the larger reservoir sizes.

- *Opportunities/challenges*. Opportunities and challenges are an inherent part of this assessment because each "area of opportunity" carries certain inherent benefits and socio-economic and environmental impacts. For example, consistent with the flexibility provided in the Comprehensive State Water Planning process, potential diversion and/or storage sites on Recreational-designated reaches continue to be considered, recognizing more extensive evaluation of environmental issues would need to occur in the approval/feasibility analysis. Trade-offs will be discussed in this section.

4.2.1 Lower South Fork Boise "Area of Opportunity"

- *Figure*. Figure 4-2 shows an enlarged map of this "area of opportunity."
- *Description*. Indian Creek-Mayfield and Krall Mountain were previously identified as potential off-stream storage sites associated with this reach of river. Either facility would require a diversion pipeline or tunnel to overcome hydrologic divides. A State-designated Natural River reach is within the "area of opportunity" as is a Federally proposed Wild and Scenic designation. Additionally, this section of river is important bull trout wintering habitat. Any development within this reach would need to further analyze impacts to special designations and protected species.
- *Maximum hydrologic potential*. Results of the MODSIM analysis for the South Fork Boise site (see Figure 3-3) indicate that approximately 50,000 to 60,000 AF could be stored and delivered reliably 90 percent of the time to water users. Depending on how an off-stream facility is designed and operated, additional volume could be available for flood control capacity.
- *Feasible uses*. Uses include DCM&I, irrigation, and flow augmentation. There may be limited flood control capacity depending on the configuration of an off-stream diversion structure and conveyance. If an off-stream facility in the Indian Creek drainage were pursued, direct downstream DCM&I and irrigation uses would be limited.
- *Cost considerations*. Assessment-level field (direct) construction cost estimates range between $410 to $600 million for an off-stream, 100,000-AF reservoir (the higher volume is associated with flood control capacity) (see Appendix H). The relatively high costs are associated with diversion, conveyance, and pump station structures that would be necessary for any off-stream facility.
- *Opportunities/challenges*. This area represents a nearby day-use flat-water recreational opportunity for Treasure Valley residents, which would need to be weighed against loss

of free-flowing fishery recreation and habitat. Also, any new facility in this area would need to be operated in a unified manner with other existing upstream and downstream reservoirs.

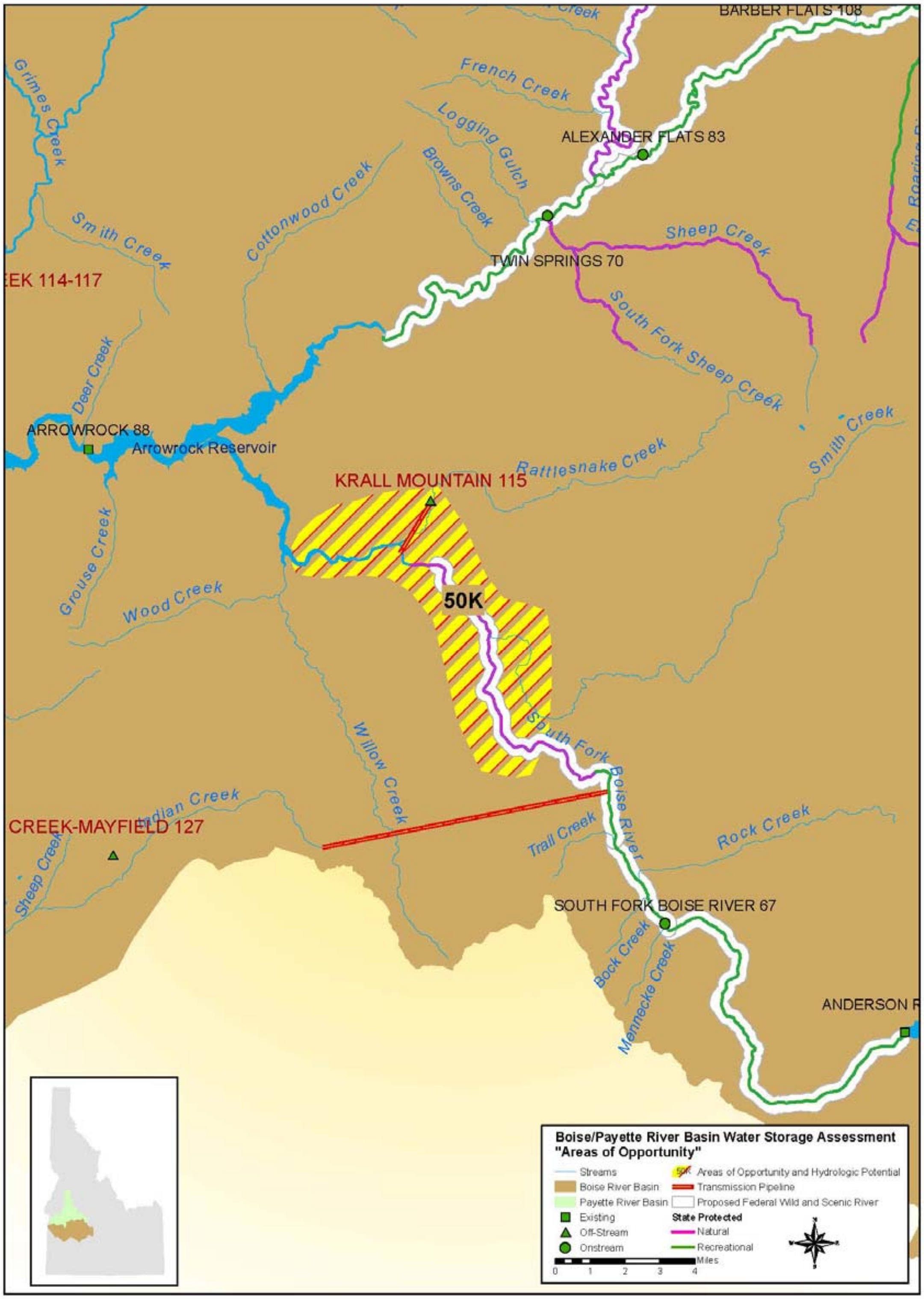

Figure 4-2. Lower South Fork Boise “Area of Opportunity”

4.2.2 North Fork/Middle Fork Boise “Area of Opportunity”

- *Figure*. Figure 4-3 shows an enlarged map of this “area of opportunity.”
- *Description*. This area represents a catchment area where two major forks join, which is strategic for providing flood control. Within this area, multiple configurations of on-stream and off-stream diversions may be possible. Barber Flats, Alexander Flats, Twin Springs, and Rabbit Creek are previously identified sites associated with this stream segment. A State-designated Natural River reach is within the “area of opportunity,” as is a Federally proposed Wild and Scenic designation. Additionally, this section of river is important bull trout migratory habitat. Any development within this reach would need to further analyze impacts to special designations and protected species.
- *Maximum hydrologic potential*. Results of the MODSIM analysis for the Twin Springs and Rabbit Creek sites (see Figure 3-3) indicate that approximately 50,000 AF could be stored and delivered reliably 90 percent of the time to water users. Depending on how a storage facility is designed and operated, additional volume could be available for flood control capacity.
- *Feasible uses*. This area potentially represents on-stream and/or off-stream storage, and associated uses include DCM&I, irrigation, flood control capacity, and flow augmentation.
- *Cost considerations*. Assessment-level field (direct) construction cost estimates range between $150 to $380 million for an off-stream, 100,000-AF reservoir (the higher volume is associated with flood control capacity) (see Appendix H). Compared to the Lower South Fork Boise “area of opportunity,” the high-end estimates are less costly because off-stream facilities are closer to potential diversion points.
- *Opportunities/challenges*. This area represents the most flexible combination of on-stream and off-stream storage, and represents the best flood control opportunity in the Boise River basin. Storage sites would provide a nearby day-use flat-water recreational opportunity for Treasure Valley residents that would need to be weighed against loss of free-flowing fishery recreation and habitat. Also, any new facility in this area would need to be operated in a unified manner with other existing reservoirs.

