Economic Significance of the Great Salt Lake to the State of Utah

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State of Utah
Great Salt Lake Advisory Council

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Executive Summary

The Great Salt Lake (GSL), located in north-central Utah, is the largest terminal lake in North America and the namesake for Utah's largest city. It is also both an important natural resource and an important economic resource to the region and to the State of Utah. In addition to the lake's unique ecosystem and rich biological diversity, the specific characteristics of the lake have given rise to a number of large industrial operations, including extraction of salts and minerals, and support a unique commercial use in the annual aquaculture harvest of brine shrimp eggs. Together these industrial and aquaculture uses of the lake ecosystem, along with significant levels of recreational use of the lake, constitute a large base of employment and income for the area and the state.

The primary objective of this report is to bring together in one document both newly collected and previously published data on the economic significance of the Great Salt Lake and its surrounding ecosystem to the economy of the state of Utah. Economic significance is a measure of the amount of total state economic activity (output, income, and employment) tied to uses of the lake ecosystem.

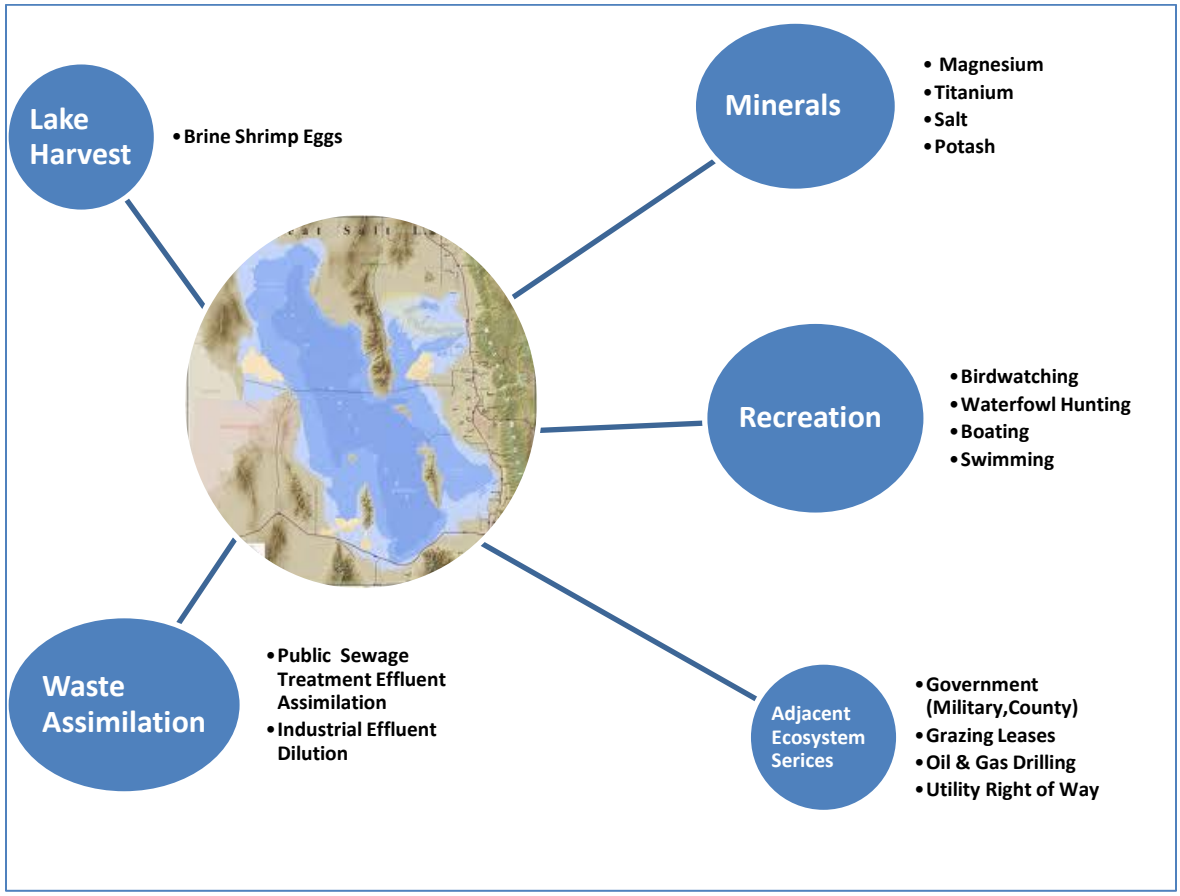

Figure 1. Economic and Ecosystem Services Provided by the Great Salt Lake Ecosystem.

