Final Great Salt Lake Mineral Leasing Plan and Record of Decision

Utah Department of Natural Resources
Division of Forestry, Fire & State Lands

SWCA
ENVIRONMENTAL CONSULTANTS

March 2013

RECORD OF DECISION

STATE OF UTAH DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FORESTRY, FIRE AND STATE LANDS

RECORD OF DECISION
GREAT SALT LAKE MINERAL LEASING PLAN
RECORD NUMBER: 13-0315-2

Date of Execution: March 27, 2013

INTRODUCTION

Pursuant to UTAH CODE §§ 65A-2-2 and 65A-2-4 and the implementing regulations of Utah Administrative Code (UTAH ADMIN. CODE) R652-90, the Division of Forestry, Fire and State Lands (FFSL or division) is empowered to prepare and adopt management plans for sovereign lands and resources. Given this direction, FFSL initiated the Great Salt Lake (GSL) Mineral Leasing Plan (MLP) revision process with interagency cooperation and collaboration, and open public participation. For the duration of the planning process, a withdrawal was ordered on the lakebed from new mineral leasing until the completion of the resource management plan. Existing leases were allowed to be renewed or extended in accordance with UTAH ADMIN. CODE R652-90-700.

The primary purpose of the GSL MLP is to guide FFSL, along with other local, state, and federal partners, in managing, allocating, and appropriately using GSL's mineral resources. The GSL MLP sets forth guidance and direction for future mineral resource management activities on GSL.

In compliance with policy, procedures, rules, and statutes for resource management planning, FFSL has completed the mineral resource management plan for the subject site. Therefore, FFSL issues this Record of Decision for the GSL MLP.

DESCRIPTION OF LANDS DIRECTLY AFFECTED

The planning unit area encompasses those sovereign lands below the surveyed meander line of GSL (an elevation range of 4,202–4,212 feet above sea level), located in Box Elder, Weber County, Davis, Salt Lake, and Tooele counties. The lands below the meander line are represented as owned by the State of Utah. Some of the sovereign land boundaries have not been settled, but the visions, goals, policies, and objectives in the GSL MLP will apply to those lands that are judged to be sovereign lands.

PROPOSED ACTION

The Proposed Action associated with this Record of Decision is the adoption and implementation of the 2013 GSL MLP.

RELEVANT FACTUAL BACKGROUND

The GSL MLP revision process began in March 2010. FFSL initiated the revision to update the 16-year-old management plan, to assess the current conditions of GSL at low levels (4,193.6 feet in the fall of 2010), and to incorporate research on the lake that had been completed in the last 10 years. In addition to the GSL MLP revision, FFSL concurrently updated the GSL Comprehensive Management Plan (CMP). Through a rigorous competitive process, SWCA Environmental Consultants (SWCA) was hired to facilitate the development of both the 2013 GSL MLP and CMP.

As part of the GSL CMP and MLP revision, FFSL convened the GSL Planning Team comprising representatives from Utah Department of Natural Resources and Utah Department of Environmental Quality to provide input and support throughout the revision process. Throughout the process, the GSL Planning Team represented the long-term collaborative approach necessary to holistically manage the complex GSL ecosystem. The purposes of the GSL Planning Team were to

- provide resource-specific guidance throughout the planning process;
- provide the most recent, relevant research and data pertaining to GSL;
- provide timely review and comment on the document throughout the revision process; and
- offer project updates, milestones, and opportunities for comment to State of Utah agencies and the general public.

The GSL MLP planning process was designed to achieve a cumulative and linear development of visions, goals, and management direction and to encourage public participation throughout the process. The planning process is illustrated in Figure 1.

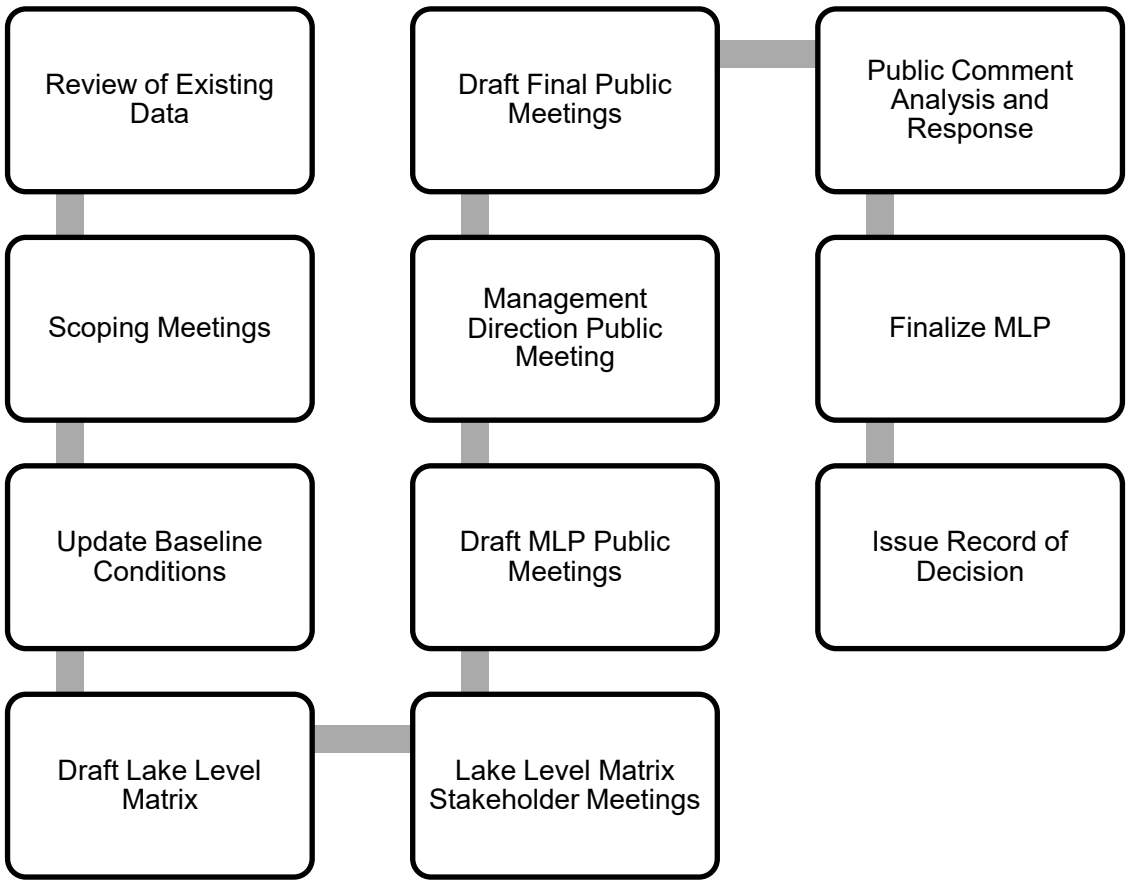

Figure 1. Great Salt Lake Mineral Leasing Plan planning process.

PUBLIC INVOLVEMENT

The GSL MLP revision comprised a two-year public involvement process. FFSL submitted a notice of intent to initiate the GSL MLP revision process to the Resource Development Coordinating Committee (RDCC) in March 2010. Following that submittal, FFSL and SWCA conducted three rounds of public involvement meetings: 1) at scoping, 2) at the release of the draft GSL MLP, and 3) at the release of the final GSL MLP. During the development of the GSL Lake Level Matrix (developed specifically for the CMP but then applied to the MLP) and CMP Lake Level–Specific Management Strategies, FFSL held two rounds of stakeholder meetings to get feedback on a range of resource-specific lake level impacts. A summary of the GSL CMP and MLP public involvement opportunities is provided below.

1. In August 2010, FFSL and SWCA conducted one scoping meeting in each of the five affected counties to solicit public and agency concerns and comments (Table 1).

Table 1. *Scoping Meeting Dates, Times, and Locations*

Date	Time	City, State	Address
August 10, 2010	10:00 a.m.–1:00 p.m.	Ogden, Utah	2380 Washington Blvd
August 17, 2010	10:00 a.m.–1:00 p.m.	Farmington, Utah	28 East State Street
August 17, 2010	4:00–7:00 p.m.	Salt Lake City, Utah	2001 South State Street
August 24, 2010	3:00–6:00 p.m.	Tooele, Utah	47 South Main Street
August 31, 2010	9:00 a.m.–Noon	Brigham City, Utah	01 South Main Street

2. In May 2011, FFSL and SWCA conducted one public meeting in each of the five counties that surround GSL to solicit public and agency feedback on the draft GSL MLP (Table 2).

Table 2. *Draft Great Salt Lake Comprehensive Management Plan and Mineral Leasing Plan Meeting Dates, Times, and Locations*

Date	Time	City, State	Address
May 12, 2011	6:00–8:00 p.m.	Brigham City, Utah	01 South Main Street
May 17, 2011	6:00–8:00 p.m.	Ogden, Utah	2380 Washington Blvd.
May 18, 2011	6:00–8:00 p.m.	Farmington, Utah	28 East State Street
May 19, 2011	6:00–8:00 p.m.	Tooele, Utah	47 South Main Street
May 24, 2011	6:00–8:00 p.m.	Salt Lake City, Utah	1594 West North Temple

3. In March 2012, FFSL and SWCA conducted one public meeting in each of the five counties that surround the GSL to solicit public and agency feedback on the draft final GSL MLP (Table 3).

Table 3. *Draft Final Great Salt Lake Comprehensive Management Plan and Mineral Leasing Plan Meeting Dates, Times, and Locations*

Date	Time	City, State	Address
March 20, 2012	6:00–8:00 p.m.	Clearfield, Utah	562 South 1000 East
March 21, 2012	6:00–8:00 p.m.	Tooele, Utah	47 South Main Street
March 22, 2012	6:00–8:00 p.m.	Salt Lake City, Utah	1575 West 1000 North
March 27, 2012	6:00–8:00 p.m.	Brigham City, Utah	26 East Forest Street
March 28, 2012	6:00–8:00 p.m.	Ogden, Utah	2464 Jefferson Avenue

Meeting Design

The public involvement meetings combined formal presentation and open house formats. At each meeting, SWCA's project manager provided a brief project overview or presentation. Following this informational session, an open house meeting was conducted in a meeting space within the same building. Attendees were greeted and asked to sign in, as well as informed about the meeting format and given the option of taking a business card with the project website and contact information and/or a

scoping comment form. Attendees were informed about ways to submit comments and encouraged to ask questions of SWCA's public involvement staff and resource specialists from the GSL Planning Team.

Informational display boards were also arranged around the meeting room to provide the following background information:

- Explanation of the plan revision process and the general timeline and sequence of events
- Description of the general need for a plan revision and responsible entities
- Definition of sovereign lands, public trust, and multiple-use/sustainable yield
- Map and list of potential resource issues
- Opportunities for public comment and a description of available comment methods
- Description of the mineral leasing process
- Lake Level Matrix

Meeting Advertising

Pursuant to FFSL requirements, public involvement meetings were advertised in a variety of formats (Table 4) prior to their scheduled dates. In each format, the advertisements provided logistics, explained the purpose of the scoping meetings, gave the schedule for the public and agency comment period, outlined additional ways to comment, and provided methods of obtaining additional information.

Table 4. *Advertising of Public Meetings*

Media Notices and Other Forms of Advertising
Media notice releases for the scoping period were emailed on July 30, 2010, to the following: • *Davis County Clipper* • *Box Elder News Journal* • *Deseret News* • *Ogden Standard-Examiner* • *Salt Lake Tribune* • *Tooele Transcript-Bulletin* • *The Leader*
Media notice releases for the draft GSL MLP were emailed on April 19, 2011, to the following: • *Davis County Clipper* • *Box Elder News Journal* • *Deseret News* • *Ogden Standard-Examiner* • *Salt Lake Tribune* • *Tooele Transcript-Bulletin* • *The Leader*
Media notice releases for the draft final GSL MLP were emailed on March 7, 2012, to the following: • *Davis County Clipper* • *Box Elder News Journal* • *Deseret News* • *Ogden Standard-Examiner* • *Salt Lake Tribune* • *Tooele Transcript-Bulletin* • *The Leader*
Meeting information was posted on the project website, www.gslplanning.utah.gov on July 30, 2010.
The draft GSL MLP was posted on the project website, www.gslplanning.utah.gov on May 2, 2011.
The final GSL MLP was posted on the project website, www.gslplanning.utah.gov on March 7, 2012.

Table 4. *Advertising of Public Meetings*

Postcards and Other Invitations
Postcards announcing the scoping meetings were sent to those on the mailing list on August 2, 2010 The GLS CMP/MLP Mailing List (Exhibit A) included the following: • UDNR staff identified as having an interest in the project • Prior and current GSL Planning Team members • Nongovernmental organizations identified as having a possible interest in the project • Local and state agencies identified as having jurisdictional authority in the project • Residents who had attended prior plan meetings • Members of the general public who signed up for updates via the project website • Members of the press • All landowners adjacent to the meander line within the affected counties
A meeting invitation was emailed to those on the project mailing list for whom email addresses were provided or were obtainable on August 2, 2010.
A scoping meeting announcement was posted on the following listserves: • GSL Technical Team • Jordan River Watershed Council • South Shore Cooperative Weed Management Area
A project poster was displayed at the FRIENDS of GSL Issues Forum April 28–30, 2010.
A meeting invitation was emailed to the 416 individuals on the project mailing list for whom email addresses were provided or were obtainable as of April 19, 2011.
Postcards announcing the meetings were sent to the 567 individuals on the project mailing list for whom mailing addresses were provided or were obtainable as of April 19, 2011. These comprise the following: • UDNR staff identified as having an interest in the project • Prior and current GSL Planning Team members • Nongovernmental organizations identified as having a possible interest in the project • Local and state agencies identified as having jurisdictional authority in the project • Residents who had attended prior plan meetings • Members of the general public who signed up for updates via the project website • Members of the press • All landowners adjacent to the meander line within the affected counties
A meeting invitation was emailed to the 416 individuals on the project mailing list for whom email addresses were provided or were obtainable as of March 7, 2012.
Postcards announcing the meetings were sent to the 638 individuals on the project mailing list for whom mailing addresses were provided or were obtainable as of March 7, 2012. These comprise the following: • UDNR staff identified as having an interest in the project • Prior and current GSL Planning Team members • Nongovernmental organizations identified as having a possible interest in the project • Local and state agencies identified as having jurisdictional authority in the project • Residents who had attended prior plan meetings • Members of the general public who signed up for updates via the project website • Members of the press • All landowners adjacent to the meander line within the affected counties

Stakeholder Meetings

During the revision process, two rounds of stakeholder meetings also took place (one in January 2011 and one in November 2011). The stakeholders invited to the meeting consisted of industry, recreation, and environmental advocacy groups. The GSL Planning Team members were also invited to the stakeholder meetings. The objective of the first stakeholder meeting was to preview and gather comment on the GSL Lake Level Matrix. The objective of the second meeting was to preview and comment on the draft management strategies. The comments gathered at the stakeholder meetings were incorporated into the document, as appropriate. A summary of the public meetings held to date is provided in Table 5.

Table 5. *Meeting Dates, Times, and Locations*

Date	Time	City, State	Address
January 4, 2011	2:00–4:00 p.m.	Salt Lake City, Utah	SWCA, 257 East 200 South
January 6, 2011	2:00–4:00 p.m.	Salt Lake City, Utah	SWCA, 257 East 200 South
November 1, 2011	10:00 a.m.–Noon	Salt Lake City, Utah	SWCA, 257 East 200 South
November 3, 2011	1:00–3:00 p.m.	Salt Lake City, Utah	SWCA, 257 East 200 South

PUBLIC TRUST

FFSL acknowledges its responsibility to the Public Trust and obligation to multiple-use, sustained yield management. FFSL will manage GSL and its resources under multiple-use, sustained yield principles (UTAH CODE § 65A-2-1) by implementing legislative policies (UTAH CODE § 65A-10-8) and accommodating public and private uses to the extent that those policies and uses do not substantially impair Public Trust resources and or the lake's sustainability.

The 2013 GSL MLP was designed to facilitate FFSL's management of GSL's mineral resources under multiple-use, sustained-yield principles, as stated in UTAH CODE § 65A-2-1. In particular, the management direction outlines how FFSL will promote a sustained yield of GSL resources.

INTERAGENCY COORDINATION

As part of the GSL CMP and MLP planning processes, FFSL recognized the importance of maintaining the communication that was occurring with the implementation of the GSL CMP Planning Team. Cross-agency coordination and communication are required because GSL resources are complex and because multiple government agencies are involved with various aspects of GSL. As required in UTAH CODE § 65A-2-2, FFSL is interested in maintaining support across state agencies as it implements the 2013 GSL CMP and MLP. The planning process for the management plans has highlighted the need for increased ongoing interagency coordination. Section 5.2 of the MLP encourages communication between FFSL and other GSL managers, researchers, and agencies responsible for permitting. The overarching management direction outlined in Section 5 of the MLP encourages numerous opportunities for coordination with respect to GSL resources, a fundamental responsibility of FFSL according to UTAH CODE § 65A-10-8(9). Further, the revised GSL CMP specifically outlines FFSL's strategy for communication between agencies in the Coordination Framework chapter of the document.

PUBLIC INVOLVEMENT: NOTIFICATION, COMMENT, AND REVIEW

Public involvement was essential to the GSL MLP planning process. As illustrated in the Public Involvement section above, there were numerous opportunities for the public to play a role in the revision of the GSL MLP. FFSL began the planning process with a notification to RDCC in March 2010 on the Project Management System website for 30 days (Exhibit B). Notifications of each GSL MLP draft were also noticed to RDCC. State, federal, local governments, and stakeholders were notified numerous times throughout the planning process, requesting attendance at public meetings and comment response. Notification for each round of public meetings and the announcement of this ROD was sent to interested parties by postcard to 567 addresses and 416 email addresses (Exhibit A). Fifteen public meetings and four stakeholder meetings were held throughout the planning process. A public comment period followed each public and stakeholder meeting; each comment period was 30 days, except the final comment period, which was 75 days. Comments were accepted by comment response forms at public meetings, project website, email, and postal mail.

Public comments received throughout the planning process were numerous. FFSL received 225 public comment submissions on the draft final GSL CMP and MLP. From the 225 comment letters, 1,211 individual comments were extracted for review of acceptance or non-acceptance, as required by statute (UTAH CODE 65-A-2-4). Comments for each phase of the planning process were acknowledged and addressed, as appropriate, by FFSL. FFSL used the substantive, technical and editorial comments to fortify the document throughout the planning process. Comments regarding the GSL Minerals Environmental Impact Statement were accepted by FFSL during the process but were acknowledged as out of scope to the MLP and CMP revision process. The comment responses for the final MLP and CMP are provided in the final GSL CMP (Appendix B).