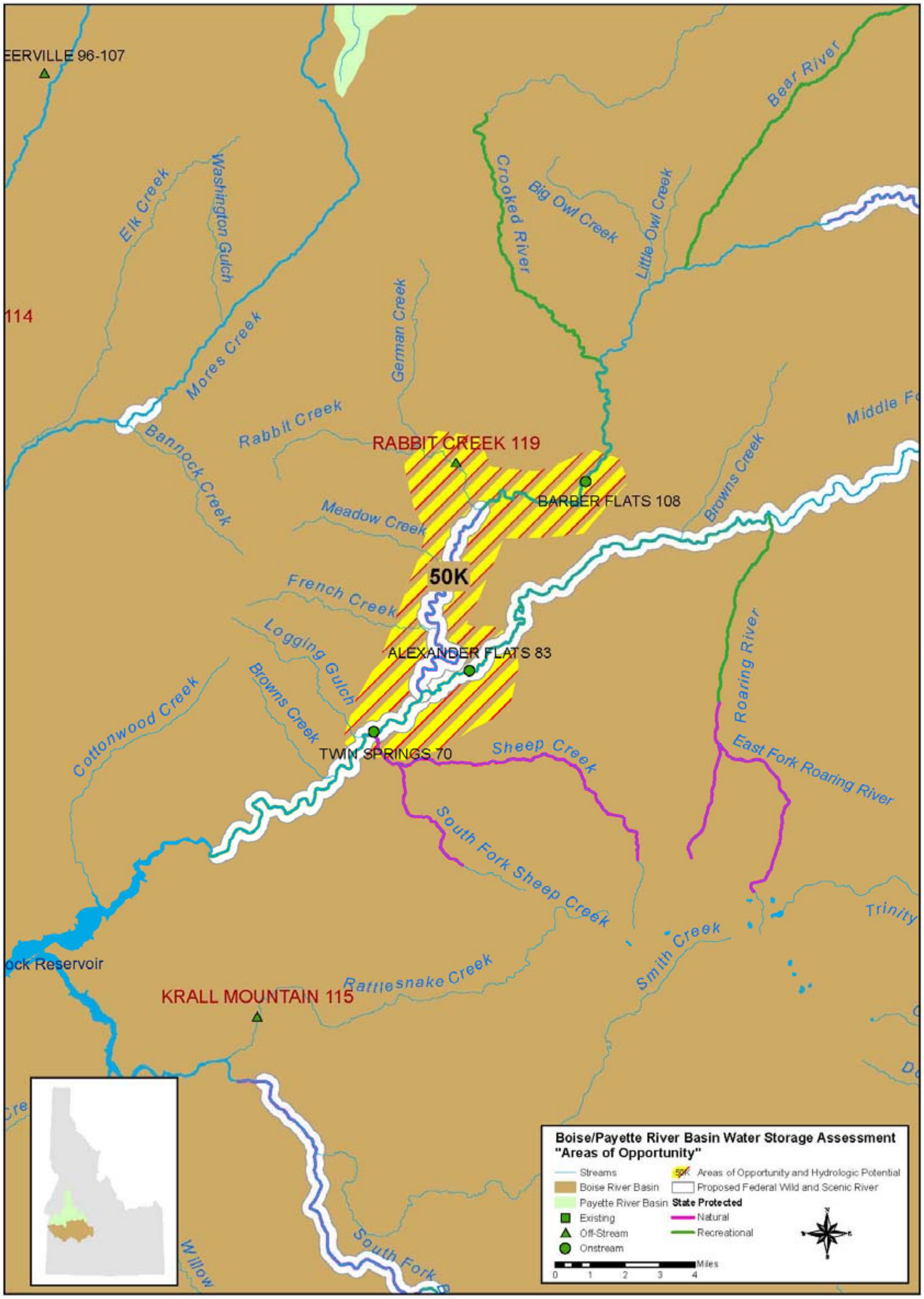

Figure 4-3. North Fork/Middle Fork Boise “Area of Opportunity”

4.2.3 Lucky Peak, Arrowrock, or Anderson Ranch "Area of Opportunity"

- *Figure*. Figures 4-4a and 4-4b show this "area of opportunity" for retrofitting existing facilities. These figures reflect the Lucky Peak/Arrowrock and Anderson Ranch components, respectively, of this retrofit "areas of opportunity."
- *Description*. Various entities have evaluated raising the height of these dams to create an additional 6,300 AF (Lucky Peak/Arrowrock) to 29,000 AF (Anderson Ranch) of storage capacity. Any increased footprint resulting from dam raising would need to take into consideration potential effects on reaches with State Natural-designation and Federally proposed Wild and Scenic designation and bull trout habitat. Any development within this reach would need to further analyze impacts to special designations and protected species.
- *Maximum hydrologic potential*. Results of the MODSIM analysis for the South Fork Boise site (for Lucky Peak/Arrowrock) (see Figure 3-3) indicate that although approximately 60,000 AF could be stored and delivered reliably 90 percent of the time to water users, the maximum storage potential is 6,300 AF to reflect Reclamation's analysis of the maximum raise possible at Lucky Peak/Arrowrock (Appendix D).

  Results of the MODSIM analysis for the Casey Ranch site (for Anderson Ranch) (see Figure 3-3) indicate that approximately 10,000 AF could be stored and delivered reliably 90 percent of the time to water users (with respect to the 29,000 AF of additional storage evaluated by Reclamation [2005c; Appendix D], 30,000 AF could be stored and delivered reliably 60 percent of the time to water users). Depending on how a storage facility is designed and operated, additional volume could be available for flood control capacity.
- *Feasible uses*. Retrofitting existing facilities meets all uses, including DCM&I, irrigation, flood control capacity, and flow augmentation.
- *Cost considerations.* Reclamation estimated the conceptual field costs associated with raising Anderson Ranch at between $16 and $26 million (which would result in 29,000 AF of additional storage, plus an additional volume of flood control capacity) (Appendix D). Costs associated with raising Lucky Peak/Arrowrock dam were not included in Reclamation's analysis (2005c).
- *Opportunities/challenges*. Retrofitting might allow for an easier permitting process, and certainly the infrastructure is in place to manage increased flat-water recreational benefits. Impacts on upstream fisheries resources (particularly bull trout) would need to be considered carefully.