Economic uses of the Great Salt Lake and its ecosystem can be categorized into five general groups (Figure 1). Each of these groups is responsible for economic benefits to the State of Utah. Lake harvest is the aquaculture harvest of brine shrimp eggs from the unique lake environment. The minerals group includes the extraction, processing, or production of salt, magnesium chloride, magnesium metal, titanium sponge, and sulfate of potash. The recreation group includes hunting, bird watching, boating, swimming, and general recreation. Waste assimilation refers to the use of the lake to dilute and process effluent from both public sewage treatment plants, as well as industrial uses. Finally, "adjacent ecosystem services" refers to a mix of uses of Utah state land leases that are not captured within the other groups.

Regional Economic Significance of the Great Salt Lake Ecosystem

This analysis presents two different measures of economic contribution by the Great Salt Lake Ecosystem. First is a "regional economic significance" estimate of the contribution of the lake's industry, aquaculture, and recreational use to the total economic output, employment and labor income of the State of Utah. Table 1 shows this total estimated regional economic significance. Overall, these uses account for an estimated $1.32 billion in total economic output, $375 million in total labor income, and 7,700 full and part-time jobs annually within Utah (Table 1).

Table 1. Total Estimated Output, Income, and Employment Attributable to GSL Economic Activity.

Statistic	**Direct Economic Effect**	**Indirect Economic Effect**	**Induced Economic Effect**	**Total Economic Effect**
Total Economic Output (millions of 2010 $)				
Recreation Sector	74.6	27.8	33.5	135.8
Industrial Sector (Mineral)	685.2	217.7	227.9	1,130.8
Aquaculture (brine shrimp eggs)	33.9	8.0	14.8	56.7
TOTAL ALL SECTORS				***1,323.3***
Total Labor Income (millions of 2010 $)				
Recreation Sector	25.7	9.2	10.8	45.7
Industrial Sector	168.3	67.1	73.7	309.2
Aquaculture (brine shrimp eggs)	12.3	3.2	4.8	20.2
TOTAL ALL SECTORS				***375.1***
Total Employment (Full and Part-time Jobs)				
Recreation Sector	1,217	236	310	1,764
Industrial Sector	1,967	1,288	2,112	5,368
Aquaculture (brine shrimp eggs)	373	63	138	574
TOTAL ALL SECTORS				***7,706***

Net Economic Value of Uses of the Great Salt Lake Ecosystem

A second measure of value can be described as the "net economic value" of activities tied to uses of the lake ecosystem. These "net economic values" do not directly represent spending and employment in the local economy. Rather, these values represent dollars that would be spent in the economy were resource users charged the full market value/price of the services being valued (such as a fee for swimming at the beach). For example, the net economic value associated with recreational use of the lake is a measure of the value of lake-based recreational experiences over and above what users actually spend for gas, food, or other purchases tied to that recreation. It is estimated that total net economic value associated with recreational uses of the lake are in the range of $36 million annually.

A significant additional source of net economic value to the state is associated with discharge from publicly owned treatment works (POTW) into the lake system. The unique characteristics of the lake environment process this nutrient discharge while a typical Western freshwater riparian system would likely require the POTWs to meet higher, more expensive treatment standards prior to discharge. This avoided cost of water treatment represents real value to the state and users of the POTWs in the range of $10.3 to $58.9 million annually.

For combined recreational and POTW use of the lake ecosystem, it is estimated that the total annual net economic value of the Great Salt Lake is in the range of $46 million to $95 million.