CONSTITUTIONAL PROVISIONS, STATUTES, AND ADMINISTRATIVE RULES

Utah Constitution Article XX, Section 1

> All lands of the state that have been, or may hereafter be granted to the State by Congress, and all lands acquired by gift, grant or devise, from any person or corporation, or that may otherwise be acquired, are hereby accepted, and … are declared to be the public land of the State; and shall be held in trust for the people, to be disposed of as may be provided by law, for the respective purposes for which they have been of may be granted, devised or otherwise acquired.

UTAH CODE § 65A-2-1. Administration of state lands - Multiple-use sustained yield management.

> The Division shall administer state lands under comprehensive land management programs using multiple-use sustained yield principles.

UTAH CODE § 65A-2-2. State land management planning procedures for natural and cultural resources - Assistance from other state agencies- Division action.

> The Division:
>
> (1) shall develop planning procedures for natural and cultural resources on state lands; and
>
> (2) may request other state agencies to generate technical data or other management support services for the development and implementation of state land management plans.

UTAH CODE § 65A-2-4. State land management plans -- Division to adopt rules for notifying and consulting with interested parties.

(1) The division shall adopt rules for notifying and consulting with interested parties including the general public, resources users, and federal, state, and local agencies on state land management plans.

(2) Division rules shall provide:

(a) for reasonable notice and comment periods; and

(b) that the division respond to all commenting parties and give the rationale for the acceptance or nonacceptance of the comments.

UTAH CODE § 65A-10-1. Authority of division to manage sovereign lands.

(1) The division is the management authority for sovereign lands, and may exchange, sell, or lease sovereign lands but only in the quantities and for the purposes as serve the public interest and do not interfere with the public trust.

UTAH ADMIN. CODE R652-70-200. Classifications of Sovereign Lands.

Sovereign lands may be classified based upon their current and planned uses. A synopsis of some possible classes and an example of each class follows. For more detailed information, consult the management plan for the area in question.

1. Class 1: Manage to protect existing resource development uses. The Utah State Park Marinas on Bear Lake and on Great Salt Lake are areas where the current use emphasizes development.

2. Class 2: Manage to protect potential resource development options. For example, areas adjacent to Class 1 areas which have the potential to be developed.

3. Class 3: Manage as open for consideration of any use. This might include areas which do not currently show development potential but which are not now, or in the foreseeable future, needed to protect or preserve the resources.

4. Class 4: Manage for resource inventory and analysis. This is a temporary classification which allows the division to gather the necessary resource information to make a responsible classification decision.

5. Class 5: Manage to protect potential resource preservation options. Sensitive areas of wildlife habitat may fall into this class.

6. Class 6: Manage to protect existing resource preservation uses. Cisco Beach on Bear Lake is an example of an area where the resource is currently being protected.

UTAH ADMIN. CODE R652-90-300. Initiation of Planning Process.

2. Resource Management planning is initiated by the division's identification and determination that there is a need for such a plan.

UTAH ADMIN. CODE R652-90-500. Notification and Public Comment.

3. Notice that a site-specific or resource planning effort is under way shall be given to:

(a) Affected parties as required by rule for exchange, or lease;

(b) The Governor’s Office of Planning and Budget for inclusion in the RDCC Project Management System for public and agency notification and comment.

UTAH ADMIN. CODE R652-90-600. Public Review.

2. Resource plans shall be published and made available upon request.

(a) Persons wishing to comment on these plans may do so at any time.

(b) The division shall acknowledge all written comments.

FINDINGS OF FACT

1. As described herein, FFSL notified the public and local, federal, and state agencies, including the RDCC, of the GSL MLP planning effort.
2. As described herein, FFSL conducted public meetings in conjunction with the GSL MLP planning effort.
3. As described herein, FFSL published a draft of the GSL MLP and accepted comments from the public and other government entities and responded to comments properly submitted.

CONCLUSIONS OF LAW

1. FFSL properly initiated the planning process for a resource management plan by designating the planning unit and planning priorities established by FFSL.
2. FFSL fulfilled its notification requirements to the lessees, to local governments, and to the RDCC when the project was initiated. FFSL went beyond its required notification by also notifying upland landowners and stakeholders.
3. The notification requirements for the public meetings have been met or exceeded.
4. The public review requirements have been met or exceeded.
5. FFSL properly responded to comments received in compliance with the applicable law.
6. The GSL MLP fulfills the requirements of applicable statutes, rules, policies, and legal doctrines.
7. The planning process and subsequent GSL MLP complies with the legal requirements for a resource management plan.

DECISION AND ORDER

Based on the foregoing, FFSL hereby adopts the GSL MLP, which satisfies the requirements of applicable statutes, rules, and policies. The GSL MLP becomes the resource management plan that guides mineral leasing on the sovereign lands within the planning unit. The GSL MLP supersedes any and all previous management plans—adopted, draft, or otherwise—and represents the official position of FFSL.

DATED this _27_ day of March 2013.

ADMINISTRATIVE APPEALS

Parties having an interest in this action may file a petition for administrative review by the division pursuant to R652-9. Said petition must be in writing and shall contain

1. the statute, rule or policy with which the division action is alleged to be inconsistent;
2. the nature of the inconsistency of the division action with the statute, rule or policy;
3. the action the petitioner feels would be consistent under the circumstances with statute, rule or policy; and
4. the injury realized by the party that is specific to the party arising from division action. If the injury identified by the petition is not peculiar to the petitioner as a result of the division action, the director will decline to undertake consistency review.

Said petition must be received by the division by 5:00 p.m. on April 22, 2013.

APPROVED BY:

RICHARD J. BUEHLER, DIRECTOR

DATE: 3/27/2013

PREPARED BY:

LAURA VERNON,
SOVEREIGN LANDS PLANNER

DATE: 3/25/2013

REVIEWED BY:

LAURA AULT,
SOVEREIGN LANDS PROGRAM MANAGER

DATE: 3/27/2013

REVIEWED BY:

FREDRIC J. DONALDSON,
ASSISTANT ATTORNEY GENERAL

DATE: 3/25/2013

EXHIBITS

Exhibit A. Notice to Interested Parties (GSL CMP Mailing List)
Exhibit B. Resource Development Coordinating Committee (RDCC) Documentation

Exhibit A. Notice to Interested Parties (GSL CMP Mailing List)

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Exhibit B. Resource Development Coordinating Committee (RDCC) Documentation

View Project

http://rdcc.utah.gov/plpco/public/viewProject.action?projectId=23804[3/15/2013 3:19:43 PM]

STATE ACTIONS
Resource Development Coordinating Committee
Public Lands Policy Coordination Office
5110 State Office Building
SLC, UT 84114
Phone No. 537-9230

1. State Agency Division of Forestry, Fire and State Lands 1594 West North Temple Box 145703 Salt Lake City, Utah 84114-5703	**2. Approximate date project will start:** Spring 2010

3. Title of proposed action:
Great Salt Lake Comprehensive Management Plan - Scoping

4. Description of Project:
The Division of Forestry, Fire and State Lands in conjunction with a number of other partners, stakeholders, lessees, agencies, and other interested parties will be beginning the planning process to review and revise if necessary the Great Salt Lake Comprehensive Management Plan. The Division is looking for issues and concerns that we should be reviewing within the context of the Great Salt Lake that would contribute to the planning process. The final plan will incorporate the Mineral Leasing Plan into the Comprehensive Plan so that the mineral resources are dealt with the other uses.

5. Location and detailed map of land affected (site location map required, electronic GIS map preferred) (include UTM coordinates where possible) **(indicate county)**
Counties involved: Box Elder, Weber, Davis, Salt Lake, and Tooele
UTM coordinates: Easting: 374646 meters; Northing 4548852 meters UTM

6. Possible significant impacts likely to occur:
None. This is a planning process – no specific projects will be approved.

7. Identify local government affected
- **a. Has the government been contacted?** Yes.
- **b. When?** With this notice.
- **c. What was the response?** None yet.
- **d. If no response, how is the local government(s) likely to be impacted?** Involved, but no impacts.

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8. For acquisitions of land or interests in land by DWR or State Parks please identify state representative and state senator for the project area. Name and phone number of state representative, state senator near project site, if applicable: **a. Has the representative and senator been contacted?** N/A **9. Areawide clearinghouse(s) receiving state action: (to be sent out by agency in block 1)** Bear River Association of Governments Wasatch Front Regional Council Box Elder County Commission Weber County Commission Tooele County Commission Salt Lake County Commission Davis County Commission

10. For further information, contact:	**11. Signature and title of authorized officer**
Dave Grierson Planner/Sovereign Lands Coordinator davegrierson@utah.gov **Phone:** 801 538 5504	/s/ Dave Grierson Sovereign Lands Coordinator **Date:** 03 Mar 10

INSTRUCTIONS

Whenever a State agency proposes or is administratively responsible for an action not exempted, it shall complete a State Action form and forward one copy to the Public Lands Policy Coordination Office and the affected areawide clearinghouse(s).

Questions encountered with the areawide clearinghouse review should be directed to the areawide clearinghouse. The Public Lands Policy Coordination Office will wait for the affected areawide clearinghouse(s) to complete their review before issuing a final clearance to the originator on this STATE ACTION.

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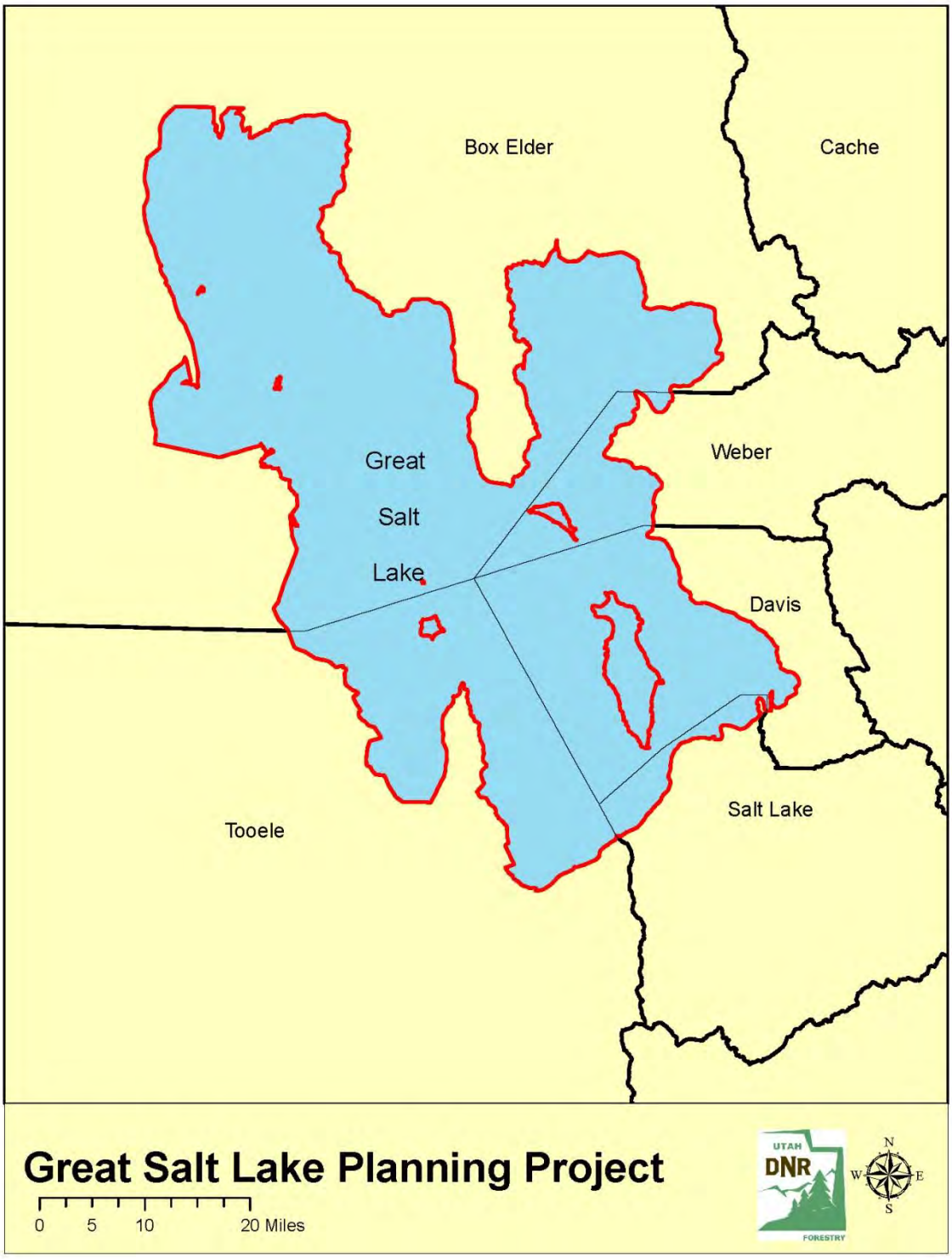
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View Project

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ABBREVIATIONS

API	American Petroleum Institute
Amoco	Amoco Exploration Company
bbl	barrel
BLM	Bureau of Land Management
Ca++	calcium
Cl-	chloride
CMP	Comprehensive Management Plan
cP	Centipoise
DOGM	Division of Oil, Gas and Mining
DSLF	Division of State Lands and Forestry
DWR	Division of Wildlife Resources
FFSL	Division of Forestry, Fire and State Lands
GSL	Great Salt Lake
GSL CMP	Great Salt Lake Comprehensive Management Plan
GSL Minerals	GSL Minerals Corporation
K+	potassium
L	lease
Mg++	magnesium
mg/l	milligrams per liter
MLP	Mineral Leasing Plan
MMbbl	million barrels
Na+	sodium
n/a	not available
NB	no billing
NAMSCO	North American Salt Company
OGH	oil, gas, and hydrocarbon
P	pending
SO4--	sulfate
SWCA	SWCA Environmental Consultants
TBD	to be determined
TDS	total dissolved solids
UDNR	Utah Department of Natural Resources
UGA	Utah Geological Association
UGS	Utah Geological Survey
US Magnesium	US Magnesium LLC
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
Utah Admin. Code	Utah Administrative Code

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CHAPTER 1 INTRODUCTION AND BRIEF HISTORY

Sovereign lands are defined by state law as "those lands lying below the ordinary high water mark of navigable bodies of water at the date of statehood and owned by the state by virtue of its sovereignty" (UTAH CODE § 65A-1-1(5)). Navigable bodies of water in the state of Utah that are considered sovereign lands include the beds of Great Salt Lake (GSL), Utah Lake, and the Jordan River, along with portions of Bear Lake, Bear River, Colorado River, and Green River. The ownership boundary for most of GSL has been judicially determined to be the federally surveyed high water mark; it is referred to here as the *meander line.*

Sovereign lands in GSL are the largest contiguous area (approximately 1.35 million acres within the surveyed meander line) managed by the State of Utah (Map 1.1). These "lands" are part of a hypersaline lake rich in mineral resources, recreational values, expansive views, and wildlife. Ornithologically speaking, GSL is the most impressive salt lake on the continent (Jehl 1994).

Management plans were prepared for GSL in 1976 and 1987. However, planning for mineral resources was not fully incorporated into those plans because mineral leasing was administered by the Division of State Lands and Forestry (DSLF), whereas planning and coordination for the lake was first conducted by the Division of Great Salt Lake in 1976–1979 and then by the Utah Department of Natural Resources (UDNR) in 1980–1988.

To account for different management mandates, in 1994, the Division of Sovereign Lands and Forestry (now the Division of Forestry, Fire & State Lands [FFSL]) was created to manage sovereign lands apart from state school and institutional trust lands. Under statute, sovereign lands are to be managed under the Public Trust Doctrine, discussed below, whereas school trust lands are managed to generate revenue for Utah's schools. Additionally, FFSL manages GSL pursuant to multiple-use, sustained yield principles and other statutory directions; see Utah Code § 65A-2-1 and Utah Code § 65A-10-8.

As an agency, FFSL is able to plan for and manage GSL's Public Trust lands with the broader view of how the lake's many resources are interrelated with its mineral resources. To accomplish this task, in 1996, FFSL developed the Mineral Leasing Plan (MLP) for GSL (FFSL 1996). The 1996 MLP provides an initial history of mineral ownership and leasing, inventories mineral resources, and examines the existing conflicts among resources on the lake.

In 2010, a revision of the MLP was initiated, along with the GSL Comprehensive Management Plan (GSL CMP) revision. Completed in 2013, this MLP revision provides updated information concerning existing mineral leasing activities on GSL and future potential mineral leasing activities.

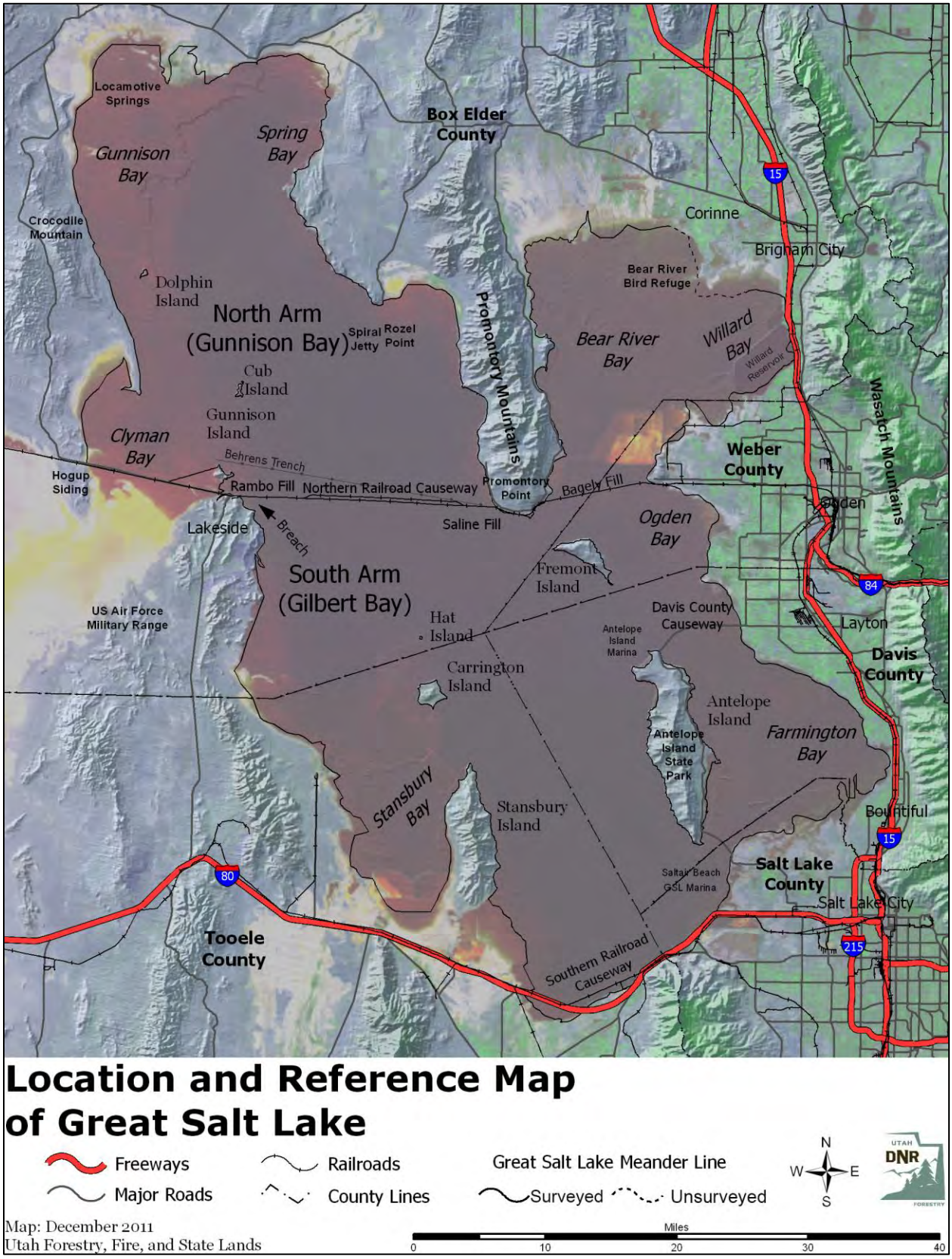
1.1 History of Land and Mineral Ownership and Disposition on Great Salt Lake

To achieve parity with eastern states, which gained ownership of the beds of their navigable waterways at independence, the Equal Footing doctrine grants states originating from federal territories control and ownership of lands underneath those waters within their borders. Accordingly, ownership of the bed of GSL began in 1896 when Utah achieved statehood.