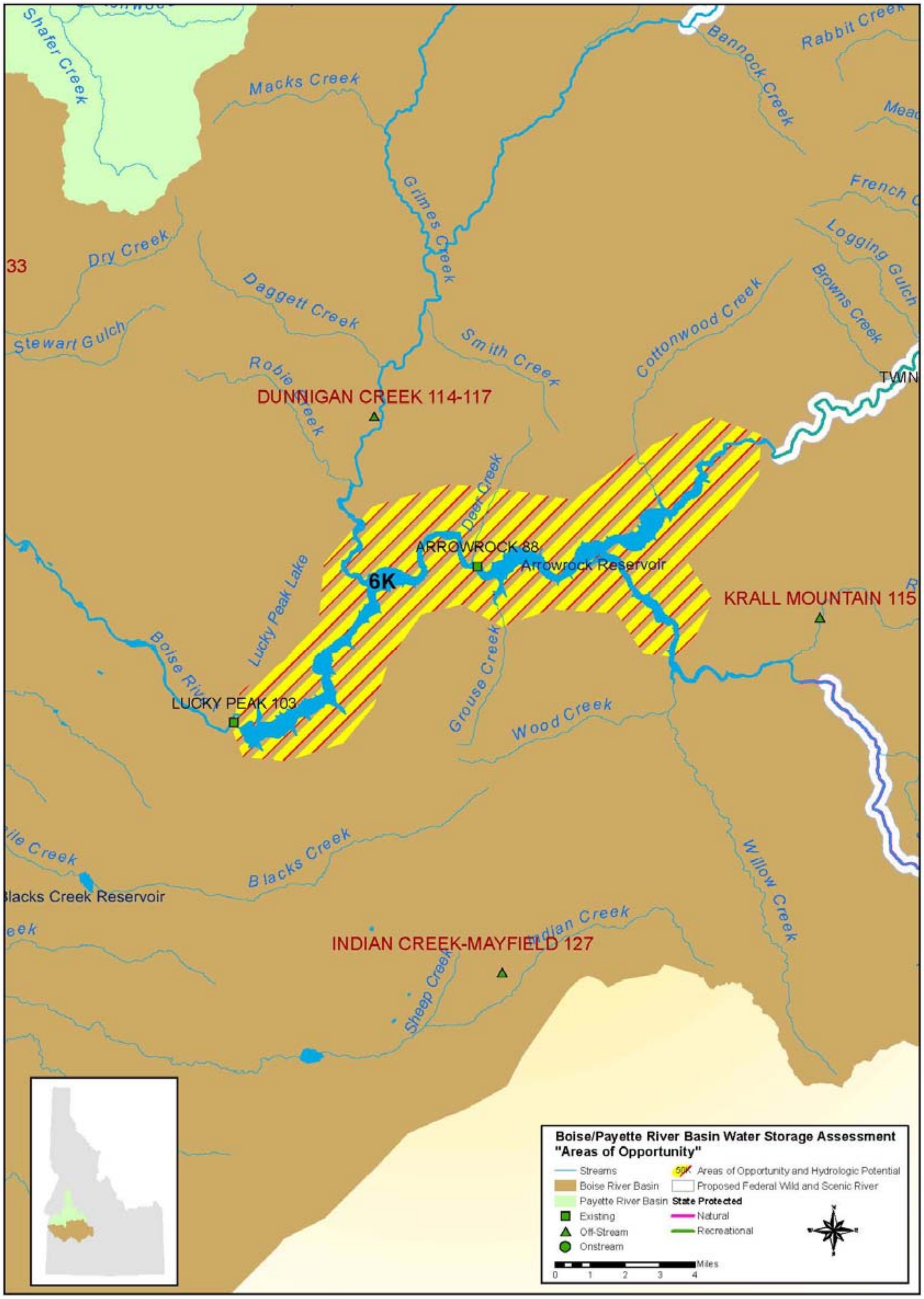

Figure 4-4a. Lucky Peak/Arrowrock "Area of Opportunity"

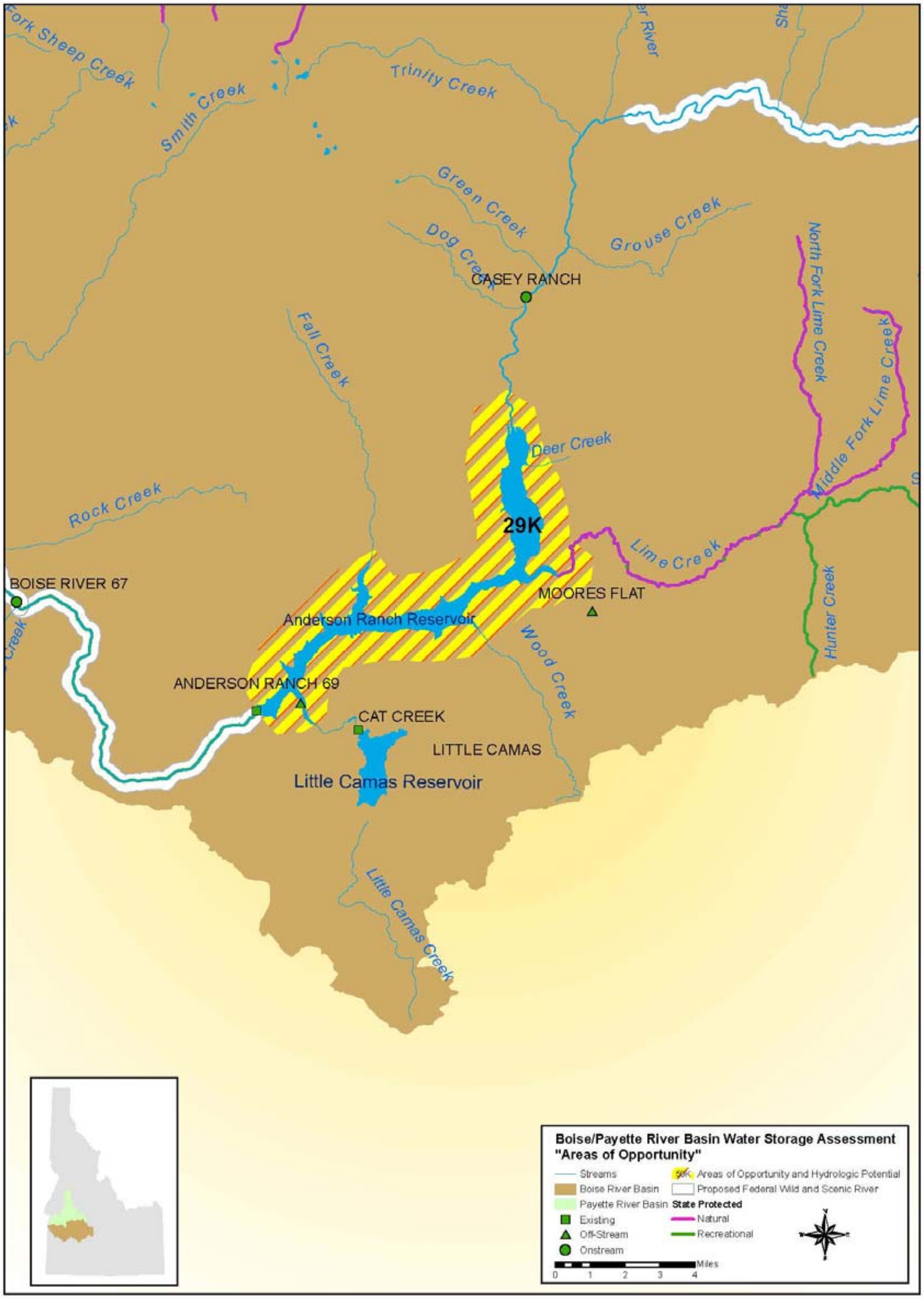

Figure 4-4b. Anderson Ranch “Area of Opportunity”