Possible Passive Use Values Associated with the Great Salt Lake Ecosystem

In addition to the contribution of economic activity tied to the Great Salt Lake in terms of output, income, jobs, and net economic value, the lake ecosystem likely also has tremendous value both within the state and nationwide for its unique contribution to bird habitat as well as its other geologic and ecological characteristics. These values, sometimes referred to as "passive use values", are not tied to direct economic uses of the lake, but are a measure of the value people place on simply preserving the resource. Studies of passive use values associated with protection of other unique resources in the Western U.S., such as Mono Lake in California, have shown these resources to have very high value to households. Any "passive use values" associated with the Great Salt Lake Ecosystem would be in addition to the regional economic significance and net economic values presented above. No passive use valuation studies have been done for the Great Salt Lake Ecosystem. However, using the inflation-adjusted value per household estimated for Mono Lake (Loomis 1989) of $125, and the approximately 830,000 Utah households, suggests the passive use value associated with preservation of the Great Salt Lake Ecosystem could be in the range of $100 million annually for Utah households.

Data Sources and Limitations of Analysis

This analysis relied on two primary types of data. For the recreation sectors, previously published data on use levels, values, and expenditures were combined to estimate total direct spending and net economic value associated with lake recreational activities. For the industrial and aquaculture businesses, individual businesses were contacted directly and asked to provide

information on the annual value of production, employment, payroll, and state and local taxes. Business representatives were in large part generous and forthcoming with information. This cooperation was key to, and greatly facilitated, the preparation of this report.

In addition to published studies, usage data, and industry-supplied estimates, information was also collected through contacts with State of Utah and USFWS personnel. Additionally, public Annual Reports, and SEC filings for the businesses involved were examined to better understand the industries.

While the data and estimates presented in this report are intended to be comprehensive, there are likely still gaps in them. More complete counts of recreational users, even more precise business production estimates, and better estimates of recreational expenditures, and values would likely improve the reported estimates.

1.0 Introduction and Setting

The Great Salt Lake (GSL), located in north-central Utah, is the largest terminal lake in North American and the namesake for Utah's largest city. It is also both an important natural resource and an important economic resource to the region and the State of Utah. In addition to the lake's unique ecosystem and rich biological diversity, the specific characteristics of the lake have given rise to a number of large industrial operations, including extraction of salts and minerals, and support a unique commercial use in the annual aquaculture harvest of brine shrimp eggs. Together these industrial and aquaculture uses of the lake ecosystem constitute a large base of employment and income for the area and the state.

The lake's wetlands and open waters are a bird and wildlife resource of hemispheric importance, and support significant fractions of the continent's total populations of a number of shorebird species including white pelican, Wilson's phalaropes, American avocets, black stilts, white-faced ibis, eared grebes, snowy plovers, and tundra swans. The lake is also the most important waterfowl breeding area remaining in the United States, with annual waterfowl use exceeding three million birds, which is about 30 percent of all waterfowl in the Pacific and Central Flyway. A number of sites on the lake, including the Bear River National Wildlife Refuge and Antelope Island, are important recreational resources. There are also a number of duck hunting clubs and wildlife management areas, primarily on wetlands and open water on the south, east, and northeast shore.

The primary objective of this report is to bring together in one document both new and previously collected data on the economic significance of the GSL and its surrounding ecosystem to the economy of the state of Utah.

It is likely that the key economic values provided by this lake are associated with three general types of use: direct recreational use, direct industrial use, and aquaculture. Direct recreational use would include birding and other wildlife observation, duck hunting, boating, and direct contact recreation. Direct industrial use of the lake and its environs includes production of salts and other metals and minerals. Aquaculture includes the annual harvest of brine shrimp eggs from the lake.

This report presents estimates of direct use values within two accounting frameworks: regional economic significance, and net economic value.

1.1 Scope of Report

To date, estimates of economic values associated with the GSL Ecosystem have largely been piecemeal and lacked a comprehensive structure that brings both recreational and commercial uses of the ecosystem together in one place. An exception to this was the 2002 Special Publication by the Utah Department of Natural Resources, which included a chapter on the economics of the Great Salt Lake that addressed both industrial and recreational aspects GSL

economic activity (Isaacson, Hachman and Robson, 2002). The current study extends this previous work by estimating the regional economic significance of both recreational and industrial/commercial uses of the lake within one consistent model of the Utah economy (MIG 2011). The contributions of both recreational and industrial/commercial activity to the Utah economy are measured in total output (gross state product), employee compensation, and employment. Additionally, the indirect and induced effects of GSL economic activity are also estimated. These secondary effects measure the "multiplier" effect of income generated by the primary activities tied to the GSL as that income is spent and re-spent within the Utah economy.