With respect to minerals management, directives for sovereign lands have changed over the years. Initially, management and disposition of minerals were a low priority, relative to agricultural uses and water rights on or adjacent to sovereign lands. For example, legislation in 1917 allowed the sale of

submerged lands, but only if lakes or waterways were dewatered “to reclaim the bed thereof for agricultural purposes” (Laws of Utah, 1917, Chapter 114).

The state soon asserted control over mineral resources on state lands, including sovereign lands. Authority for management and disposition of sovereign lands was given to the State Land Board. For example, by 1925, submerged lands could also be sold if riparian landowners had made valuable improvements below the water’s edge, but mineral rights had to be reserved to the state (Laws of Utah, 1925, Chapter 31). In 1933, legislation allowed sovereign lands to be sold for “public or quasi-public use or service” (Laws of Utah, 1933, Chapter 46), as long as such sales did not interfere with navigation.



Map 1.1. Great Salt Lake location and reference map.

Leases for salt and sodium sulfate from GSL lands were issued beginning in 1920. However, the state allowed extraction of sodium chloride from the waters of GSL without payment of royalties until the 1940s. In 1935, the legislature made reservation of coal and other minerals on state lands mandatory and "reserved from sale, except on a rental and royalty basis" (UTAH CODE § 65A-6-1). In 1941, the legislature added to that section "salts and other minerals in the waters of navigable lakes and streams" to be sold on a royalty basis only. A 1946 decision of the Utah Supreme Court, *Deseret Cattle Co. v. State*, affirmed the state's right to dispose of minerals in the brines of the lake through lease and royalty payments (FFSL 1996).

1.2 U.S. Supreme Court Decision Affirming State Ownership

In the early 1960s as interest in other minerals besides salt in the lake grew,

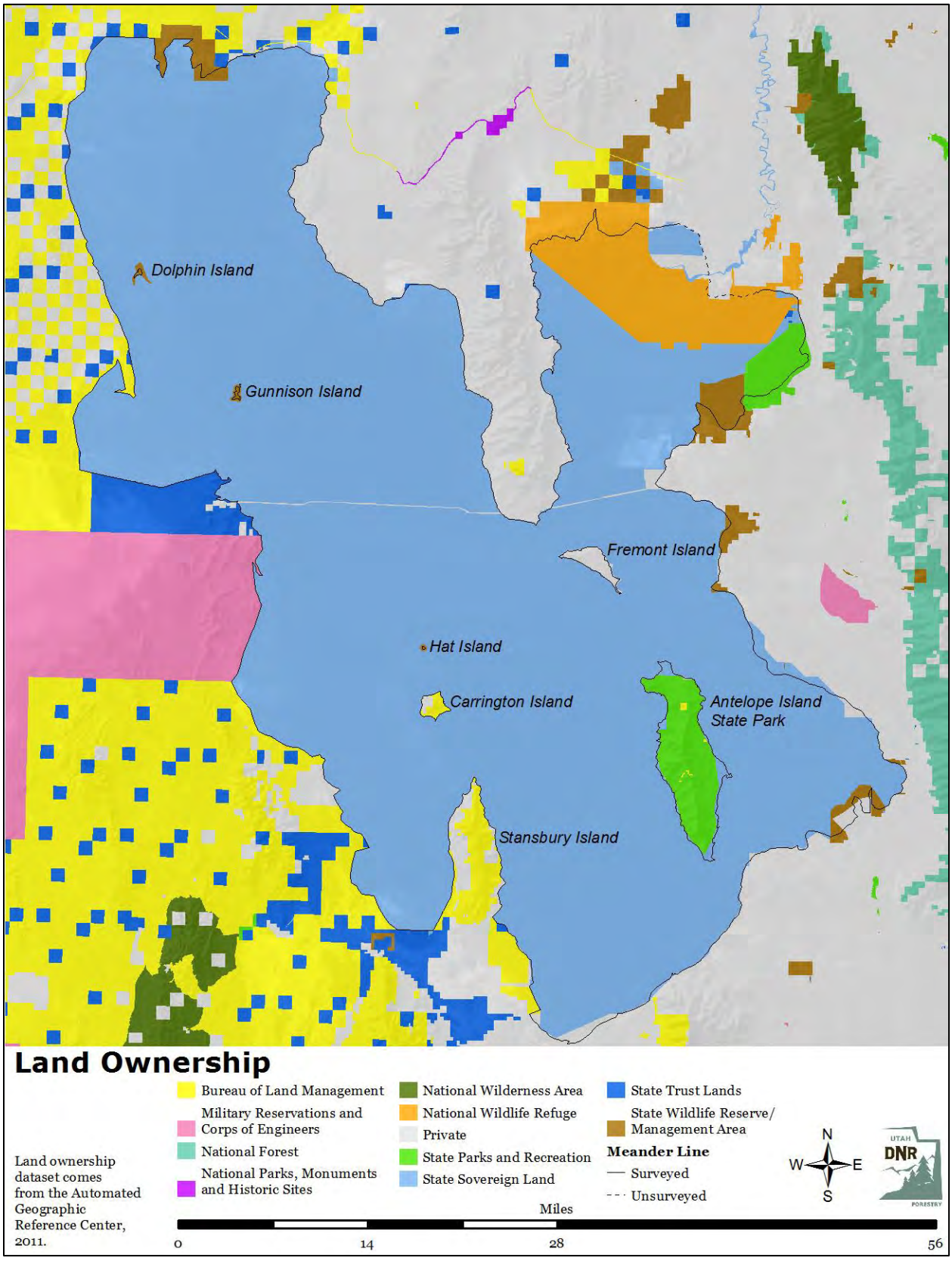
> the Bureau of Land Management [BLM] . . . served notice on the Utah State Land Board . . . that it intended to survey a boundary line along GSL to separate state and federal ownership, and that it would locate such boundary line at an elevation of 4,201.8 feet above mean sea level, which was the same elevation as the water level on January 4, 1896, when Utah obtained statehood. Utah believed that the State owned GSL, the water-covered bed, and the shore lands located within the surveyed meander line as officially surveyed and approved by the United States Government. (Dewsnup 1980)

In 1975, after nearly 15 years of congressional and legal proceedings, the U.S. Supreme Court ruled to affirm "in Utah ownership of all lands, brines, and other mineral within the waters of the lake and within the bed and all shore lands located within the official surveyed meander line . . . as duly surveyed prior to or in accordance with Section 1 of the Act June 3, 1966, 80 Stat. 192" (State of Utah v. United States, 31 Original, U.S. Supreme Court, June 28, 1976). This meander line represented 18 surveys from 1855 to the final survey of portions of the west side of the lake done by the BLM in 1966. The lake was at many different elevations during that 111-year period.

The final decree by the U.S. Supreme Court on June 15, 1967, did not determine the boundary lines between federal and state land within the Bear River Refuge, the Weber Basin Federal Reclamation Project, and the Hill Air Force Range. The boundaries within the Bear River Migratory Bird Refuge and the Weber Basin Project are still under litigation.

With regard to ownership of islands in the lake, the state considers unsurveyed islands as sovereign lands, whereas surveyed islands are in the ownership of the "upland" land owner. Surveyed islands in the lake are Antelope, Fremont, and Carrington islands. Unsurveyed islands are Gunnison/Cub, Dolphin, Egg, Goose, Hat, and Badger islands. At the time of the 1975 Supreme Court decision, significant parts of Gunnison and Hat islands were in private ownership. Following legislation passed in 1977, lands in private ownership on Gunnison/Cub and Hat islands were purchased by the state to be designated as wildlife management areas for the protection of the American white pelican. Map 1.2[1] shows ownership of the islands in GSL.

[1] The following statement is a disclaimer from the Utah Automated Geographic Reference Center (AGRC). It pertains to all maps used in this report that have used any dataset created or hosted at AGRC. "This product is for informational purposes and may not have been prepared for, or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information. AGRC [Automated Geographic Reference Center] provides these data in good faith and shall in no event be liable for any incorrect results, any lost profits and special, indirect or consequential damages to any party, arising out of or in connection with the use or the inability to use the data hereon or the services provided. AGRC provides these data and services as a convenience to the public. Furthermore, AGRC reserves the right to change or revise published data and/or these services at any time."



Map 1.2. Land ownership around Great Salt Lake.

1.3 Management of the Resources for Public Trust under Multiple-use, Sustained-yield Principles

In 1988, the management direction for sovereign lands was changed by the state legislature to allow FFSL the ability to "exchange, sell or lease sovereign lands but only in the quantities and for the purposes as serve the public trust and do not interfere with the public trust" (UTAH CODE § 65A-10-1(1)). The state legislature also enacted legislation defining the powers and duties of the division in the management of the GSL. According to UTAH CODE § 65A-10-8, these powers and duties include the following:

1) Prepare and maintain a comprehensive plan for the lake that recognizes the following policies:
    a. Develop strategies to deal with a fluctuating lake level.
    b. Encourage development of the lake in a manner that will preserve the lake, encourage availability of brines to lake extraction industries, protect wildlife, and protect recreational facilities.
    c. Maintain the lake's floodplain as a hazard zone.
    d. Promote water quality management for the lake and its tributary streams.
    e. Promote the development of lake brines, minerals, chemicals, and petro-chemicals to aid the state's economy.
    f. Encourage the use of appropriate areas for extraction of brine, minerals, chemicals, and petro-chemicals.
    g. Maintain the lake and the marshes as important to the waterfowl flyway system.
    h. Encourage the development of an integrated industrial complex.
    i. Promote and maintain recreation areas on and surrounding the lake.
    j. Encourage safe boating use of the lake.
    k. Maintain and protect state, federal, and private marshlands, rookeries, and wildlife refuges.
    l. Provide public access to the lake for recreation, hunting, and fishing.
2) Employ personnel and purchase equipment and supplies that the legislature authorizes through appropriations for the purposes of this chapter.
3) Initiate studies of the lake and its related resources.
4) Publish scientific and technical information concerning the lake.
5) Define the lake's floodplain.
6) Qualify for, accept, and administer grants, gifts, or other funds from the federal government and other sources, for carrying out any functions under this chapter.
7) Determine the need for public works and utilities for the lake area.
8) Implement the comprehensive plan through state and local entities or agencies.
9) Coordinate the activities of the various divisions within UDNR with respect to the lake.
10) Perform all other acts reasonably necessary to carry out the purposes and provisions of this chapter.
11) Retain and encourage the continued activity of the GSL Technical Team.

In 1994, when DSLF (now FFSL) was created, the state legislature directed them to manage/administer all state lands, including sovereign lands, under "comprehensive land management programs using multiple-use, sustained-yield principles" (UTAH CODE § 65A-2-1). The purpose of this MLP and the revised GSL CMP is to provide the data and information FFSL needs to effectively manage GSL pursuant to statutes and sovereign land management rules.

1.4 Previous Great Salt Lake Planning Efforts

The 1984 GSL CMP focused extensively on managing lake level and defining the lake's floodplain. Many of the objectives identified in the 1976 CMP have been accomplished, per the 1996 MLP (FFSL 1996).

With regard to mineral extraction, nearly the entire lake bed had previously been leased for oil and gas exploration or for evaporation ponds for the extraction of mineral products such as magnesium, potassium sulfate, and sodium chloride. The FFSL *Great Salt Lake and Its Environs Status Report for Management* draft report (FFSL 1984) summarizes the potential for competing or incompatible uses as follows:

> [T]here are many competing uses for Great Salt Lake's varied resources. The legislature has recognized this and established in law a very broad framework for planning and management of the lake and its environs. The area of the lake and its environs below elevation 4,212 contains 2,456 square miles or 1,572,000 acres. That is more than double the size of the State of Rhode Island and larger than the State of Delaware. Because of its immense size and the general distribution of its varied resources, there are relatively few places where incompatible uses overlap.

Many of these areas of "incompatible uses" involved mineral extraction activities. As for areas of concern, the *Great Salt Lake and Its Environs Status Report for Management* report (FFSL 1984) summarizes these actions:

> [T]he Division of State Lands and Forestry, Parks and Recreation, and Wildlife Resources limit oil, gas and hydrocarbon leases within a mile of the lake's shorelines, including islands. A one mile protective zone has also been placed around Gunnison Island to protect the white pelican rookery. A mitigation plan to increase waterfowl production has been approved to allow expansion of evaporation ponds in Bear River Bay when the lake level cooperates. Extensive areas along the east side of the lake have been designated for wildlife management by the Division of Wildlife Resources (DWR) under provision of UTAH CODE § 65-1-14. Lands around Antelope Island have also been made available to the Division of Parks and Recreation for recreation purposes.

The 1984 CMP also developed six management classes to address resource conflicts on GSL. These classes were added to the FFSL's rules in 1987 and continue, with minor revisions, under Utah Administrative Code (UTAH ADMIN. CODE) R652-70-200 to apply to all sovereign lands as follows:

- **Class 1:** Manage to protect existing resource development uses (the Utah State Park marinas on Bear Lake and on GSL are examples of areas where the current use emphasizes development).
- **Class 2:** Manage to protect potential resource development options (for example, areas adjacent to Class 1 areas that have the potential to be developed).
- **Class 3:** Manage as open for consideration for any use (this might include areas that do not currently exhibit development potential but that are not now, or in the foreseeable future, needed to protect or preserve specific resources).

- **Class 4:** Manage for resource inventory and analysis (a temporary classification that allows the division to gather necessary information to make a responsible classification decision).
- **Class 5:** Manage to protect potential resource preservation uses (for example, areas thought to be sensitive wildlife habitat).
- **Class 6:** Manage to protect existing resource preservation uses (areas that are currently protected for preservation purposes).

Map 1.3 shows these management classes as they have been designated on GSL, as well as drilling restrictions imposed by Utah Division of Oil, Gas and Mining (DOGM) regulations.

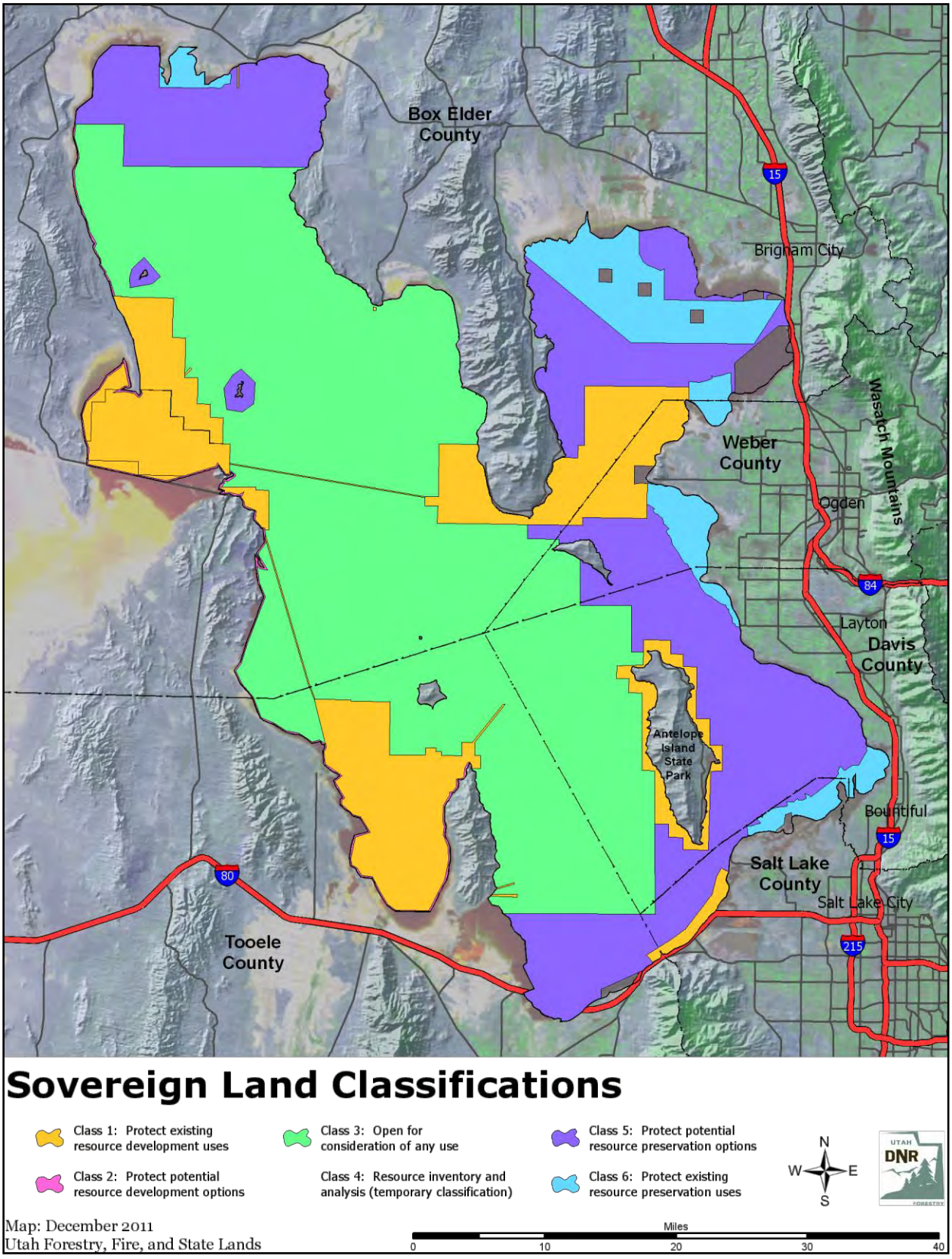
In September 1995, FFSL, through the GSL Technical Team, distributed the GSL CMP (FFSL 1995), as mandated by UTAH CODE § 65A-10-8. The three-year planning process involved state and local governmental agencies as well as representatives from lake industries. It also involved updating previous plans prepared in 1976 and 1984. The 1995 GSL CMP identified issues under the broad categories of geological hazards, hydrology, industry, sovereign lands management, tourism, recreation, and wildlife, all of which were incorporated for consideration into the MLP developed in 1996.