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4.2.4 Lower South Fork Payette “Area of Opportunity”

- *Figure*. Figure 4-5 shows an enlarged map of this “area of opportunity.”
- *Description*. This area could provide water to potential off-stream storage sites within the Payette River basin (previously identified sites include Wash Creek, Anderson Creek) or via a transbasin transfer to the Boise River basin (previously identified sites include Grimes Creek, Dunnigan Creek). Any of the facilities would require a diversion pipeline or tunnel to overcome hydrologic divides. Diversion would need to occur from within a State-designated Recreational River reach. Also, the upper reach of the “area of opportunity” is coincident with a Federally proposed Wild and Scenic designation. Any development within this reach would need to further analyze impact to these designations.
- *Maximum hydrologic potential*. Results of the MODSIM analysis for the Wash Creek and Big Pine Creek sites (see Figure 3-4) indicate that between 150,000 AF and 225,000 AF could be stored and delivered reliably 90 percent of the time to water users. Depending on the design and operation of a storage facility, additional volume could be available for flood control capacity.
- *Feasible uses*. Uses include DCM&I, irrigation, and flow augmentation. There may be limited flood control capacity depending on the configuration of an off-stream diversion structure and conveyance.
- *Cost considerations*. Assessment-level field (direct) construction cost estimates range between $170 to $1,290 million for an off-stream, 300,000-AF reservoir (the higher volume is associated with flood control capacity) (see Appendix H). Compared to other “areas of opportunity,” higher-end estimates are more costly because of the size of pumping facilities that would be necessary for transbasin transfer.
- *Opportunities/challenges*. This area represents a very flexible combination of off-stream storage, including potentially more effective coordinated water flow management with Deadwood Reservoir. This area is also close enough for weekend recreational uses; however, larger reservoir storage volumes may reduce instream flows at Letha by more than 30 percent and capital costs associated with constructing transmission lines/tunnels are expensive.

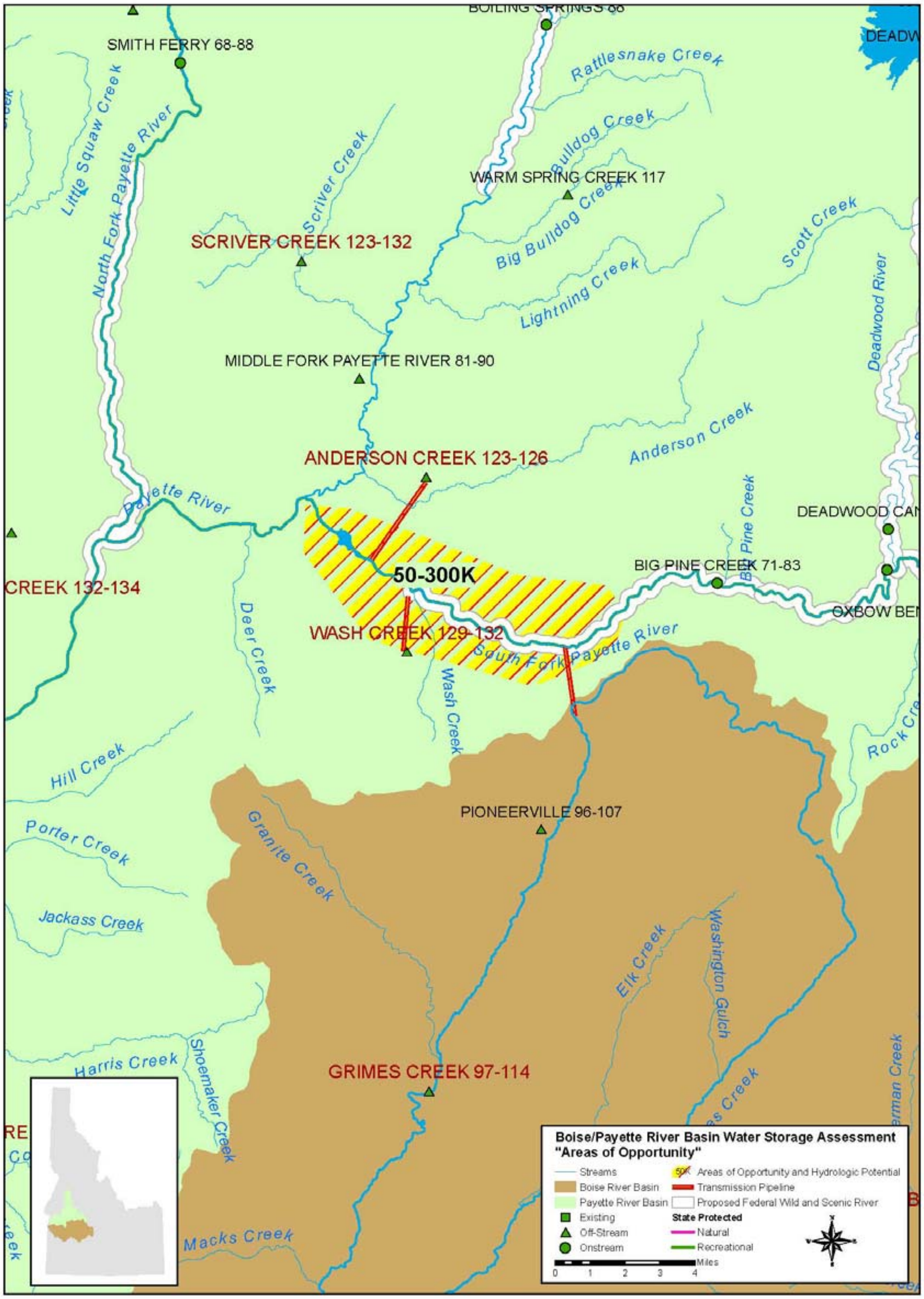

Figure 4-5. Lower South Fork Payette "Area of Opportunity"

4.2.5 Lower North Fork Payette “Area of Opportunity”

- *Figure*. Figure 4-6 shows an enlarged map of this “area of opportunity.”
- *Description*. This area could provide water to potential off-stream storage sites (previously identified sites include Tripod Creek, Schriver Creek, Upper Squaw Creek, and Lower Squaw Creek) 90 percent of the time. These facilities would require a diversion pipeline or tunnel to overcome hydrologic divides. Diversion would occur from the State-designated Recreational River reach, and the lower reach of the “area of opportunity” is coincident with a Federally proposed Wild and Scenic designation. Any development within this reach would need to further analyze impact to special designations.
- *Maximum hydrologic potential*. Results of the MODSIM analysis for the Cabarton site (see Figure 3-4) indicate that 300,000 AF could be stored and delivered reliably 90 percent of the time to water users. Depending on the design and operation of a storage facility, some of this volume could be available for flood control capacity.
- *Feasible uses*. Uses include DCM&I, irrigation, and flow augmentation. Because this area represents intrabasin transfer potential (from the North Fork Payette to Squaw Creek or Scriver Creek/Middle Fork Payette), there may be limited flood control capacity depending on the configuration of an off-stream diversion structure and conveyance. For example, water could be diverted and stored in Upper Squaw Creek during the flood season for release for Snake River flow augmentation in the summer months, and proportionately less flow augmentation water would need to be released from Cascade Reservoir.
- *Cost considerations*. Assessment-level field (direct) construction cost estimates range between $170 to $1,200 million for an off-stream, 300,000-AF reservoir (see Appendix H). Compared to other “areas of opportunity,” higher-end estimates are greater due to the size of pumping facilities that would be necessary for intrabasin transfer.
- *Opportunities/challenges*. This area represents a very flexible combination of off-stream storage, including potentially more effective coordinated management with Cascade Reservoir. In terms of storage on the Squaw Creek drainage, a gravity-driver conveyance pipeline from this reach of the North Fork Payette is much shorter than one identified closer to the confluence with the South Fork Payette (as shown in Mainstem Payette “area of opportunity.”) This area is also close enough for weekend recreational uses; however, capital costs associated with transmission lines/tunnels are expensive.