The 1995 GSL CMP was revised in 2000 (FFSL 2000). The primary focus of the 2000 GSL CMP was on managing the impacts from the flooding and high lake levels of the 1980s and 1990s. In the fall of 2010, the lake level reached a near-record low of 4,193.6 feet (compared with the recorded low of 4,191.4 feet in 1963).

To assess the current conditions of GSL at low lake levels and to simply provide updates to a decade-old management plan, FFSL began the GSL CMP revision process in 2010. Further, FFSL was interested in incorporating a decade's worth of GSL research into a management approach that specifically deals with a fluctuating lake level in a collaborative multi-agency manner.

As part of the 2013 GSL CMP revision, FFSL convened the GSL Planning Team, which includes UDNR and Department of Environmental Quality representatives, to provide input and support throughout the revision process. The GSL Planning Team represents the long-term collaborative approach necessary to holistically manage the complex GSL ecosystem. A list of the planning team members is provided in the introductory pages of the 2013 GSL CMP revision. The purposes of the GSL Planning Team are to

- provide resource-specific guidance throughout the planning process;
- provide the most recent, relevant research and data pertaining to the project area;
- provide timely review and comment on the document throughout the revision process; and
- offer project updates, milestones, and opportunities for comment to State of Utah agencies and the general public.



Map 1.3. Sovereign lands management classes and Division of Oil, Gas and Mining drilling restrictions.

1.5 Mineral Leasing Plan for Great Salt Lake

In December 1994, the FFSL issued a press release advising the public that all sovereign lands were withdrawn from mineral leasing so that the initial MLP could be prepared for GSL. The resulting 1996 MLP illustrates how many GSL resources are interrelated with its mineral resources. The plan also provides an initial history of mineral ownership and leasing, inventories mineral resources, and examines the existing conflicts among resources on the lake. Since its adoption, the MLP has provided FFSL a framework for managing mineral leasing on GSL.

As mentioned above, the most recent GSL CMP and MLP revisions began in 2010. In preparation for the revision process, in August 2009, FFSL initiated a moratorium on leasing and permitting on GSL. To ensure that future development of the lake's resources is not burdened by activities that may be authorized without the benefit of a comprehensive study, FFSL did not issue new leases, general permits, or easements during the planning process. The initial withdrawal was extended in February 2011 for 18 months or until the completion of the GSL CMP and MLP, whichever comes first. The withdrawal was extended two more times during the planning process.

This 2013 revision of the MLP provides a brief update to the 1996 MLP. As the GSL CMP reached its 10-year planning horizon in 2010, a review of the plan was initiated by FFSL. Although most of the effort during the 2013 GSL CMP planning process focused on incorporating new data and developing a comprehensive GSL Lake Level Matrix and lake level management strategies, the 1996 MLP was also reviewed and updated.

During the 2013 GSL CMP and MLP planning process, one of the primary concerns was low lake levels. In the fall of 2010, lake levels reached 4,193 feet, and concerns arose about how the near-historic lake level would impact the GSL ecosystem and existing mineral extraction operations. Additional issues related to low lake levels raised during the planning process included the expansion of existing mineral extraction operations and how the allocation of water rights impacts GSL lake levels.

CHAPTER 2 GOALS FOR THE 2013 MINERAL LEASING PLAN

The purpose of the 2013 MLP is to guide FFSL in accomplishing the following goals, as outlined in the following sections.

2.1 Assess Current Conditions Related to Mineral Resource Extraction and Known Reserves/Balances

- Describe historical mineral extraction activities as of the date of the MLP.
- Document existing mineral extraction activities, including location, type of mineral extracted, uses for extracted minerals, and quantity of minerals being extracted.
- Identify mineral balances (i.e., salt balances) based on current conditions and known reserves of oil, gas, and hydrocarbon resources and promote their sustainable yield and mitigation of effects on the environment.

2.2 Integrate Mineral Resource Planning with Other Resource Planning

- Create a framework for long-term policy direction for minerals management that also has the flexibility to respond to the dynamic character of GSL.
- Integrate management of GSL's mineral resources with the lake's other resources so that all resources are managed for the health and integrity of the GSL ecosystem.
- Identify compatible uses and conflicts among mineral resource development and other resources on GSL and try to identify possible resolutions for conflicts.
- Align with and use the GSL Lake Level Matrix and management strategies outlined in the 2013 GSL CMP when considering new applications.

2.3 Plan for Leasing and Efficient Development of Mineral Resources

- Classify areas of GSL that are suitable for mineral extraction and areas that are to be excluded from mineral extraction.
- Provide for the orderly leasing of mineral resources to existing and potential mineral lessees.
- Ensure fair compensation to the state from development and extraction of GSL's various mineral resources.

2.4 Establish Transparent Mineral Leasing Application Process

- Initiate the development of a FFSL permitting process that the winning bidder is required to complete once the winning bidder has been notified of the award.
- Ensure that the applicant knows about the various permits, applications, etc., required by other State of Utah and federal government agencies.
- Allow for coordination and review of a proposed project by pertinent state and federal agencies.
- Allow opportunities for project-specific analysis, as deemed appropriate.
- Provide opportunities for public comment on proposed projects as deemed appropriate and pursuant to division rules.

- Provide applicant with a record of decision.

2.5 Identify Data Gaps in Existing Knowledge Related to Mineral Extraction

- Provide a summary of areas requiring further study, particularly as they relate to existing and potential impacts from mineral extraction on mineral balances, lake levels, water quality, and habitat degradation.

2.6 Assert Role of FFSL as a Manager of State-owned Lands

- Clearly define sovereign lands for resource users, the public, and other resource management agencies.
- Act as lead agency in coordinating GSL-related activities, as outlined in UTAH CODE § 65A-10-8.

CHAPTER 3 MINERAL RESOURCES IN GREAT SALT LAKE

3.1 Mineral Resources in Brines

The brines of GSL contain several ions that can be combined into valuable minerals during evaporative processes. The major ions in GSL brines in order of relative abundance are chloride (Cl^-), sodium (Na^+), sulfate (SO_4^{--}), magnesium (Mg^{++}), and potassium (K^+). Because of the terminal nature of GSL, the only way for the ions, or salts, as they are commonly called, to be removed from GSL is through mineral extraction.

An early estimate of total tons of dissolved salts in GSL was 4.2 billion tons of salt in 1966 (Sturm 1980). Since then, the Utah Geological Survey (UGS) estimates of total tons of dissolved solids in GSL have fluctuated from 4.0 to 5.5 billion tons because of the dynamic conditions in the lake (Gwynn 1995). In 2011, UGS estimated that there are 4.5–4.9 billion tons of dissolved solids in GSL (Naftz 2011).

3.1.1 Composition of Lake Brine

Six major ions occur in GSL: sodium, potassium, magnesium, calcium (Ca^{++}), chloride, and sulfate. The combination of natural and human-influenced processes in GSL has resulted in a brine composition that is dominated by sodium chloride (Naftz 2011). This chemical consistency exists because 1) chemical homogeneity existed throughout the lake prior to the construction of the railroad causeway and other causeways; and 2) continual brine mixing, however limited, occurs among all portions of the lake. Slight, long-term changes in ion ratios have been observed throughout the lake as a whole. Tables 3.1 and 3.2 show the estimated total dissolved solids (TDS) of individual salts in the North and South arms of the lake at an elevation of 4,200 feet (Trimmer 1996). The composition of salts in the North Arm, South Arm, and water inflow to the lake is shown in Figure 3.1.

More recent salt concentration data are available for the South Arm for both the shallow and deep brines (Diaz et al. 2009). Table 3.3 shows the average concentrations of multi-element analysis in raw acidified GSL water samples from the shallow and deep brines (Diaz et al. 2009). Although the volume of dissolved solids varies between the shallow (139,217 milligrams per liter [mg/l]) and deep brines (315,592 mg/l), the percentage of concentrations of elemental salts is roughly the same as illustrated in Table 3.3. The proportion of salts in the older data, based on an elevation of 4,200 feet, differs slightly from these newer data, in part because lake elevation is different for the two datasets (see Table 3.1 vs. Table 3.2). However, the more recent data do not suggest substantial proportion changes since the last MLP and confirm that Trimmer's (1996) data are a reasonable estimate of total salt and its composition in the lake.

Table 3.1. *Total Dissolved Solids in Great Salt Lake at a 4,200-foot Elevation (000s of tons)*

Ion	North Arm		South Arm		Total Lake
	Total Tons	TDS (%)	Total Tons	TDS (%)	Total Tons
Chloride	1,465,800	55.39%	1,111,400	55.14%	**2,557,200**
Sodium	847,900	32.04%	632,000	34.35%	**1,479,900**
Sulfate	175,300	6.62%	145,700	7.23%	**321,000**
Magnesium	83,900	3.17%	68,500	3.40%	**152,400**
Potassium	68,400	2.58%	53,500	2.65%	**121,900**
Calcium	3,400	0.13%	3,300	0.16%	**6,700**
Bromine	928	0.04%	757	0.04%	**1,685**
Lithium	419	0.02%	330	0.02%	**749**
Boron	323	0.01%	253	0.01%	**576**
Bicarbonate	0	0.00%	0	0.00%	**0**
Total Dissolved Solids	**2,646,370**	**–**	**2,015,740**	**–**	**4,662,110**

Table 3.2. *Annual Inflows/Losses of Dissolved Solids in Great Salt Lake at a 4,200-Foot Elevation (000s of tons)*

Ion	South Arm		South Arm		North Arm	
	Annual Inflow*	TDS (%)	Losses/ Ponds Annual†	TDS (%)	Losses/ Ponds Annual†‡	TDS (%)
Chloride	728	36.4%	5,500	59.3%	11,100	59.0%
Sodium	460	23.0%	3,500	37.8%	7.400	39.3%
Sulfate	106	5.3%	200	2.2%	200	1.1%
Magnesium	58	2.9%	45	0.5%	10	0.1%
Potassium	32	1.6%	25	0.3%	100	0.5%
Calcium	106	5.3%	–	–	–	–
Bromine	0	0.0%	–	–	–	–
Lithium	0	0.0%	–	–	–	–
Boron	0	0.0%	–	–	–	–
Bicarbonate	508	25.4%	–	–	–	–
Total Dissolved Solids	**2,000**	–	**9,270**	–	**18,810**	–

* Data from Gwynn (1990).

† Based on annual average estimates of production and personal communication with company representatives.

‡ Significant portions of sodium chloride and other entrained salts retuned to lake by flushing of ponds.

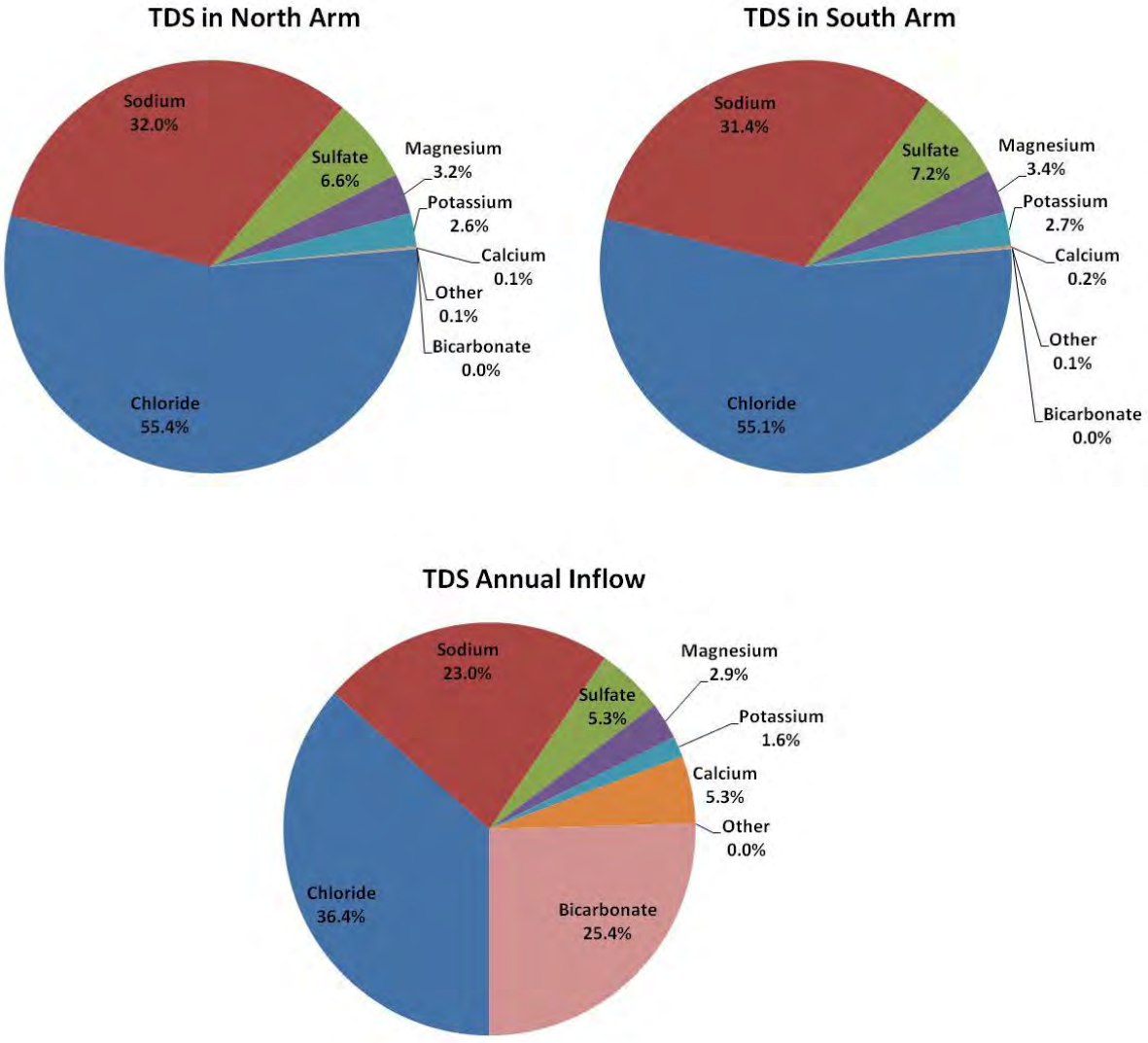


Figure 3.1. Proportion of total dissolved solids in the North Arm, South Arm, and annual inflow to Great Salt Lake at an elevation of 4,200 feet.

Table 3.3. *Elemental Chemical Composition of the Dissolved Salts (in deep and shallow brines) in the Waters of the South Arm of Great Salt Lake (mg/l)*

Elemental Salt	Mean Raw Acidified Water Samples (shallow brine)	TDS (%)	Mean Raw Acidified Water Samples (deep brine)	TDS (%)
Sodium	44,539.20	32.0%	56,787.75	32.2%
Magnesium	4,585.77	3.3%	5,927.74	3.4%
Sulfur	3,325.41	2.4%	4,207.50	2.4%
Chloride	83,917.80	60.3%	105,842.25	60.0%
Potassium	2,576.07	1.9%	3,309.98	1.9%
Calcium	272.88	0.2%	299.89	0.2%

Source: Diaz et al. (2009).

It has been suggested that the absolute quantities of the ions of magnesium, potassium, calcium, and sulfate in lake brines are decreasing relative to sodium and chloride. The decreases, however, may reflect the quality of the very early chemical analyses that were done by the Utah Experiment Station (Gwynn 2011a). Data collected by UGS since 1966 show a slight decline in the yearly average of South Arm dry-weight percentages of magnesium, potassium, calcium, and sulfate, whereas sodium and chloride show a slight increase (FFSL 1999). This trend is also supported by an analysis completed by Diaz et al. (2009). During the low surface-elevation stages of the lake, from 1935 to 1945 and from 1959 to the mid-1960s, sodium chloride precipitated in the main body of the lake (South Arm) and in Gunnison Bay (the North Arm). Madison (1970) states that salt precipitated at lake elevations below 4,195 feet, and Whelan (1973) reports that approximately 1.21 billion metric tons of sodium chloride precipitated throughout the lake at those low elevations. In addition to the main salt ions, three other elements are abundant in GSL: lithium, bromine, and boron (Figure 3.2).

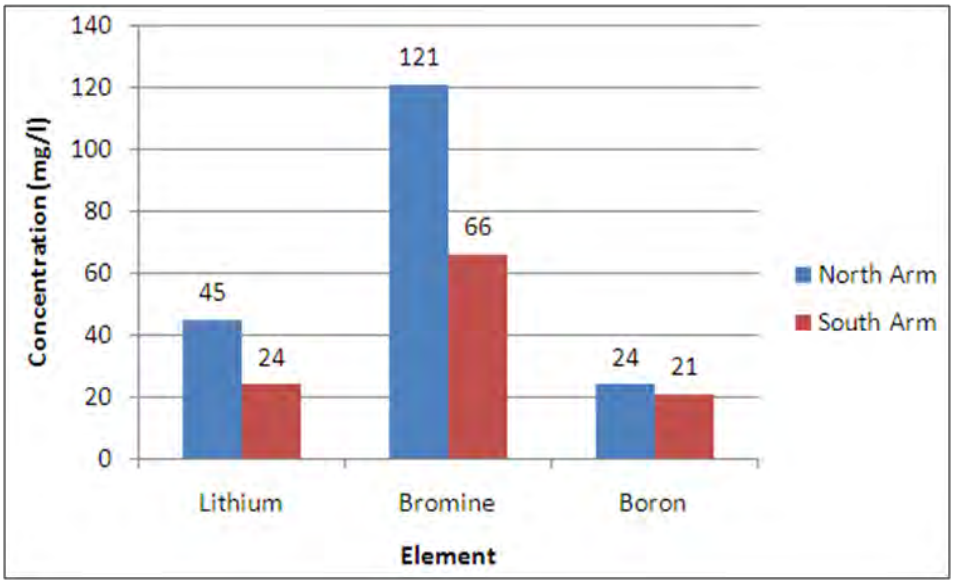


Figure 3.2. Average elemental chemical composition of the dissolved salts (in deep and shallow brines) in the waters of Great Salt Lake (raw acidified). *Source*: Diaz et al. (2009).

Although the precipitated salt in the South Arm had re-dissolved by mid-1972, it took until approximately 1986 before all the salt in the North Arm had re-dissolved (Wold et al. 1996). In 1992, salt again began to precipitate on the floor of the North Arm during the summer months, and it is believed that precipitation in the North Arm continues today. Dry-weight percentages of magnesium, potassium, and calcium increased during historic low lake levels because sodium chloride is the first salt to precipitate as the concentration of lake brine increases. Notwithstanding slight fluctuations in relative ion ratios in lake water with changes in lake level, the consensus is that overall chemistry of lake brines has not changed significantly. Between 1966 and 1996, the re-solution of sodium chloride that had precipitated on the bottom of the lake's North Arm and South Arm resulted in a decline of the dry-weight percentages of potassium, magnesium, and sulfate, compared with sodium and chloride (Gwynn 2002).

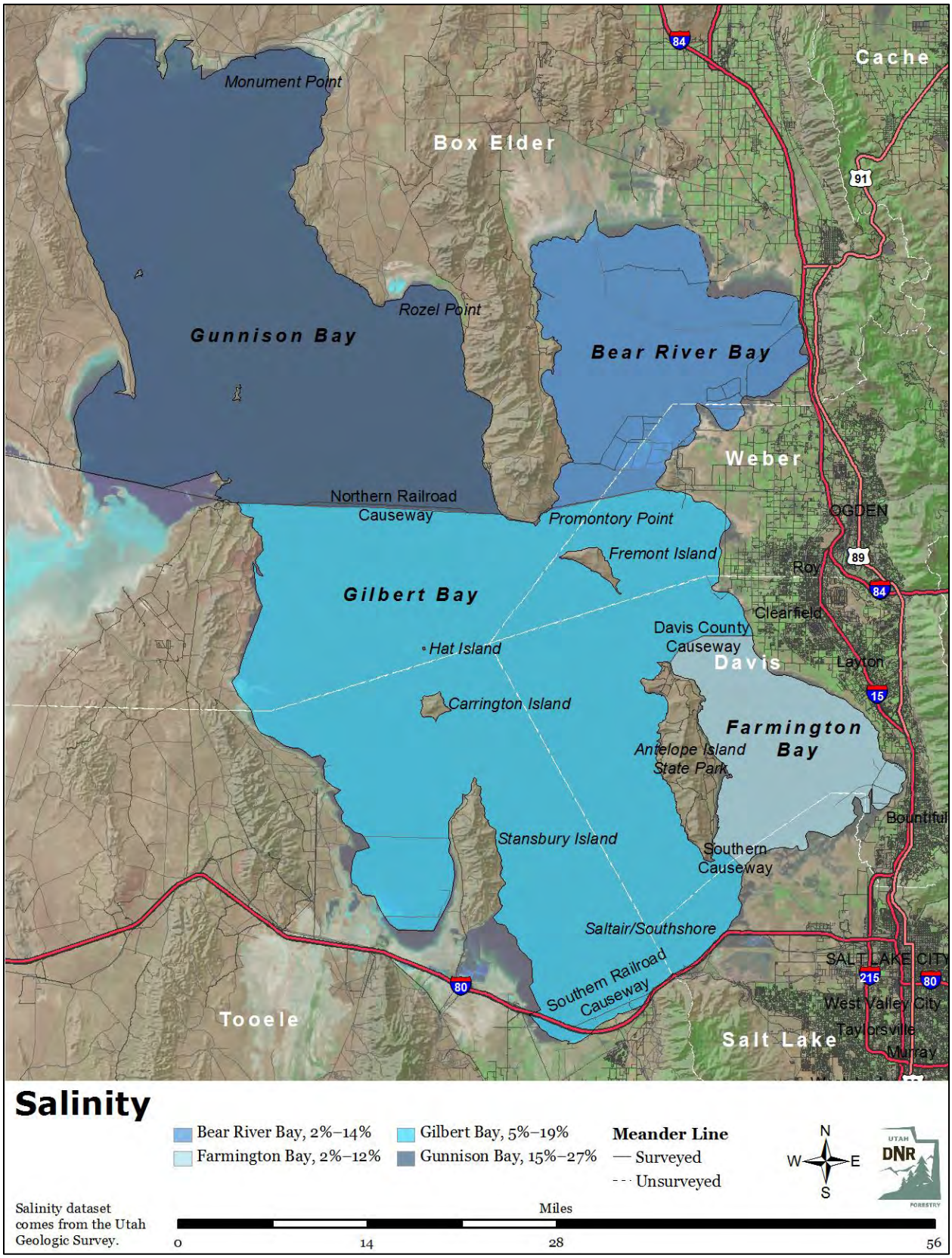
The U.S. Geological Survey (USGS) has developed a salt balance model that simulates salinity and dissolved solids concentrations in each of the four distinct bays (or areas) of GSL under different mixing conditions and lake levels (Loving et al. 2000). It is hoped that this model could be used to further assess impacts of extraction operations on the composition of lake brine.

3.1.2 Concentration of Brines

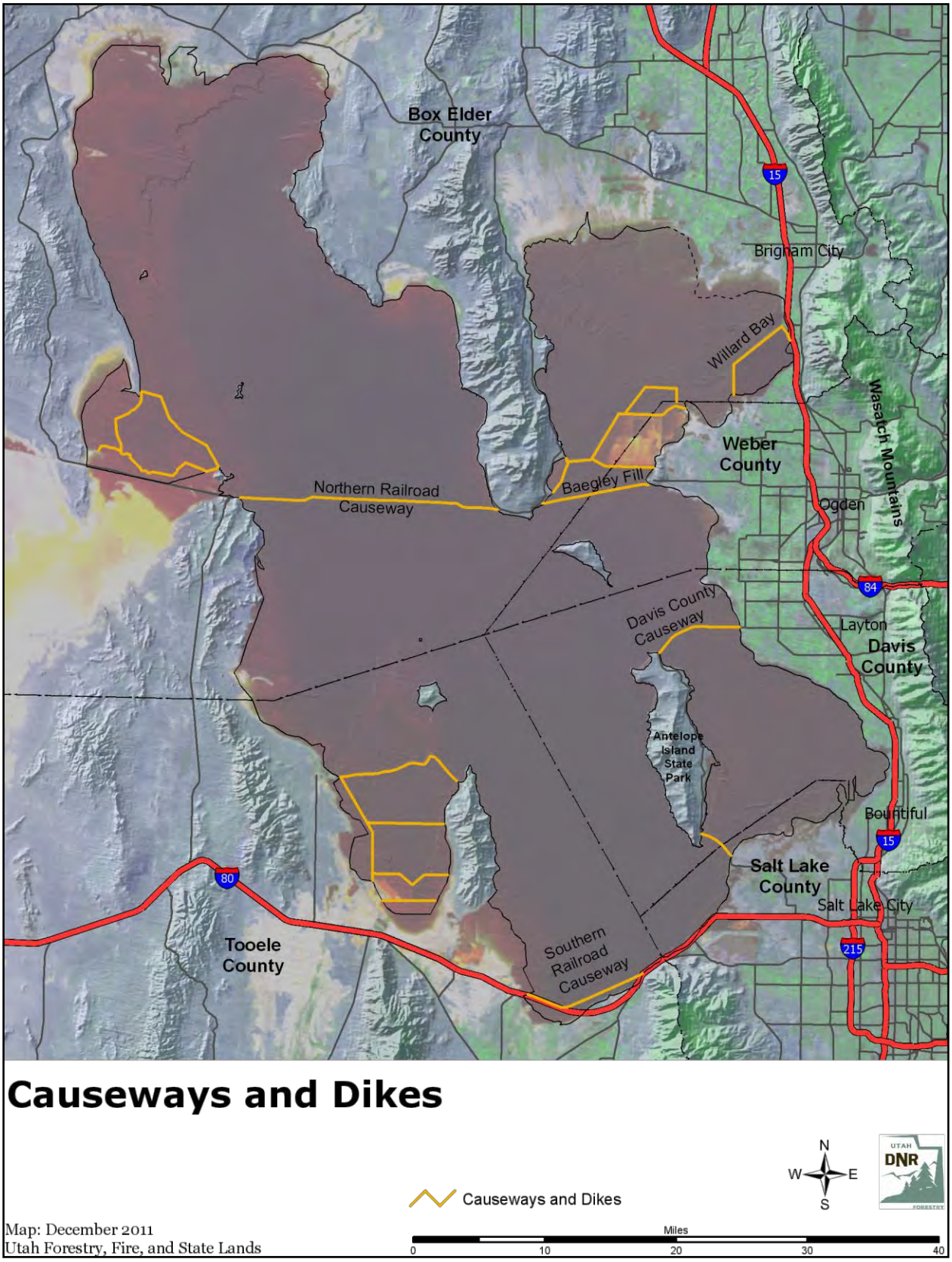
Salinity throughout GSL is governed by lake level, freshwater inflows, precipitation and re-solution of salt, mineral extraction, seasonal variations in temperature, and circulation and constriction between bays of the lake. Distinct salinity conditions have developed in the four main areas of the lake as a result of 1) fragmentation of the lake resulting from causeways and dikes, and 2) the fact that 95% of the freshwater inflow to the lake occurs on the eastern shore south of the causeway (Loving et al. 2000). From freshest to most saline, the largest bays in GSL today are Bear River Bay, Farmington Bay, Gilbert Bay (the main body of the lake also referred to as the South Arm), and Gunnison Bay (i.e., the North Arm). Map 3.1 shows the range of brine concentrations in different areas of GSL.

3.1.3 Impacts of Causeway, Diking, and Diversion Operations on Brine Concentrations

How brine concentrations are distributed throughout the lake is directly influenced by the causeway and other diking systems (Map 3.2). Continuous monitoring of brine concentrations began in 1966, seven years after the construction of the Northern Railroad Causeway (originally called the Southern Pacific Railroad Causeway). Prior to that time, there is little information about brine concentrations beyond historical references. These early records indicate that the lake was a relatively homogeneous saline body of water, with somewhat higher concentrations of brine on the west side of the lake as a result of small inflows of fresh water and higher rates of evaporation.



Map 3.1. Salinity range in Great Salt Lake Bays from 1982–2010.



Map 3.2. Causeways and dikes in Great Salt Lake.

After construction of the Northern Railroad Causeway, the lake was divided into two bodies of water: the North Arm and the South Arm. There was some interchange of brines through the two culverts in the causeway and through the causeway itself. Over time, the two arms developed distinct physical and chemical characteristics. In addition to higher concentrations along the west side of the lake, the North Arm of the lake had brine concentrations nearly twice the concentrations of the South Arm. The South Arm was stratified into a shallow, less concentrated layer and a deep layer of dense, fetid (due to the hydrogen sulfide and considerable organic matter) brine at the center of the lake. Concentrations of these deep brines were approximately twice those of the upper layer. Since the development of the Northern Railroad Causeway, breach, and culverts more than 40 years ago, the breach and culverts have compacted and continually fill with sediment. The exchange between the two arms, through the breach and culverts, is thought to be minimal but is not well understood. It is assumed that lake level elevation and composition of sediment in the culverts impact the interchange between the two bays.

Elsewhere in the lake, diking at the north end of Antelope Island and Stansbury Bay causes differences in salinity. Farmington Bay is more diluted than the rest of the South Arm of the lake, whereas Stansbury Bay has concentrations equaling those of the North Arm. The Southern Causeway, once used to access Antelope Island, is no longer maintained, but the existence of the infrastructure has the ability to affect salinity at low lake levels.

Flood management during the high water years in the mid-1980s had significant impacts on the lake's salinity. When the 300-foot breach on the west end of the Northern Railroad Causeway was opened, a very large volume of dilute South Arm brine flowed through the opening at the surface into the North Arm of the lake. Also, a large volume of North Arm brine moved though the same opening into the depths of the South Arm as a deep return flow. As a result, the North Arm of the lake became temporarily stratified. By mid-1991, wave actions in the North Arm of the lake caused amalgamation, and all signs of stratification were gone. Due to the general lowering of the lake levels, the denser brine from the North Arm stopped flowing through the breach to the South Arm in 1990, at which time the brine depth at the breach decreased to approximately 4 feet. The preexisting and additional fill along the length of the causeway during the flooding years combined to reduce the return flow from the North Arm. A recurrent theme on GSL is that placement of dikes and diversions can have significant impacts on various conditions in the lake. As illustrated in Map 3.2, diking and other human-made structures have resulted in four distinct bays, each with their own range of salinity, depending on lake level.

3.1.4 Natural Sources of Salinity and Minerals

The inflow waters to GSL carry natural salinity and minerals from the weathering of the diverse rock types in the GSL Basin. Lake Bonneville, the larger predecessor to GSL, routinely deposited carbonate into lake-bottom sediments. Today, the largest mineral inputs come from the three large river systems that primarily carry calcium and bicarbonate ions, and GSL continues to deposit carbonate on the bottom of the lake. In addition, each of the large river systems carries unique combinations of secondary constituents, primarily sodium and carbonate minerals (Jones et al. 2009). The Bear River to the north generally contains a higher proportion of sodium carbonate minerals originating in its upper watershed. The rivers to the south that drain into Utah Lake and that are eventually drained by the Jordan River contain higher concentrations of sulfate ions. The Weber River is typically the most dilute source due to the predominance of silicate rocks in its watershed (Jones et al. 2009). In addition, springs and groundwater around the lake are characterized by sodium chloride ions (Jones et al. 2009). Once deposited in GSL, water evaporation results in increased concentrations of dissolved salts. Because there is no outlet from the lake, these salts stay within the GSL system, and as is the case in closed basin systems, evaporative effects are the driving forces that affect mineral formation and solute evolution. The accumulation of salts over a millennia and the effects of dikes and causeways have resulted in the hypersaline conditions in portions of GSL today.

GSL is one of the most saline waterbodies in the world (Strum 1980). Prior to segmentation of the lake through dikes and causeways, lake brines were similar in composition and concentration throughout the lake (Loving et al. 2000). Today, Gunnison Bay (the North Arm) continues to be hypersaline, with salinities over 25%. The other bays of GSL typically range in salinity from 5% to 15%, depending on freshwater inputs, circulation, and lake level.

3.1.5 Mineral Salt Extractive Industries

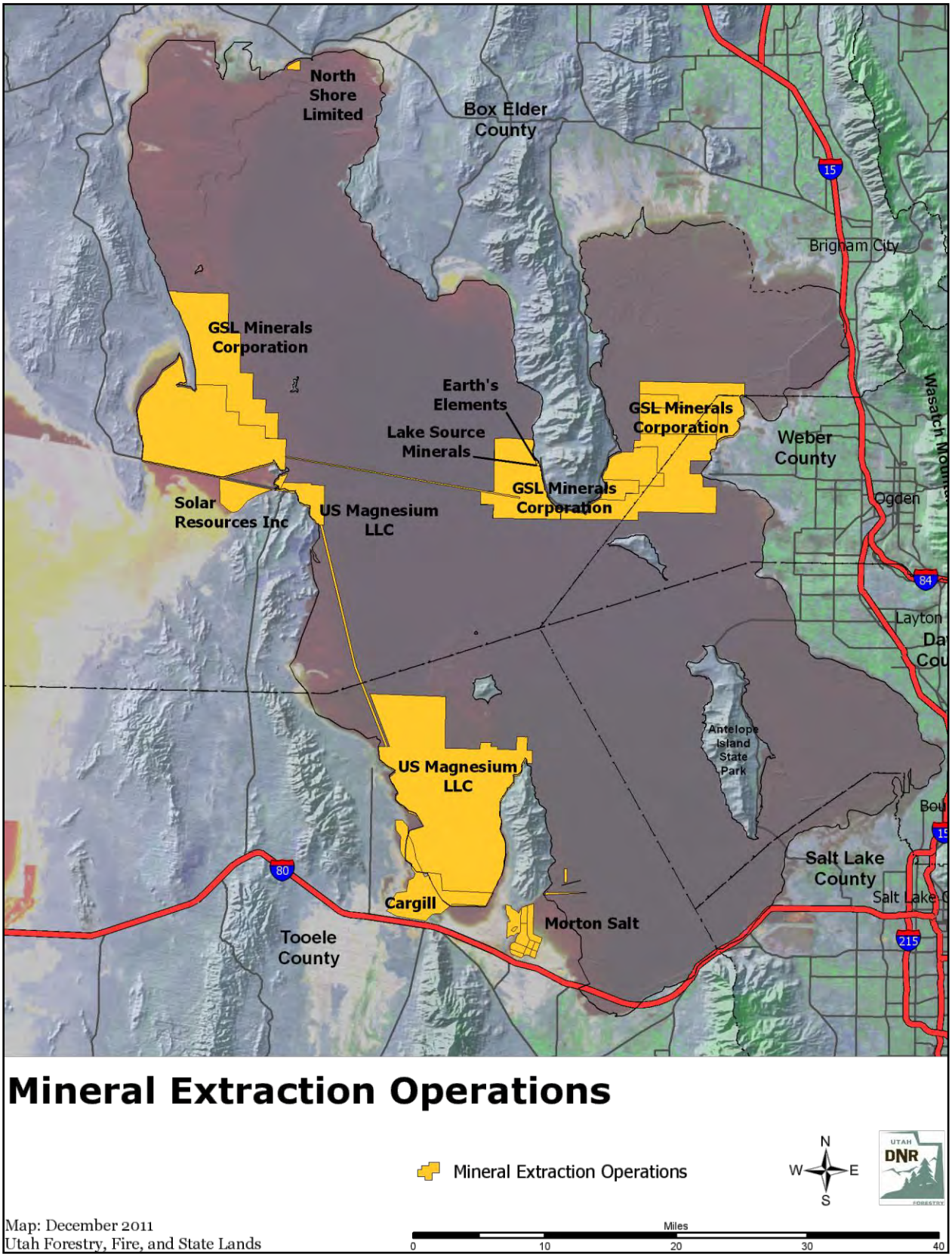
Salt extraction is one of Utah's oldest industries. Salt has been harvested from the waters of GSL for over 150 years (Gwynn 2002). Early important salt extraction sites from 1850 through the 1950s were along the south shore, with intermittent operations established along the east and north shores. Beginning in the 1960s, research and development led to the economic production of potassium sulfate, magnesium metal, magnesium chloride products, nutritional supplements (Gwynn 2002), and other products. During this time, chemical salt companies established operations on Stansbury and Bear River bays.

Concentrated brine derived from GSL is almost exclusively produced from evaporation ponding. Brine-derived products were the largest contributors to the value of industrial mineral production in Utah in 2009 (Bon and Krahulec 2009). Depending on the product being produced, the salts or brines are used as-is or are subjected to further processing. Sodium chloride is the most common product produced through pond evaporation techniques.