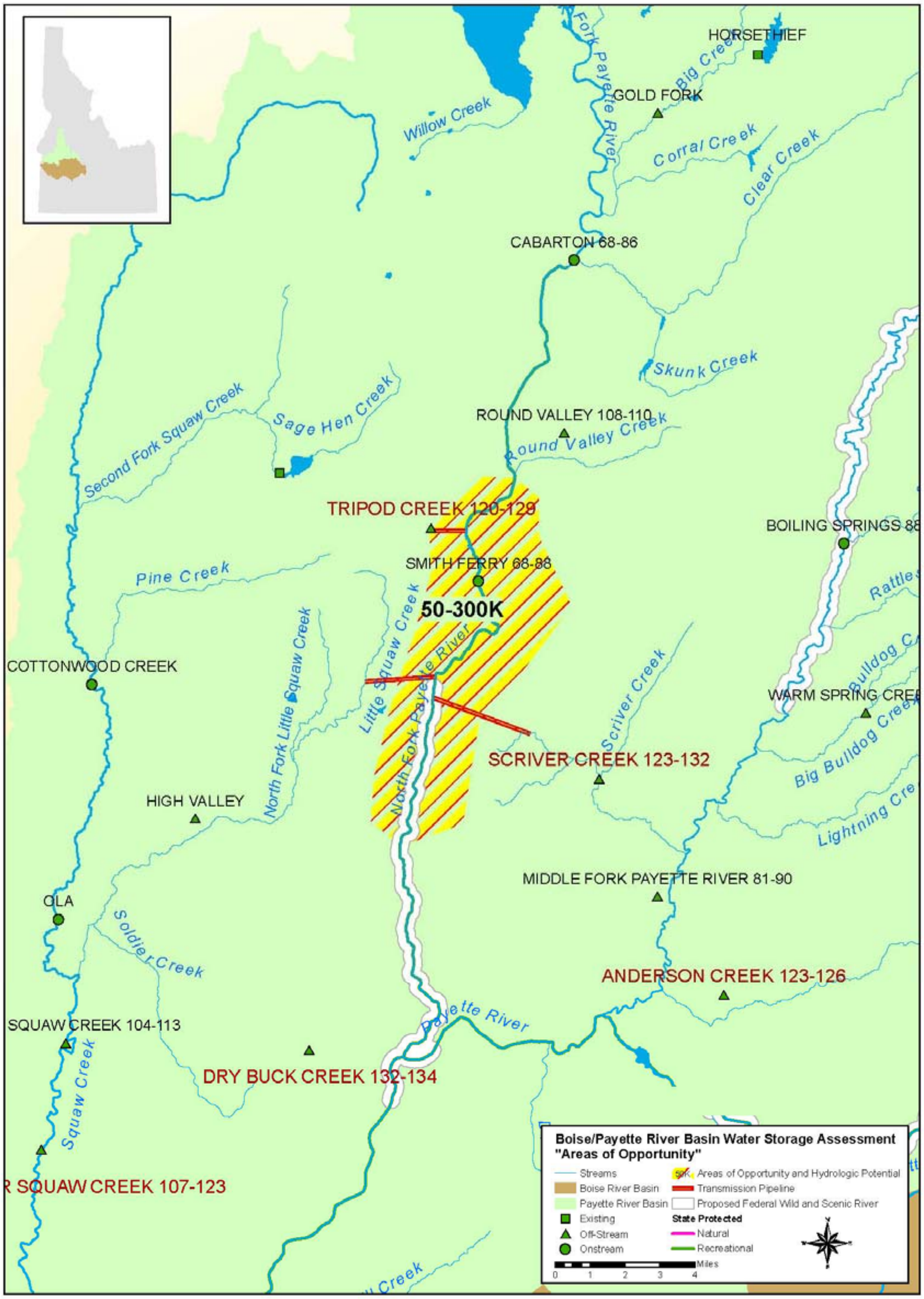

Figure 4-6. Lower North Fork Payette "Area of Opportunity"

4.2.6 Mainstem Payette “Area of Opportunity”

- *Figure*. Figure 4-7 shows an enlarged map of this “area of opportunity.”
- *Description*. Below the confluence of the North Fork and South Fork, this area could provide potential off-stream storage sites within the Payette River basin (previously identified sites include Dry Buck Creek, Lower Squaw Creek, and Upper Shafer Creek). (A transbasin transfer to the Boise River basin might also be possible to previously identified sites such as Firebird, even though the diversion would likely occur downstream from Black Canyon Dam; see Figure 4-8). Any of the facilities would require a diversion pipeline or tunnel to overcome hydrologic divides. Diversion could occur from the State-designated Recreational River reach, but any development within this reach would need to further analyze impacts to special designation.
- *Maximum hydrologic potential*. Results of the MODSIM analysis for the Upper Shafer site (see Figure 3-4) indicate that 300,000 AF could be stored and delivered reliably 90 percent of the time to water users. Depending on how a storage facility is designed and operated, some of this volume could be available for flood control capacity.
- *Feasible uses*. Uses for storage facilities within the Payette River basin include DCM&I, irrigation, and flow augmentation. Because this area represents intrabasin transfer potential (from the Mainstem Payette to Squaw Creek or Shafer Creek), there may be limited flood control capacity depending on the configuration of an off-stream diversion structure and conveyance. For example, water could be diverted and stored in Upper Squaw Creek during the flood season for release for Snake River flow augmentation in the summer months, and proportionately less flow augmentation water would need to be released from Cascade Reservoir. Uses associated with the Firebird site in the Boise River basin are limited to only flow augmentation and potentially limited irrigation, given its location in the watershed.
- *Cost considerations*. Assessment-level field (direct) construction cost estimates range between $170 to $1,200 million for an off-stream, 300,000-AF reservoir (see Appendix H). Compared to other “areas of opportunity,” higher-end estimates are larger because of the size of pumping facilities that would be necessary for intrabasin or transbasin transfers. Detailed information regarding how the costs were developed is contained in Appendix H.
- *Opportunities/challenges*. This area is also close enough for day trip or weekend recreational uses, with high visibility along Highway 55. In terms of storage on the Squaw Creek drainage, a conveyance pipeline from this reach of the Mainstem Payette is much longer than one identified from the North Fork Payette (as shown in the Lower North Fork Payette “area of opportunity.”) Consideration of the operational impact on Black Canyon would be critical and capital costs associated with transmission lines/tunnels are expensive.

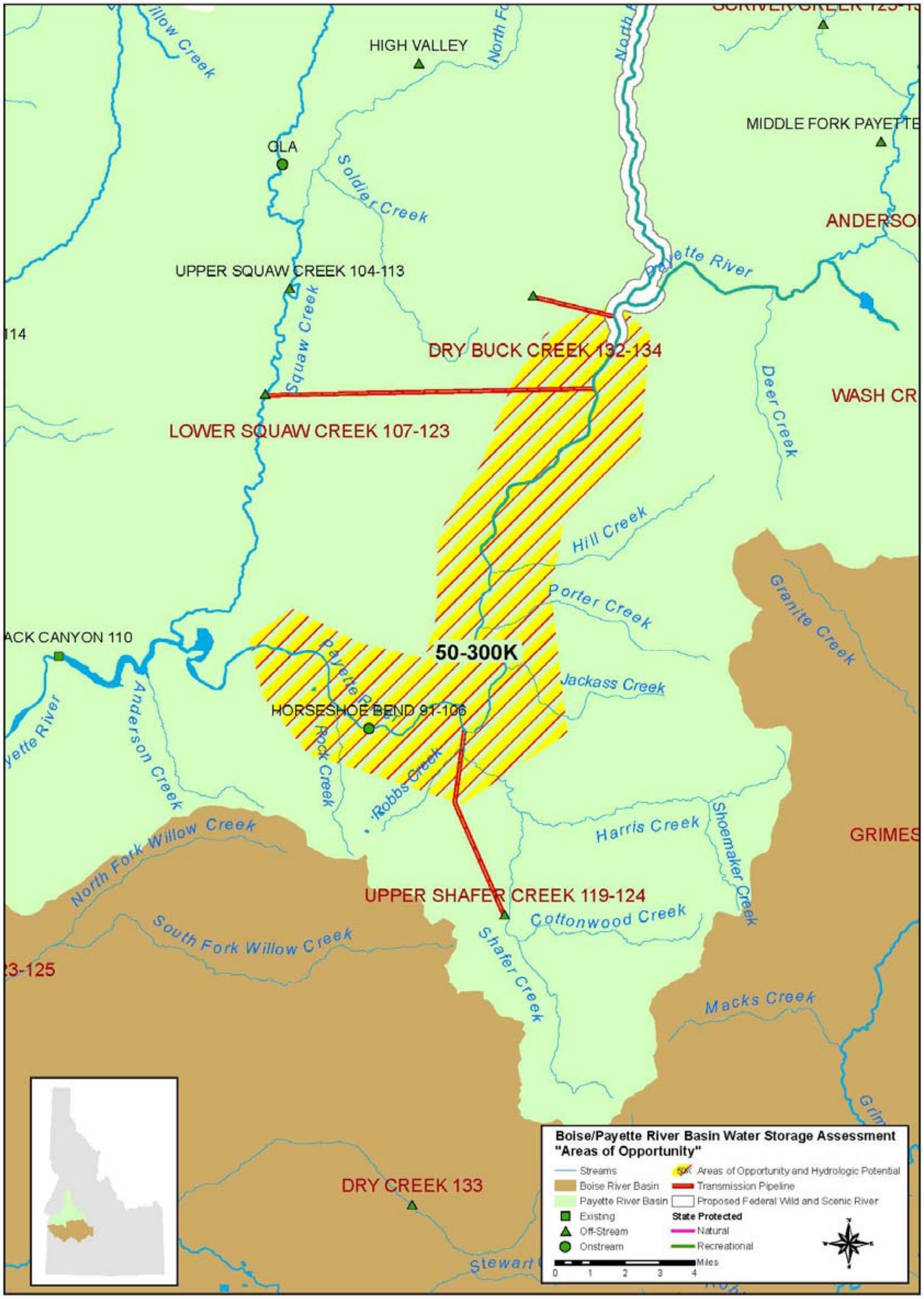

Figure 4-7. Mainstem Payette River "Area of Opportunity"

4.2.7 Lower Payette “Area of Opportunity”

- *Figure*. Figure 4-8 shows an enlarged map of this “area of opportunity.”
- *Description*. Near the mouth of the Payette River, this area could provide potential off-stream storage sites (previously identified sites include Big Willow Creek, Bissel Creek, and Sand Hollow Creek). Off-stream facilities in the Lower Payette River basin may only require a gravity pipeline. There are no State- or Federal-designated reaches within this area that would preclude diversion and/or storage.
- *Maximum hydrologic potential*. Results of the MODSIM analysis for the Upper Shafer and Bissel Creek sites (see Figure 3-4) indicate that 300,000 to 400,000 AF could be stored and delivered reliably 90 percent of the time to water users. Depending on how a storage facility is designed and operated, some of this volume could be available for flood control capacity.
- *Feasible uses*. Uses for storage facilities within the Payette River basin include primarily flow augmentation. For example, water could be diverted and stored in Bissel Creek during the flood season for release for Snake River flow augmentation in the summer months, and proportionately less flow augmentation water would need to be released from Cascade Reservoir. Because this area represents intrabasin transfer potential (from the Mainstem Payette to Big Willow Creek), there may be limited flood control capacity depending on the configuration of an off-stream diversion structure and conveyance. There is little to no use for DCM&I or irrigation water this low in the Payette River basin.
- *Cost considerations*. Assessment-level field (direct) construction cost estimates range between $140 to $450 million for an off-stream, 300,000-AF reservoir (see Appendix H). Compared to other “areas of opportunity,” higher-end estimates are less costly because of the smaller size of pumping facilities that would be necessary for an intrabasin transfer and the relative proximity of an off-stream facility to a potential diversion point. Detailed information regarding how the costs were developed is contained in Appendix H.
- *Opportunities/challenges*. This area is also close enough for day trip or weekend recreational uses. Consideration of the operational impact on Black Canyon would be critical.