Four large-scale companies have active mineral extraction operations on the lake (Map 3.3):

1) Morton Salt in Tooele County produces sodium chloride salt from the lake.
2) GSL Minerals Corporation (hereafter referred to as GSL Minerals, a subsidiary of Compass Minerals) in Weber County produces potassium sulfate and magnesium chloride products from GSL brines. North American Salt Company (NAMSCO), a sister company, produces a variety of sodium chloride products.
3) Cargill Salt in Tooele County produces sodium chloride salt from the lake.
4) US Magnesium LLC (US Magnesium), located 60 miles west of Salt Lake City, produces magnesium metal and other salable by-products, including commodity grand liquid chlorine.

North Shore Limited Partnership/Mineral Resources International in the North Arm of GSL in Box Elder County produces concentrated brines. Their sister company, Mineral Resources International, produces nutritional supplements and beauty products/facial products/bath salts from the concentrated brines. Another company, Salt Lake Minerals obtains small amounts of brine from Little Valley Harbor. Both operations have evaporation ponds located on adjacent, upland, private property, and they have rights-of-entry from FFSL for the placement of pumps and associated hoses to pump the brine from GSL to the evaporation ponds. Solar Resources Incorporated, a small extraction operation, is located on State of Utah School and Institutional Trust Lands Administration lands above the GSL meander line. A summary of the mineral salt extraction industries currently in operation on GSL is included in Table 3.4.



Map 3.3. Mineral extraction operations in Great Salt Lake.

3.1.6 Mineral Salt Extraction Requirements

A key factor to extractive industries is the concentration of brines. The lower the concentration of brines, the larger the area required to produce a given quantity of salt. Similarly, those companies extracting potassium or magnesium require much larger ponding areas than companies extracting salt, because those ions are in far less abundance in lake brines.

Evaporation ponds for mineral extraction require large areas with tight or relatively impermeable soils, access to transportation and utilities, a supply of fresh water to flush excess salts from evaporation ponds, and a climate conducive to high evaporation rates. These conditions place the greatest constraints on new or expanded operations on the lake.

3.1.7 Depletion of Chemical Ions in Great Salt Lake as a Result of Mineral Extraction

Salts have been extracted at a significant and increasing rate since 1965. In that year, salt companies produced approximately 300,000 tons of sodium chloride. In 1994, production from GSL was over 2 million tons of sodium chloride and approximately 300,000 tons of other salts. A far more significant depletion of the resource was the loss of approximately 10% of dissolved salts following the pumping of brines into the Newfoundland Evaporation Basin west of GSL as part of the West Desert Pumping Project. By the late 2000s, approximately 3 million tons of salts were being extracted annually (UGS 2011).

In previous years, geologists and industry representatives estimated that it would take at least 200 years to deplete 10% of the lake's remaining sodium chloride at current rates of extraction (or 1,000 years to deplete the sodium chloride in the lake to the point that further extraction is not economic). This is not accounting for the annual replenishment of salt from surface and groundwater inflows. Some ions, notably sulfate, magnesium, and potassium, are more limited in supply than sodium and chloride ions, but their production cannot be separated in the production of salt. Furthermore, removal of salts as a waste product that is not returned, or returned after selected ions have been extracted, has not been factored into this estimate (Trimmer 1996).

As of 2010–2012, the amount of salt ions entering the lake is approximately 2.2 million tons per year (Gwynn 2011b; Gwynn 2005). However, approximately 1.0 million tons of this is calcium carbonate that precipitates out of solution, leaving 1.2 million tons of salt ions in solution. As stated above, an average of approximately 3.0 million tons of minerals was extracted from lake water annually in the later part of the previous decade (ending in 2009) (UGS 2011). Therefore, approximately 1.8 million more tons of minerals are removed from the lake than what enters each year. This equates to approximately 0.04% of the lake's total salt load of 4.5 billion tons (Gwynn 2011b). Because less salt enters GSL each year than what is extracted, some have expressed concern over the potential long-term depletion of the ions that form the unique nature of GSL.

Extractive industries produce substantially more salts than they process and sell. Significant amounts of sodium chloride are used to form floors for the harvesting ponds. Remaining unwanted salts either accumulate on the bed of the evaporation ponds (as in US Magnesium's portion of Stansbury Bay) or are flushed with fresh water from the ponds each season (as in GSL Minerals' ponds in Bear River Bay). At both these locations, significant amounts of sodium chloride are harvested by other salt companies under agreements with the original lessees. Morton Salt returns its bitterns or brines containing potassium and magnesium salts back to the lake. The returned salts are altered in chemical composition from lake brines because target salts have been removed. Millions of tons of salts are precipitated out annually in Stansbury Basin and Clyman Bay or are used as floors in harvesting ponds in all salt operations and therefore not returned to lake brines. Table 3.2 estimates the amount of salts flushed back into the lake and the amount that likely remains on the floors of evaporation ponds.

3.2 Deposits

Sodium chloride precipitates on the lake bed as salinity increases in the North Arm and in Stansbury Bay. If the North Arm of GSL stabilizes at or near saturation for sodium chloride, as it did from 1966 to 1983, these lake bed deposits will accumulate.

Sodium sulfate (mirabilite) also precipitates on the bed during the winter months in response to cooler temperatures and higher salinity. Mirabilite deposits are found primarily in the North Arm of GSL during winter months. A substantial portion of these deposits re-dissolve as temperatures warm again. "Permanent" deposits occur around much of the perimeter of the lake. These are mirabilite-cemented sands that were possibly formed by mirabilite blown up on the beaches, dissolving, then re-solidifying, cementing the sands at depth. These cemented sands have been found at Saltair and the South Shore Marina, where they had to be blasted to deepen the marina. There is also a very thick layer of mirabilite westward from the southern tip of Promontory Point.

The potential for mineral extraction of these deposits is small because of their low value, limited or declining markets, and high extraction costs. Sodium sulfate deposits along Promontory Point have been under lease to GSL Minerals for many years but have not been developed.

3.3 Hydrocarbon Resources

Hydrocarbon resources on the lake are significant but presently undeveloped. The hydrocarbons are low gravity, tar like, have high nitrogen content, and are up to 12% sulfur. Hydrocarbon density is measured according to American Petroleum Institute (API) standards and reported in degrees as indication of yield from distillation. Extra-heavy oil has an API gravity of less than 10 degrees (USGS 2003), and the API gravity of hydrocarbons from the lake is 4 to 9 degrees. A previous report indicated, "The oil is chemically similar to ichtyol; a rare substance used for medicinal purposes and thus has the potential to be an extremely valuable commodity. Higher fractions, when added to oil, are known to increase the lubricity of the oil" (Chidsey 1995). The unusual characteristics of the oil have been the subject of studies by chemists at Weber State University and Université Louis Pasteur de Strasbourg. However, these resources are difficult to extract and are presently uneconomic to produce using current technology because of the nature of the hydrocarbons and production in "an offshore, highly saline environment" (Kendall 1993).

The Utah Geological Association (UGA) identifies two oil fields on GSL in its publication *Oil and Gas Fields of Utah* (1993): Rozel Point and West Rozel. The Rozel Point field is located in Township 8 North, Range 7 West, along the shore of GSL. The West Rozel field is located in Township 8 North, Range 8 West, 3 miles from the shoreline and the Rozel Point field. The locations of these fields are shown in Map 3.4.

The estimated area of the Rozel Point field is approximately 10 acres, with low reserve estimates because of the poor reservoir seal. Small amounts of hydrocarbons or asphaltum have been recovered from natural seeps and shallow wells at Rozel Point since the turn of the century. The earliest uses were as a lubricant. More recent uses have been to resurface roads and for impregnating tire cords (Chidsey 1995). In the early 1960s, several wells were drilled on a 1-acre spacing order from DOGM. There are no current leases in the Rozel Point area.

The West Rozel field was discovered as part of Amoco Exploration Company's (Amoco's) massive exploration program on GSL in the 1970s. Thirteen "offshore" wells were drilled between June 1978 and December 1980, resulting in the discovery of the West Rozel field in one of the wells and oil shows in eight of the other wells. Two additional development wells were drilled at West Rozel, identifying a field covering 2,300 acres with heavy oil similar to that at Rozel Point. Reserve estimates at this field are

higher than at Rozel Point, ranging from approximately 1 to 10 million barrels of oil. However, Amoco did not develop the field "because of the high water cut and the high cost of operating an offshore field" (Bortz 1987). The characteristics of the oil also contributed to this decision. The West Rozel field is considered by UGA (1993) to be "low potential" due to current production economics. Changing technology may make the field viable in the future. The other Amoco exploration wells indicate some hydrocarbon potential elsewhere in the structural north basin of the lake. The North and South arms are separated by a subsurface structural arch that extends from Fremont Island to Carrington Island. Exploration around Antelope Island has indicated low potential for oil and gas. No wells have been drilled on the island, and no companies are currently exploring the area. Leases that once covered the Antelope Island area expired in 2002 and have not been renewed. Map 3.4 shows the location of oil fields and oil, gas, and hydrocarbon leases on GSL. Table 3.4 summarizes lessees, acres, and producing status for active leases on GSL. Table 3.5 shows the characteristics of oil estimates. Data are from *Oil and Gas Fields of Utah* (UGA 1993).

Table 3.4. *Current Mineral/Oil Gas and Hydrocarbon Leases on Great Salt Lake*

Lease No.	Lessee	Lease Type	Acres	Lease Status
20000001	North Shore Limited Partnership	Salt	0*	L
20000002	Cargill Salt	Salt	0*	L
20000003	Morton Salt	Salt	87.28	L
20000005	Cargill Salt	Salt	0*	NB
20000050	W.G. Boonenberg	OGH	2,615	NB
20000051	W.G. Boonenberg	OGH	2,614.23	L
20000052	W.G. Boonenberg	OGH	1,892.05	L
20000053	W.G. Boonenberg	OGH	1,854.42	L
20000054	W.G. Boonenberg	OGH	2,553.64	L
20000055	W.G. Boonenberg	OGH	2,549.81	L
20000056	W.G. Boonenberg	OGH	2,515.88	L
20000057	W.G. Boonenberg	OGH	2,512.99	L
20000058	W.G. Boonenberg	OGH	1,822.06	L
20000059	W.G. Boonenberg	OGH	2,612.17	L
20000060	W.G. Boonenberg	OGH	2,607.08	L
20000061	W.G. Boonenberg	OGH	2,644.78	L
20000062	W.G. Boonenberg	OGH	2,591.18	L
20000063	W.G. Boonenberg	OGH	2,530.5	L
20000064	W.G. Boonenberg	OGH	2,550.25	L
20000065	W.G. Boonenberg	OGH	2,590.56	L
20000066	W.G. Boonenberg	OGH	2,583.86	L
20000067	W.G. Boonenberg	OGH	2,621.97	L
20000068	W.G. Boonenberg	OGH	1,003.61	L
20000069	W.G. Boonenberg	OGH	2,044.19	L

Table 3.4. *Current Mineral/Oil Gas and Hydrocarbon Leases on Great Salt Lake*

Lease No.	Lessee	Lease Type	Acres	Lease Status
20000070	EOG Resources, Inc.	OGH	1,579.31	L
20000071	EOG Resources, Inc.	OGH	2,442	L
20000072	W.G. Boonenberg	OGH	2,553.66	L
20000073	W.G. Boonenberg	OGH	2,535.33	L
20000074	W.G. Boonenberg	OGH	2,542.1	L
20000075	W.G. Boonenberg	OGH	2,517.94	L
20000076	W.G. Boonenberg	OGH	2,585.27	L
20000077	W.G. Boonenberg	OGH	1,734.66	L
20000078	W.G. Boonenberg	OGH	855.89	L
20000079	W.G. Boonenberg	OGH	653.06	L
20000080	W.G. Boonenberg	OGH	2,366.01	L
20000081	W.G. Boonenberg	OGH	1,645.17	L
20000082	W.G. Boonenberg	OGH	1,345.97	L
20000083	W.G. Boonenberg	OGH	749.53	L
20000084	W.G. Boonenberg	OGH	2,624.96	L
20000085	W.G. Boonenberg	OGH	2,617.06	L
20000086	W.G. Boonenberg	OGH	2,731.25	L
20000087	W.G. Boonenberg	OGH	2,647.02	L
20000088	W.G. Boonenberg	OGH	2,558.42	L
20000089	W.G. Boonenberg	OGH	2,540.52	L
20000090	W.G. Boonenberg	OGH	2,558.9	L
20000091	W.G. Boonenberg	OGH	2,538.77	L
20000092	W.G. Boonenberg	OGH	2,632.05	L
20000093	W.G. Boonenberg	OGH	2,437.23	L
20000094	W.G. Boonenberg	OGH	2,450.95	L
20000095	W.G. Boonenberg	OGH	2,540.59	L
20000096	W.G. Boonenberg	OGH	2,655.53	L
20000097	W.G. Boonenberg	OGH	2,569.19	L
20000098	W.G. Boonenberg	OGH	2,554.79	L
20000099	W.G. Boonenberg	OGH	2,552.44	L
20000100	W.G. Boonenberg	OGH	2,574.68	L
20000104	Lake Source Minerals, LLC	Salt	0*	L
20000106	Earth's Elements/Trace Minerals Research	Salt	0*	L

Table 3.4. *Current Mineral/Oil Gas and Hydrocarbon Leases on Great Salt Lake*

Lease No.	Lessee	Lease Type	Acres	Lease Status
20000107	GSL Minerals	Salt	23,088	L
20000115	GSL Minerals	Salt	37,083.18	L
ML 18779-SV	US Magnesium	Salt	75,610	L
ML 19024-SV	GSL Minerals	Salt	20,826.56	L
ML 19059-SV	GSL Minerals	Salt	2,563.79	L
ML 21708-SV	GSL Minerals	Salt	20,860.29	L
ML 22782-SV	GSL Minerals	Salt	7,580	L
ML 23023-SV	GSL Minerals	Salt	14,380.56	L
ML 24631-SV	GSL Minerals	Salt	1,911	L
ML 25859-SV	GSL Minerals	Salt	10,583.5	L
ML 43388-SV	GSL Minerals	Salt	708.3	L
ML 44607-SV	GSL Minerals	Salt	37,829.82	L

Notes:

L = lease

n/a = lease expiration is contingent upon compliance with lease, including royalty payments and active production – no expiration date is set in the lease agreement

OGH = oil, gas, and hydrocarbon

P= pending

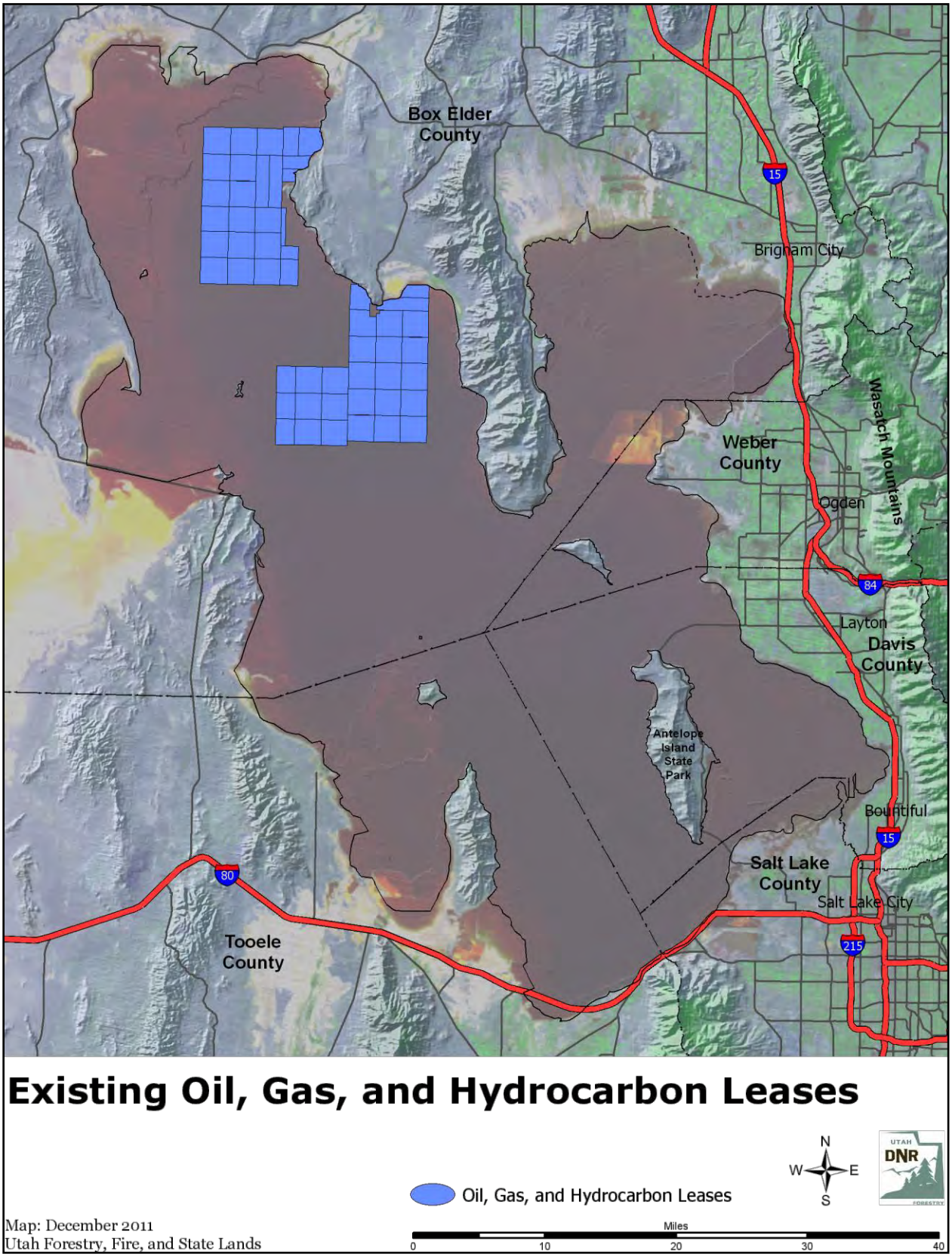
TBD = to be determined

* Acreage for these operations is zero because they occupy private upland property and therefore do not lease land through FFSL.

Table 3.5. *Oil Characteristics and Reserve Estimates Great Salt Lake Oil Fields*

Field	Oil Characteristics	Reserve Estimates
West Rozel	Gravity: 4 degrees API	Proved area: 500 acres
	Color: dark brown	Estimated primary recovery: 1–10 MMbbl
	Sulfur content: 12.5%	–
	Pour point: 75°C	–
	Viscosity 3,000–4,000 cP at 140°F	–
Rozel Point	Gravity: 5 degrees API	Proved area: 10 acres
	Color: Black, tar like	Estimated primary recovery: 2,665 bbl
	Sulfur content: 12%	–

Notes: bbl = barrel, MMbbl = million barrels, cP= Centipoise



Map 3.4. Existing oil, gas, and hydrocarbon leases on Great Salt Lake.