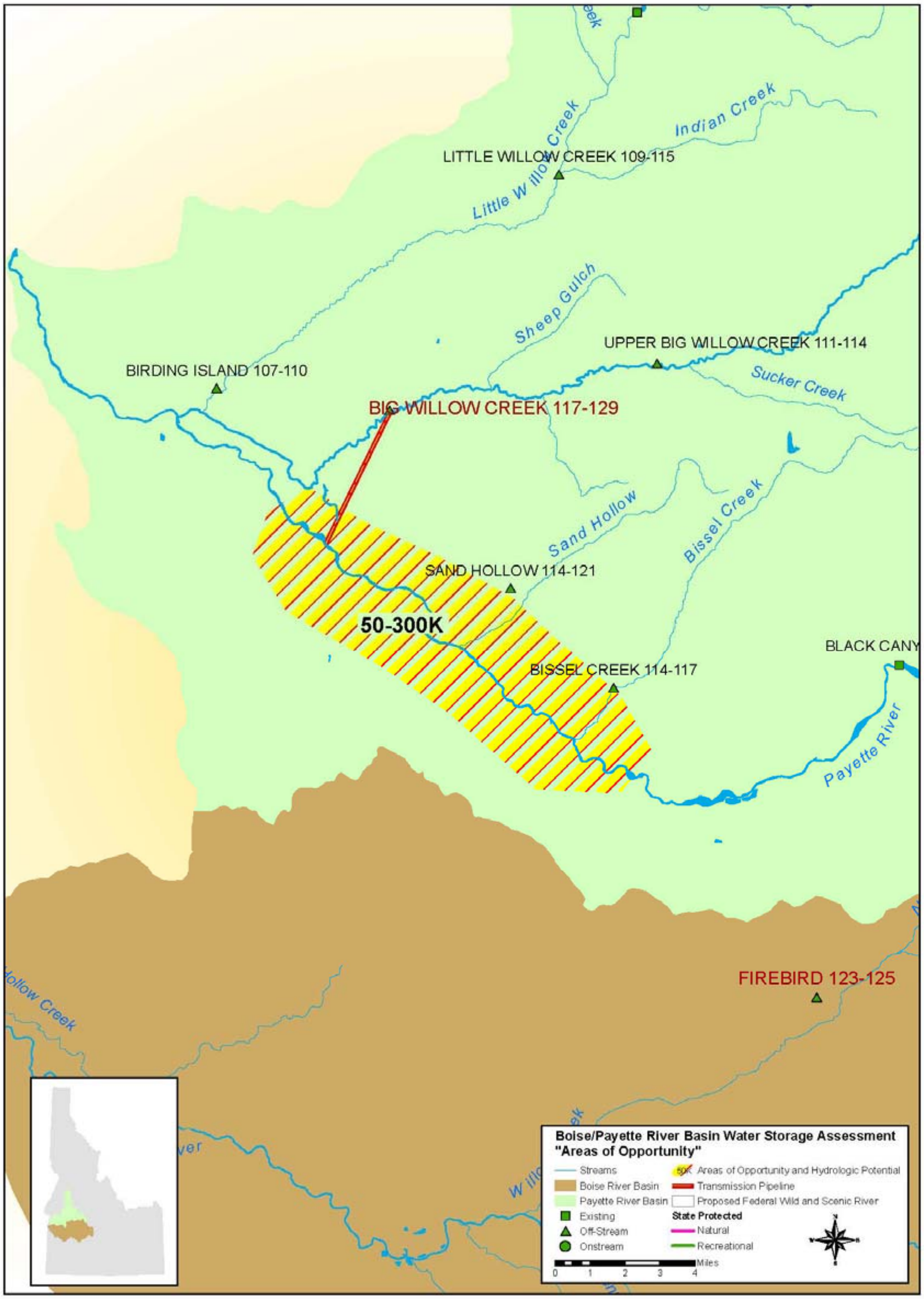

Figure 4-8. Lower Payette River "Area of Opportunity"

4.2.8 Cascade Reservoir "Area of Opportunity"

- *Figure*. Figure 4-9 shows an enlarged map of this retrofit "area of opportunity."
- *Description*. Reclamation (2005b) and others have identified potentially dredging sediments in Cascade Reservoir as another option to create more active capacity. This would not have any effect on the reservoir footprint, and there are no State- or Federal-designated reaches that would be affected.
- *Maximum hydrologic potential*. Dredging approximately 50,000 AF of sediments to create that much additional active storage capacity has been discussed.
- *Feasible uses*. Retrofitting existing facilities meets all uses, including DCM&I, irrigation, flood control capacity, and flow augmentation.
- *Cost considerations.* Costs associated with Cascade Reservoir sediment dredging have not been estimated.
- *Opportunities/challenges*. Retrofitting might allow for an easier permitting process, and certainly the infrastructure is in place to manage increased flat-water recreational benefits. Impacts on in-reservoir resources (aquatic and recreational) would need to be considered carefully.

4.3 Summary of Recommendations

The "areas of opportunity" approach represents a flexible, yet technically defensible, framework for further analysis. The eight "areas of opportunity" each contain several of the most promising sites and represent a starting point to focus on for future analysis. Next steps are discussed in the following chapter for the identified "areas of opportunity."

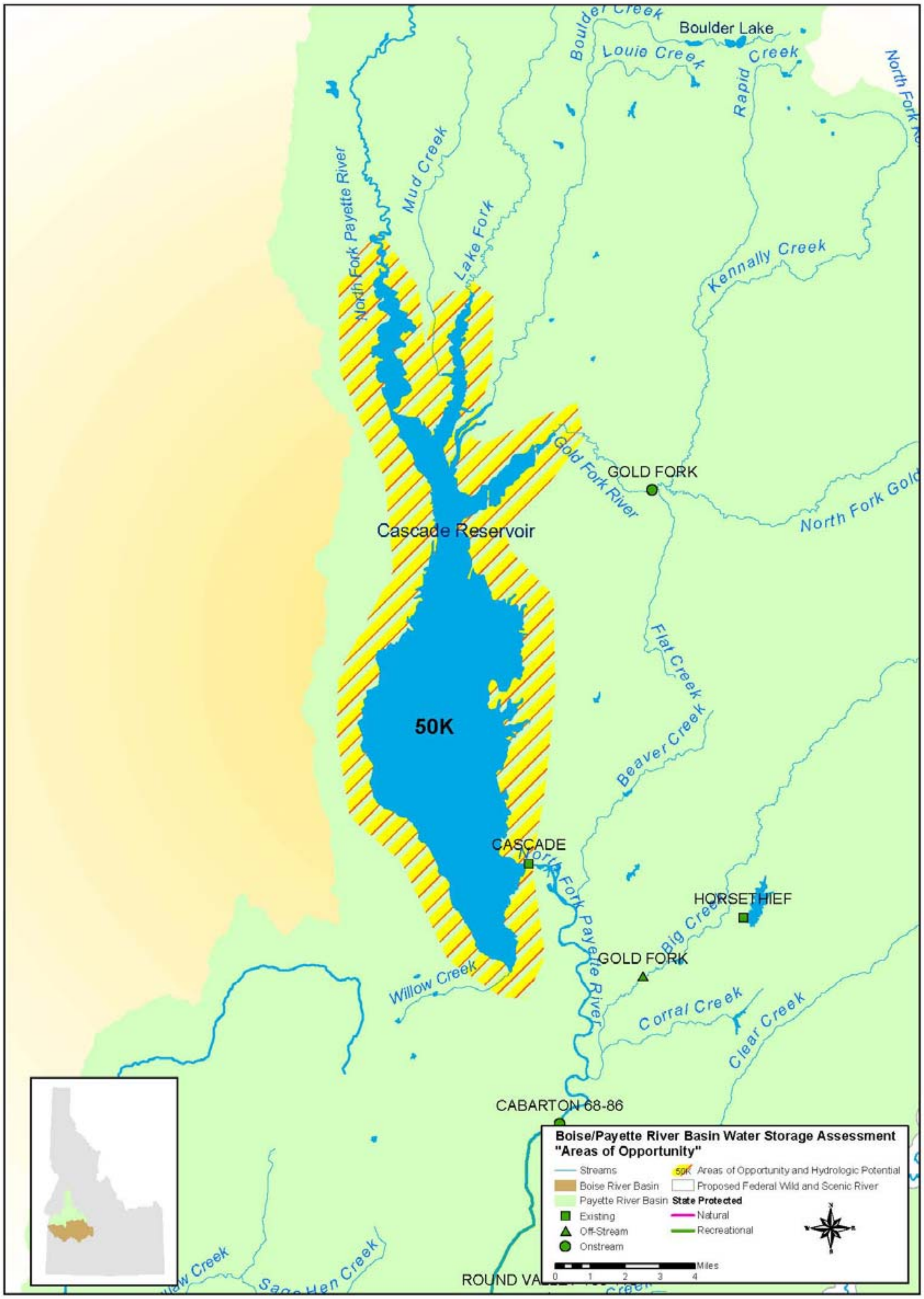

Figure 4-9. Cascade Reservoir “Area of Opportunity”

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5. Next Steps in the Federal Water Resource Planning Process

This report completes the assessment of storage opportunities in the Boise and Payette River basins. To increase or enhance water storage capabilities to meet future demands, this assessment process used existing information to narrow down 200+ previously identified storage sites to eight promising “areas of opportunity.” These “areas of opportunity” do the best job at maximizing storage potential while minimizing environmental and socio-economic impacts. If future storage projects are to be pursued, these “areas of opportunity” represent the most viable areas for further evaluation.