3.4 Other Mineral Resources

Oolitic sands are an unusual sediment type found in and around GSL at numerous locations, with higher concentrations along northwestern Antelope Island, the east side of Spring Bay, the west side of Stansbury Island, and on Carrington Island. They are light-colored calcium carbonate grains that range in shape from nearly spherical to cylindrical. Their surfaces are usually smooth, like a miniature pearl. Oolites range in size from 0.015 to 1.5 millimeters, with the average size being approximately 0.31 millimeters. The chemical composition of the outer shell consists mainly of calcium carbonate, although some calcium-magnesium carbonate (dolomite) is also present. The nucleus or central core of the ooid is usually a mineral fragment or a brine-shrimp fecal pellet.

Some of the areas in which oolites are found include 1) the west side of Stansbury Island in Stansbury Bay and the north end of the island, extending northward past Badger Island, where beds up to 18 feet thick have been measured; 2) around Antelope Island and especially in the area of the Bridger Bay bathing beaches; and 3) the southern shores of the lake.

Oolites were used in the past to neutralize the acidic gases produced during the processing of molten magnesium chloride into magnesium metal. Oolites have also been used to produce calcium chloride, which is used in the brine-desulfation process and as an industrial chemical. Oolites are also used as flux in ore-smelting operations and could also be used in most applications where limestone is used. Small amounts of oolitic sand are used in drying flowers. Because of their high calcium carbonate content, oolites have been used by US Magnesium and its predecessors for acid neutralization and dike construction. However, none of these uses require significant volumes of oolites.

Epsomite (magnesium sulfate) can be produced by the winter cooling of highly concentrated lake brines, such as those used by US Magnesium in the production of magnesium metal and chlorine (gas and liquid). Epsomite is not currently being produced from lake brines.

CHAPTER 4 HISTORY OF MINERAL LEASING ON GREAT SALT LAKE

4.1 Mineral Salt Leases

4.1.1 Sodium Chloride Leases

Leases have been issued for various products on lands under GSL since 1919. The products include sodium sulfate, salt, magnesium, and oil and gas, sometimes all in one lease. Sodium chloride is the mineral with the longest history of successful extraction. Native Americans and early explorers extracted small amounts of salt. Permanent salt production facilities began in 1850. Salt production has risen from approximately 150,000 tons per year in the 1950s to over 3 million tons per year at present.

The State Land Board began issuing leases for the extraction of salt from GSL brines in the 1940s, following legislation and a Utah Supreme Court decision affirming state ownership of minerals in the waters of the lake. Royalty terms on these leases were variously $0.35 and $0.50 per ton, but this rate was disputed by Deseret Livestock Company and Morton Salt in 1956. After eight years of negotiation with the State Land Board, Morton Salt negotiated a royalty agreement to extract sodium chloride from brines. The royalty rate was $0.10 per ton, the lease term was 15 years, and the lease did not provide any acreage for evaporation ponds within the meander line. These lease terms were subsequently offered to all producers and new lessees on the lake. Many lessees negotiated mineral leases in connection with royalty agreements, which allowed sovereign lands to be used for evaporation ponds or the lessee to extract salt precipitated on the bed of the lake. As the royalty agreements reached the end of their terms in the late 1960s, the State Land Board added language that allows leases to be held by production. Royalty rates were left at $0.10 per ton.

In July 1992, the Board of State Lands and Forestry (now defunct) changed the royalty rate for sodium chloride from $0.10 per ton to a 3% ad valorem royalty rate for all new salt leases. The FFSL had recommended a royalty range between 3% and 5%, as negotiated with the lessee (Board of State Lands and Forestry 1992b:12).

Beginning January 1, 2001, the royalty rate per ton of sodium chloride was set at $0.50 per dry ton. The royalty is to be adjusted annually based on the Producer Price Index for Industrial Commodities, as provided under UTAH ADMIN. CODE R652-20-1000(e), using 1997 as the base year.

The amount of operators that maintain sodium chloride leases has dwindled substantially since the 1940s. Following the high lake levels in the mid-1980s, Morton Salt relinquished its original royalty agreement negotiated with the State Land Board in 1954 to assume operation at a site southeast of Stansbury Island, formerly operated by American Salt Company. However, they still maintain a sodium chloride lease with FFSL. Broken Arrow Inc. relinquished its operations near Lake Point (the original lease site for Deseret Livestock Company and its many successors) and purchases raw salt from US Magnesium. American Salt Company (now NAMSCO) moved its operations to operate on a sublease agreement purchasing crude salt from GSL Minerals (both NAMSCO and GSL Minerals are subsidiaries of Compass Minerals). Cargill Salt maintains a lease from FFSL, and like Broken Arrow, they acquire salts from US Magnesium's evaporation ponds. Three smaller sodium chloride operations consist of one located on the north shore of the lake near Locomotive Springs (currently doing business as North Shore Limited Partnership) and two located on the southwestern tip of Promontory Point near Little Valley Harbor (currently doing business as Lake Source Minerals Inc. and Earth's Elements).

4.1.2 Metallic Mineral Leases

During the 1960s, the State Land Board entered into metallic mineral agreements with two companies: 1) one interested in extracting magnesium chloride to be refined into magnesium (H-K Inc., operated at present by US Magnesium, and Bonneville-on-the-Hill, operated by GSL Minerals), and 2) one interested in lithium and potassium products (Lithium Corporation, which is operated at present by GSL Minerals). These lease agreements had 49-year terms and an ad valorem royalty rate beginning at 1.5% applied against "dry" products and escalating to 5% over a 25-year period. The magnesium chloride producer was granted an exclusive right to produce that product for a period from 1961 to 1969. At the end of that period, salt lessees were offered an opportunity to convert their royalty agreements, which only allowed the extraction of sodium chloride, to an agreement that allowed extraction of all minerals, including magnesium chloride contained in brines. Also at the end of that period, a royalty rate for magnesium was added to the royalty schedule beginning at 0.1259% and escalating to 0.4196%. This rate was meant to produce equivalent royalty revenues when applied to the value of magnesium metal that the 1.5%–5% rate would have generated if applied against the value of anhydrous magnesium chloride. However, the new schedule fell significantly short of accomplishing this goal.

In addition, the two royalty agreements issued to H-K Inc./Bonneville-on-the-Hill and Lithium Corporation contained a provision that entitled the two lessees to the lowest royalty rate that may be granted to any lessee on the lake. However, this provision applied primarily to royalties on sodium chloride.

H-K Inc./Bonneville-on-the-Hill and Lithium Corporation, under these royalty agreements, began production in the mid-1970s. Ten years later, as GSL was approaching its historic high of 4,211.60 feet and most producers on the lake were experiencing major damage to their dikes, the board granted both companies royalty relief by starting the clock at year one of the royalty schedule. H-K Inc./Bonneville-on-the-Hill and Lithium Corporation have maintained their metallic mineral leases since the 1960s and are still in operation doing business as US Magnesium and GSL Minerals, respectively. Current royalty rates for mineral extraction operations are listed in Table 4.1.

Table 4.1. *Royalty Rates on Mineral Commodities, Coal, and Solid Hydrocarbons*

Mineral Commodities, Coal, or Solid Hydrocarbons	Rate	Mineral Commodities, Coal, or Solid Hydrocarbons	Rate
Coal	8%	Phosphate	5%
Oil shale*	5%	Potash and associated minerals	5%
Asphaltic/bituminous sands†	7%	Gypsum	5%
Gilsonite	10%	Clay	5%
Met. minerals:		Geothermal resources	10%
Fissionable	8%	Building Stone/limestone (except 2% for calcined lime)	5%
Nonfissionable	4%	Volcanic material	5%
Gemstone/fossil‡	10%	Industrial sands	5%
Magnesium	1%–0.5%		
Salt (Sodium chloride)§	$0.50 dry ton		

Source: UTAH ADMIN. CODE R652-20-1000

* 5% during the first five years of production and increasing annually thereafter at the rate of 1% to a maximum of 12½%.

† May be escalated after the first five years of production at the rate of 1% per annum to maximum of 12½%.

‡ Requires payment of annual minimum royalty of $5 per acre.

§ Beginning January 1, 2001, the royalty rate per ton will be adjusted annually by the Producer Price Index for Industrial Commodities as provided under R652-20-1000(e) using 1997 as the base year.

4.1.3 Current Operations

GSL contains approximately 4.5–4.9 billion tons of salt in its system (USGS 2011a). Brine-derived products such as salt (sodium chloride), magnesium chloride, and potash were the largest contributors to the value of industrial mineral production in Utah in 2009 (Bon and Krahulec 2010). In 2009, there were 10 producing mineral leases (totaling 171,644 acres), which generated $5,320,837 in royalties during the fiscal year. Currently, the largest operators on GSL are GSL Minerals (a subsidiary of Compass Minerals), Cargill Salt, Morton Salt, and US Magnesium (Bon and Krahulec 2010). The companies involved in mineral extraction on GSL are listed in Table 4.2 and highlighted in Map 3.3. See Table 3.4, which summarizes the lessee's acres, producing status, and lease expiration dates.

Table 4.2. *Summary of Mineral Companies and Type of Mineral Production*

Company	Production
Compass Minerals Subsidiaries: GSL Minerals NAMSCO	GSL Minerals Sulfate of potash, magnesium chloride brine, and flake (bischofite). Magnesium chloride is also referred to as *Chlori-Mag* by GSL Minerals. Salt for snow and ice removal, animal nutrition, water conditioning, and swimming pools. NAMSCO Packages, markets, and sells the salt products.
Cargill Salt	Salt and return bitterns (the concentrated brine that remains after sodium chloride has crystallized).
Morton Salt	Salt and return bitterns.
US Magnesium	Magnesium metal is their primary product, but they also sell the following by-products: chlorine, calcium chloride (brine), magnesium chloride (brine), sodium chloride, ferrous chloride, ferric chloride.
North Shore Limited Partnership	Magnesium brine and salts are concentrated and then processed into nutritional supplements by Mineral Resources International.

As mentioned above, the brine-derived products from GSL are almost exclusively produced from solar evaporation ponds. The industries either use salts that have precipitated from the ponds or brines that have been concentrated as a result of evaporation. Depending on the product being produced, the brine or salts are used as-is or are subjected to further processing. Sodium chloride is precipitated in evaporation ponds and is sold primarily by Morton Salt, Cargill Salt, and NAMSCO.

Potassium sulfate, also referred to as sulfate of potash, is produced by GSL Minerals for use as fertilizer. Potassium-bearing salts are produced by solar evaporation of brines, and the salts are purified and converted to potassium sulfate during processing. GSL Minerals is the only producer of sulfate of potash in North America and, at the time of writing the 2013 MLP, is in the permitting process for expansion of their operations. The U.S. Army Corps of Engineers (USACE) is in the process of developing an environmental impact statement to assess the impacts of the proposed GSL Minerals expansion.

Magnesium chloride is produced and marketed by GSL Minerals in solid and liquid forms. Magnesium chloride is used in a number of applications, including road dust suppressant, road deicer, and fertilizer.

Concentrated magnesium-chloride brine is also used by US Magnesium to produce magnesium metal. Magnesium metal was the third-largest contributor to the value of base metals in Utah in 2009 (Bon and Krahulec 2010). Magnesium metal is produced from the concentrated brines by US Magnesium at its electrolytic plant at Rowley in Tooele County. This plant is the only active magnesium processing facility in the United States (Bon and Krahulec 2010) and provides 6% of the world's magnesium supply (USGS 2011b).

Chlorine is a co-product of magnesium metal production. The chlorine is sold as a liquid. Chlorine emissions from the magnesium plant have been a point of contention for air and water quality regulators (Great Salt Lake Ecosystem Program 2011). However, US Magnesium has done much to reduce chlorine and other emissions in recent years. For example, they have significantly reduced chlorine emissions from historical levels using several innovative processes. The electrolyzers used in magnesium production were redesigned in the early 2000s, which realized significant increases in chlorine collection. In addition to

this effort, the company has installed more efficient chlorine scrubbing equipment and a chlorine conversion unit to collect vaporized chlorine as hydrochloric acid. These activities have combined to reduce chlorine emissions by over 95% since the late 1980s (Gwynn 2011a).

A titanium sponge metal plant, operated by ATI Titanium LLC, recently began operating adjacent to US Magnesium. The plant is located next to US Magnesium on the west shore of GSL because magnesium metal is a critical processing component for the production of titanium metal. The start-up of a titanium sponge plant will add incremental demand for magnesium and begin a new era in metal processing in the state (Bon and Krahulec 2010).

4.1.4 Historic and Current Withdrawals

In October 1990, the Board of State Lands and Forestry withdrew lands from all activities except oil, gas, and hydrocarbon leasing to study issues "regarding the leasing and development of brines and minerals on the lake" (Board of State Lands and Forestry 1990:8). In April 1992, this withdrawal was partially lifted, except for new leasing for brine mineral extraction. Lands for mineral salt leasing remained withdrawn because a 1991 Bureau of Economic and Business Research report indicated problems with leasing and royalty rates on existing mineral leases (Board of State Lands and Forestry 1992a:8). In January 1995, FFSL reimposed a withdrawal on all mineral leasing until an MLP was completed. The first MLP was completed in 1996, and the withdrawal was lifted.

In August 2009, a new withdrawal from GSL for leasing and permitting was issued by the FFSL. The FFSL proposed a public planning process to amend the 2000 CMP and 1996 MLP following this withdrawal of GSL lands below the meander line. The FFSL was granted authority not to issue new leases, general permits, or easements until the completion of the CMP and the MLP revisions. This moratorium on leasing was upheld until the record of decision was signed in the 2013 CMP revision process.

4.2 Oil, Gas, and, Hydrocarbon Leases

Interest in oil and gas leasing on the bed of GSL is long standing. Leases have been issued with the standard 10-year primary term and 12.5% royalty rate. Natural seeps at Rozel Point have attracted interest since the turn of the century. This area has been under a nearly continuous lease with a number of different lessees.

Despite the history of interest in the Rozel Point oil seeps and efforts to stimulate production by use of electric heaters and steam injection, there has been minimal production with no payment of royalties. In 1972, in response to lease applications for oil and gas exploration by Marvin Wolf for approximately 180,000 acres along the east shore of the lake and by Amoco Production Company for over 600,000 acres in the main body of the lake, the State Land Board held public hearings on concerns about large-scale drilling on the lake. This resulted in the creation of new rules and the issuance of a lease by DOGM and the State Land Board, respectively, in the summer of 1973. New rules approved by the DOGM provided for drilling requirements suited to drilling into the lake bed, special notification procedures, an oil spill emergency contingency plan, and procedures for "reporting undesirable events." Leases contained clauses that held the lessee responsible for all spills or spills of any polluting substance unless the lessee could prove otherwise. Both DOGM rules and leases issued by the State Land Board place timing and location restrictions on drilling, unless permission was granted by the Board of Oil, Gas, and Mining and the State Land Board. These restrictions included no drilling operations

- within 1,320 feet of an evaporation pond without the consent of the operator of such pond;
- within 1 mile of state or federal parks, wildlife management areas, or wildlife refuges;

- within 3 miles of Gunnison Island during pelican nesting season;
- within any area south of the Salt Lake Base Line;
- within any area north of Township 10 North; or
- within 1 mile inside of what would be the water's edge if the water level of the GSL were at the elevation of 4,193.3 feet above sea level.

Leases were issued to Amoco Production Company in 1973. At that time, the board decided to take no action on the Marvin Wolf leases along the east shore because of concerns about "the ecology factor." From 1973 to 1985, Amoco Production Company conducted its exploration program by drilling 13 exploration wells and two development wells after a determination in 1974 that the State Land Board had jurisdiction, rather than USACE, to grant drilling authorization (State of Utah 1976). Amoco established five units on the lake, the most promising of which was the West Rozel field in Township 8 North, Range 8 West. All units were abandoned in the early 1980s, and leases were terminated in 1985. In 1978, the State Land Board reversed its original decision to lease lands along the east shore and issued leases elsewhere that were ultimately acquired by Phillips Petroleum, Sun Exploration, and other oil and gas companies. Most of these leases were relinquished in 1986 and subsequently obtained by Pearl Montana and W.G. Boonenberg. There was some interest in drilling in the West Rozel field by Pearl Montana in 2006. However, there has been no drilling initiated or proposed by the current oil and gas lease holders on the GSL since the DOGM received permits and approved permits for drilling shallow gas wells (<500 feet deep) on private land southwest of Brigham City within a private gun club. These proposed well sites are not located below the meander line of the GSL but would be near it. Developers in this area are seeking very shallow areas of what is termed "swamp gas" (Rogers 2011). Total reserves are currently unknown.

As of 2011, no current interest in oil and gas exploration at GSL is known, according to DOGM and UGS. A summary of current salt and oil, gas, and hydrocarbon leases is included in Table 3.4. An up-to-date list of leases and permittees can be accessed through the FFSL Land Lease System Public Access website (FFSL 2011).

CHAPTER 5 MANAGEMENT DIRECTION

This chapter focuses on the management direction that FFSL will take as they evaluate new mineral leases and/or modifications to existing leases on GSL. The management direction guidelines outlined in this chapter will allow FFSL to evaluate and authorize mineral extraction activities while avoiding, minimizing, or mitigating impacts to other GSL resources. Collectively, the management directions that follow are designed to facilitate FFSL's management of GSL and its mineral resources under multiple-use, sustained-yield principles, as stated in UTAH CODE § 65A-2-1.

The MLP identifies three primary goals in management of the GSL's mineral resources over the next 10 years. These goals are as follows:

1) Integrate mineral resource development with the management of other GSL resources.
2) Plan for leasing and efficient development and sustainability of mineral resources.
3) Work closely with other interdisciplinary agencies to improve resource management.

In response to the issues and opportunities presented in the previous chapter, FFSL will implement the following management directions to accomplish the above-stated goals.

From the mid-1980s through 2011, GSL experienced near-record high and low lake levels. Although lake fluctuations are natural, expected, and an integral aspect of the GSL system, mineral resources development could impact GSL resources in different ways at different lake level elevations. The 2013 GSL Lake Level Matrix in the GSL CMP illustrates how a comprehensive range of GSL resources is impacted at a range of lake levels. Expanding or adding additional extraction operations could exacerbate these impacts when the lake is low (see the Lake Level Matrix in the 2013 GSL CMP for additional information on projected impacts at varying lake levels).

However, the impact of existing operations on GSL at a range of lake levels is not well understood. More research and data are needed to understand the impacts of new and existing mineral leasing operations on GSL salt balance at a range of lake levels. To more completely understand how mineral operations impact (and are impacted by) lake levels, further research is needed to develop a complete understanding of how much water is being used by operators and quantitative changes in salinity levels as a result of the extraction process.

Before FFSL can approve applications for new leases, applicants need to analyze, through project-specific analysis, how their proposed operations would impact GSL and other operators at a range of lake levels (e.g., high, medium, and low, as specified in the 2013 GSL CMP). The level of analysis will be determined by FFSL.