The Federal objective of water and related land resource project planning is to contribute to the national economic development consistent with protecting the Nation’s environment pursuant to national and environmental statutes. The next step in the Federal planning process for a water storage project typically includes a more in-depth analysis of identified opportunities (in this case, the identified “areas of opportunity”). This analysis is called an appraisal study, and it assists in determining if there is a viable solution with a reasonable Federal role.

An appraisal study includes an in-depth inventory of water and land resources in a chosen “area of opportunity;” the formulation of alternative plans; the evaluation of the effects of the alternatives; a comparison of alternatives; and the selection of a recommended action based on the comparison of alternatives. An appraisal study can be conducted under the general authority provided by the Reclamation Act of 1902. Local and State support must be clearly present in the form of agreements and cost share commitments.

If the appraisal study recommends a viable solution with a Federal role, that alternative could be evaluated at the next step, which is a feasibility study. Feasibility studies typically integrate constructability with compliance under a number of legislative and regulatory constraints, such as the National Environmental Policy Act (NFPA), USFWS Coordination Act, ESA, Nation Historic Preservation Act, and other related executive orders, environmental, and cultural resource laws.

Feasibility studies cannot be initiated until specifically authorized by Congress and require a 50 percent cost share from future beneficiaries of the project. Reclamation recognizes that given the necessary involvement of Congress in authorizing the project and necessary partnerships for funding future phases of this work, broad-based stakeholder support is required. Figure 5-1 presents the Federal planning process so that stakeholders better understand these next steps.

Federal water resource planning should be responsive to State and local concerns and should provide the opportunity for State and local agencies to participate in the planning process. It is recognized that water projects that are local, regional, State, or even interstate in scope do not necessarily need to have a large Federal role. State and local entities are free to initiate planning and implementation of water projects without Federal participation.

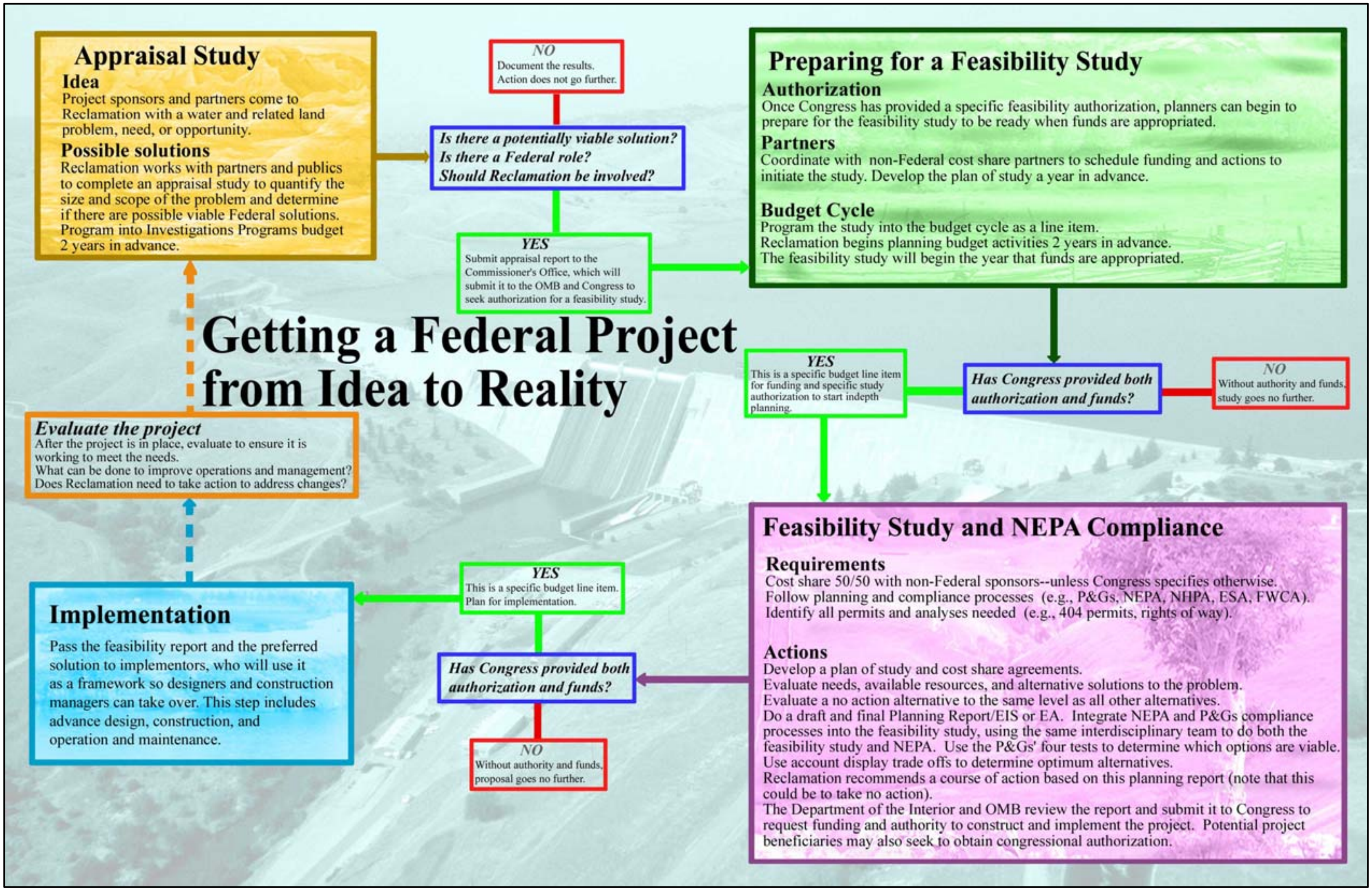

Figure 5-1. Federal Water Resources Planning Process
Source: Reclamation

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Appendices (contained on attached CD)

A Stakeholder Working Group Participants
B Stakeholder Working Group Meeting Agendas, Materials, Summary Notes
C Regional Conservation Analysis
D Literature Review Report
E MODSIM Model Set-up, Assumptions, and Sensitivity Analysis
F Stakeholder Working Group Relative Importance Value Input
G Summary of Ranking Constraint Criteria
H Development of Construction Costs
I Definitions
J Land Uses for Selected Potential Candidate Sites