Further, as discussed in the CMP, to avoid negative impacts to GSL resources when the lake is low, new applicants may be required to suspend or modify operations if the lake is trending downward and reaches 4,193 feet on October 15. This 4,193-foot lake level was selected as the threshold for cessation of pumping activities upon reviewing the GSL Lake Level Matrix and determining the numerous GSL resources that could be impacted once the lake level reaches 4,193 feet. GSL resources begin to be adversely impacted at a range of low lake levels, but by the time GSL reaches 4,193 feet, nearly all of the resources have begun to be impaired. For example, all islands would be accessible by land (leaving nesting birds more vulnerable to predation and increasing the risk of trespassing); fringe and impounded wetlands would be drying up and vulnerable to *Phragmites* intrusion; and habitat for open water, shoreline, and island colonial nesters would decrease. Further, recreation access and opportunities would be minimized, search-and-rescue efforts would become more challenging, and several existing mineral

extraction operations, particularly in the South Arm, could be compromised. The annual low lake level usually occurs in September or October. Thus, should the peak elevation only reach 4,193 feet on October 15, new mineral extraction operations would be required to temporarily cease operations until the lake reaches 4,194 feet or June 15 of the following year, whichever is later. Thus, all new leases shall include a term that outlines the possible suspension or modification of operations as a result of decreasing lake levels.

5.1 Integrate Minerals Resource Development with the Management of other Resources

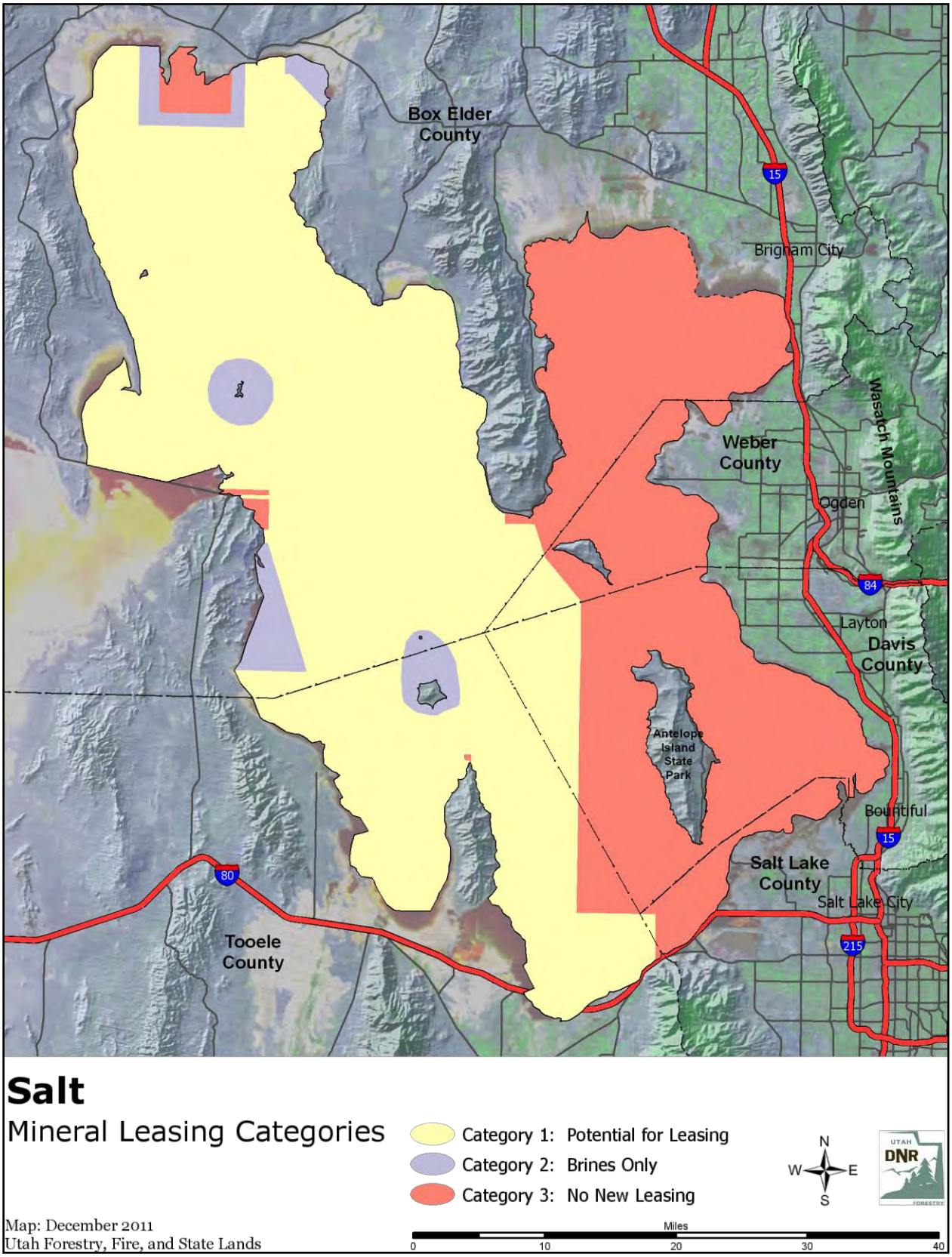
5.1.1 Guide Opportunities for Mineral Leasing in Appropriate Locations throughout Great Salt Lake

Sovereign lands within the meander line of GSL have been categorized for mineral and oil, gas, and hydrocarbon leasing as follows (Maps 5.1 and 5.2):

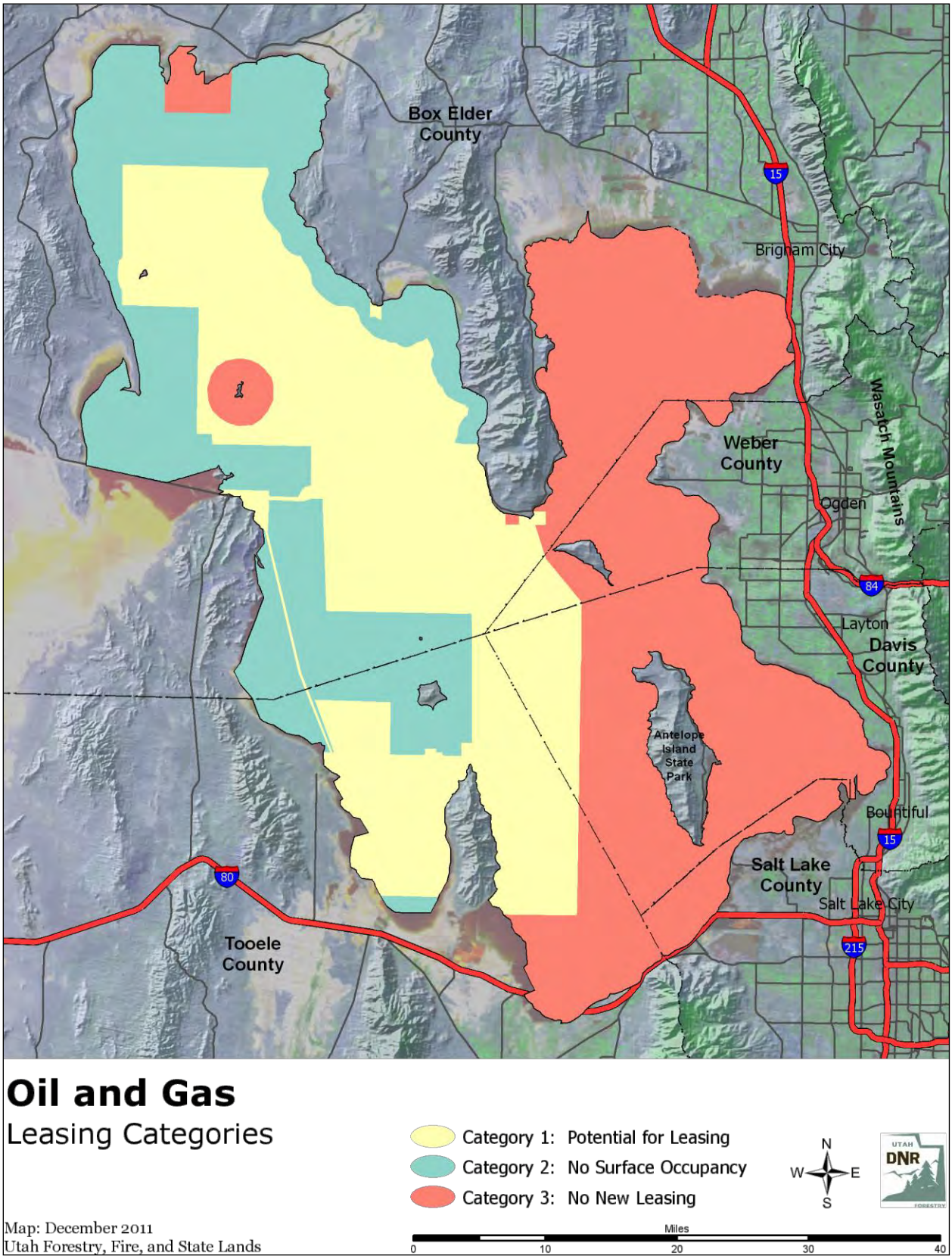
- **Category 1: Potentially Available for Leasing**. Potential areas to lease oil, gas, hydrocarbon, or mineral salts with standard lease stipulations that provide for the sustainability of the GSL environment. FFSL will consult with appropriate agencies to identify lease stipulations at the time of initial leasing and nomination and any subsequent modifications or renewals of existing leases. Stipulations for new, modified, or renewed leases in Category 1 could include, but are not limited to, the following:
    - Submit plan of operation.
    - Conduct project-specific analysis.
    - Provide lake level elevation-specific operating parameters.
    - Develop reclamation and bonding plan.
    - Prohibit physical barriers to movement of wildlife.
    - Provide temporal or seasonal restrictions on development activities or lease operations.
    - Allow for appropriate public access.
    - Require operator to implement mitigation measures.
- **Category 2: No Surface Occupancy (Oil, Gas, and Hydrocarbon Leasing) or Brine Only (Mineral Leasing).** Areas will be leased with no surface occupancy (e.g., for brine extraction without surface impact), based on resource conflicts. Lessees can access oil and gas by directional drilling from adjacent leases. Brine operations can access brine, although no evaporation ponds or dikes will be allowed. Special stipulations for new leases and modified mineral salt leases, as discussed in Category 1, may also be required.
- **Category 3: No New Leasing.** Areas with low mineral potential and/or with significant wildlife, recreational, or scenic values. No new leases will be offered. Lands within existing wildlife management areas and areas with important wildlife, recreational, and scenic values are withdrawn from development under Category 3. This category is intended to protect offshore and onshore scenic vistas along the Wasatch Front and avoid any conflicts with recreational boating (see Maps 5.1 and 5.2).

5.1.2 Understand Impacts of Proposed Projects on Great Salt Lake Resources

- Request that operator conduct project-specific analysis to more completely understand the impacts of a new project or the modification of an existing operation on the lake. The extent of analyses will be determined by the Division Director.
- Request that the analyses consider not only site-specific analyses, but also how the project will impact GSL cumulatively, in conjunction with existing land uses.
- Request that the analyses consider impacts to a range of GSL resources, including but not limited to navigability, cultural and biological resources, salinity composition, lake level, water quality, visual resources, and social and economic conditions.
- Consult and coordinate with state, federal, and local agencies to gain a more comprehensive understanding of a proposed project's impacts.



Map 5.1. Mineral salt leasing categories for Great Salt Lake.



Map 5.2. Oil, gas, and hydrocarbon leasing categories for Great Salt Lake.

5.1.3 Plan for Short- and Long-term Impacts of Mineral Operations on Great Salt Lake

- Require the applicant to conduct an analysis of the applicant's proposed action that considers the short- and long-term impacts of the proposed action. The analysis should consider how the proposed project will impact GSL resources throughout the life of the project at a range of lake levels.
- Require a term in new and renewed leases requiring them to be subject to suspended or modified operation when the lake is trending down and reaches 4,193[2] feet on October 15. Leases may resume operation on June 15 after spring runoff or when the lake reaches 4,194 (whichever is later).
- Consider that new leases and permits[3] may not be authorized if the lake is at 4,193 feet or less (UTAH CODE 65A-6-5(1)).
- Consider the cumulative effects of the proposed project in relation to existing mineral extraction operations.
- Consider and potentially require mitigation efforts to alleviate negative impacts to GSL resources in the near and long term.
- Support the data collection and analysis of UDNR, DEQ, federal agencies, universities, and the lessees themselves in order to obtain a more in-depth understanding of how mineral leasing activities impact the lake's salinity composition and the GSL ecosystem.
- Together with other agencies, seek to further understand how the extraction of salts impacts the salt balance of GSL required to support ecosystem function.

5.1.4 Understand and Plan for Long-term Impacts of Causeways and Dikes

- Continue to study how causeways and dikes impact the movements of brines, extraction or deposition of salts, and return of salts to the lake system to determine adequate levels of mineral salt resources within the GSL.
- Support further research of GSL salt balance.

5.1.5 Recognize Threats to Mineral Development Sites from Natural Hazards and Plan to Reduce Exposure to Hazards

- Encourage and potentially require (if deemed necessary by the Division Director) lessees to perform project-specific studies to identify and classify soils susceptible to earthquake-induced flooding and shallow groundwater prior to development of structures near the lake.

[2] Upon reviewing the GSL Lake Level Matrix and determining the numerous amounts of GSL resources that would be negatively impacted once the lake reaches 4,193 feet, this threshold has been determined to be an acceptable level at which new mineral extraction operations would cease pumping activities. GSL resources begin to be adversely impacted at a range of low lake levels, but by the time GSL reaches 4,193 feet, nearly all of the resources have begun to be impaired. For example, all islands would be accessible by land (leaving nesting birds more vulnerable to predation and increasing the risk of trespassing); fringe and impounded wetlands would be drying up and vulnerable to *Phragmites* intrusion; and habitat for open water, shoreline, and island colonial nesters would decrease. Further, recreation access and opportunities would be minimized, search and rescue efforts would become more challenging, and several existing mineral extraction operations would be compromised. The annual high lake level occurs between September and October. Thus, should the peak elevation only reach 4,193 feet on October 15, new mineral extraction operations would be required to temporarily cease or modify operations until the lake reaches 4,194 feet or June 15, whichever is later.

[3] A new lease or permit is defined as one that is issued by FFSL subsequent to the Record of Decision adopting this plan. Minor modifications to permits or leases for maintenance or site improvements would require only an amendment to the existing permit or lease and would not be considered a new lease or permit. The determination of whether a modification is minor, would be made at FFSL director's discretion. Renewals of expiring leases will be considered new leases.

- Encourage and potentially require (if deemed necessary by the Division Director) lessees to acquire technical information regarding GSL geology from UGS during the planning of new operations.
- Ensure that lessees understand it is their burden to comply with all applicable federal, state, and local statutes, regulations, or ordinances regarding management of hazardous substances, pollution control, public health, and environmental protection.
- Plan for leasing and efficient development of mineral resources.

5.1.6 Establish Procedures for Mineral Leasing Permitting Process

- Withdraw GSL lands from mineral salt leasing and oil, gas, and hydrocarbon leasing until nominated.
- Ensure that applicants comply with all simultaneous filing rules (UTAH ADMIN. CODE R652-20).
- Offer lands in mineral salt leasing and oil, gas, and hydrocarbon leasing Categories 1 and 2 as identified in Maps 5.1 and 5.2 for competitive bid through the nomination process.
- Evaluate nominated lands for conformance with the MLP. Evaluation will include appropriate tract size, legal description, appropriate royalty, minimum bid, and consultation with appropriate agencies and other lessees.
- Explore the possibility of establishing a mineral leasing permitting process that begins upon the award of winning bidder in the competitive leasing process required by UTAH ADMIN. CODE R652-20.
- The Division Director determines the level of project-specific analyses. The director may consult with other agencies in making the determination.
- Coordinate permitting process with other agencies at beginning of permitting process to assist the bidder in understanding, up front, the permit/application process that the bidder needs to complete.
- Consider conducting a pre-work meeting with the winning bidder and other applicable divisions/agencies to discuss the project and identify required agency permits, applications, and potential analysis requirements.

5.1.7 Balance the Interests between the Public Trust and Private Entities to Encourage Efficient Use of Mineral Resources

- Conduct lease negotiations with private industry in a manner that ensures that Public Trust objectives are met.
- Amend leases as necessary to ensure lease compliance with rules and statute and to ensure adequate financial compensation for use of public lands.
- Make economically sound decisions, including royalty rates and lease agreements with mineral producers and other industrial operations/lease holders on the GSL.

5.1.8 Ensure Prudent Operations during Mineral Operations and Appropriate Reclamation after Mineral Developments Cease

- Coordinate with operator and DOGM to develop hazardous materials incident response strategies for oil spills or other identified hazardous material risks consequential to mineral operations and other industrial activities on GSL.

- Work closely with DOGM during operations to help ensure that all DOGM rules are complied with and that operations found to be in violation are corrected within a specified time frame.
- Implement appropriate bonding requirements by, among other things, reviewing any bonding requirements imposed by DOGM.

5.2 Work Closely with other Agencies to Improve Resource Management

5.2.1 Coordinate Management, Permitting, and Research Activities between Applicable Local, State, and Federal Agencies Surrounding Great Salt Lake.

- Improve coordination between agencies with respect to management, research, permitting, and monitoring by acting as the lead management agency in future coordination efforts as outlined in UTAH CODE § 65A-10-8.
- Facilitate coordinating committee meetings where agencies will review proposed actions on GSL, provide comment, and advise on resource or permitting issues related to the action.
- Notify other agencies of proposed actions on GSL.
- Organize and facilitate regularly scheduled meetings to discuss research, management, and permitting issues.
- Provide proposed action summaries and notifications to other agencies.
- Provide substantive comment on resource or permitting issues when prompted by other agencies.
- Use the 2013 GSL CMP lake level management strategies to determine appropriate agencies to coordinate with on a particular issue or project proposal.
- Communicate proposed management actions through the Resource Development Coordinating Committee, GSL Advisory Council, and GSL Technical Team.

5.2.2 Enhance Coordination Efforts between FFSL and other Government Agencies

- Work with public relations staff to educate the public and other resource management agencies about sovereign lands and FFSL's role in managing these lands.
- Continue working relationship with other government agencies, industry representatives, private parties, and organizations to expand resource management within the GSL.
- Allocate staff time and financial resources to provide public outreach/education tools by providing staff for volunteer events on sovereign lands, expending financial resources to purchase and install interpretive signs at key public use areas, hosting cleanup events on sovereign lands, and developing educational pamphlets and brochures.

CHAPTER 6 LITERATURE CITED

Board of State Land and Forestry.1990. Board Minutes. October 11.

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