One key element of this analysis is the use of economic data gathered directly from the brine shrimp egg businesses and mineral extraction industries on levels of production, sales, and employment. Previous efforts have generally reported this economic information based on estimation, and interpolation from public data sources, resulting in broad ranges of estimates. The intent in the current analysis is to provide, to the extent possible, current average production value and employment for these industries based on data provided by the industries.

In addition to the estimation of the significance of the GSL economic activity within a "regional economic expenditure model," this report aims to also address in as comprehensive a manner as possible the "net economic values" associated with GSL activity, both recreational and industrial/commercial. This "net economic value" shows a measure of economic value associated with the GSL resource that is not measured through the traditional income and expenditure model described above. This second accounting framework is referred to as a benefit-cost accounting framework.

To meet the goals of this project, it was necessary to rely on a wide spectrum of data sources. These sources included reported levels of economic activity (sales, employment, etc.) from GSL industries and aquaculture operators (mineral extraction and brine shrimp), and existing studies of recreational use levels, values and expenditures specific to the GSL (and from other similar resources and settings where applicable. A synthesis of available information and data collected from Federal and State agencies and industry was developed for the key direct use sectors including tourism, wildlife viewing, hunting, and industrial/commercial use. Industrial use centers on mineral production around the lake, while other commercial uses include brine shrimp egg businesses, livestock grazing, oil and gas production, and other permitted or adjacent commercial activities on or surrounding the lake. A less analytical discussion of a secondary source of value associated with "lake effect" snows is also addressed.

A final narrative also discusses possible "passive use values" identified during the course of the study. These passive use values may include what are commonly referred to as existence value or bequest value. This discussion of potential values associated with passive use of the GSL introduces the concept of passive use, outlines the theoretical basis for the concept, presents evidence of validity, and discusses estimates of passive use values from similar settings.

Table 2 details the economic uses and sectors associated with the GSL and how they are presented within this report.

Table 2. Scope of Major Components of Great Salt Lake Economic Analysis

Relationship of Areas of Analysis and Economic Sectors to Accounting Frameworks and Market Characteristics.		
Issue / Sector	**Accounting Framework**	
	Benefit / Cost	**Regional Economics**
I. Baseline Benefits and Jobs		
A) Direct and Indirect Recreation (including recreation, Tourism, Wildlife Viewing and Hunting)	Market & Nonmarket	Market
B) Industrial Use (including Mineral Extraction Industry and Brine Shrimp Industry)	Market	Market
SUBTOTAL: Baseline	*Net Economic Value*	*Overall Employment and Income*

1.2 Geographic and Ecological Setting

As the largest naturally formed lake west of the Mississippi River, the Great Salt Lake is currently approximately 75 miles long and about 35 miles wide. Due to the location of the lake, quite small elevation changes in the lake can dramatically change the overall size of the lake. The Great Salt Lake is located in a wide, shallow basin, and a slight rise in the lake level increases the surface area of the lake considerably. Since 1849 the lake level has fluctuated by approximately 20 feet. Due to the lake's geographic setting, this fluctuation has moved the shoreline as much as 15 miles.

The Great Salt Lake is the modern day remains of glacial Lake Bonneville, which covered the area some 30,000 years ago. Great Salt Lake is a "terminal lake" in that it has no outlet. This leads to the accumulation and concentration of salts and other minerals in the lake and its bed resulting in very salty water and large accumulated deposits of mineral salts.

As a highly saline water body, the Great Salt Lake supports no commonly found fish or other aquatic species. Instead, the lake supports algae, brine shrimp and brine flies which can tolerate the high salinity. Brine shrimp eggs are commercially harvested and are marketed largely as an on-demand live feed for shrimp and fish around the world.

The lake is surrounded by an extensive system of wetlands making it a nationally significant resource for migrating and nesting birds.

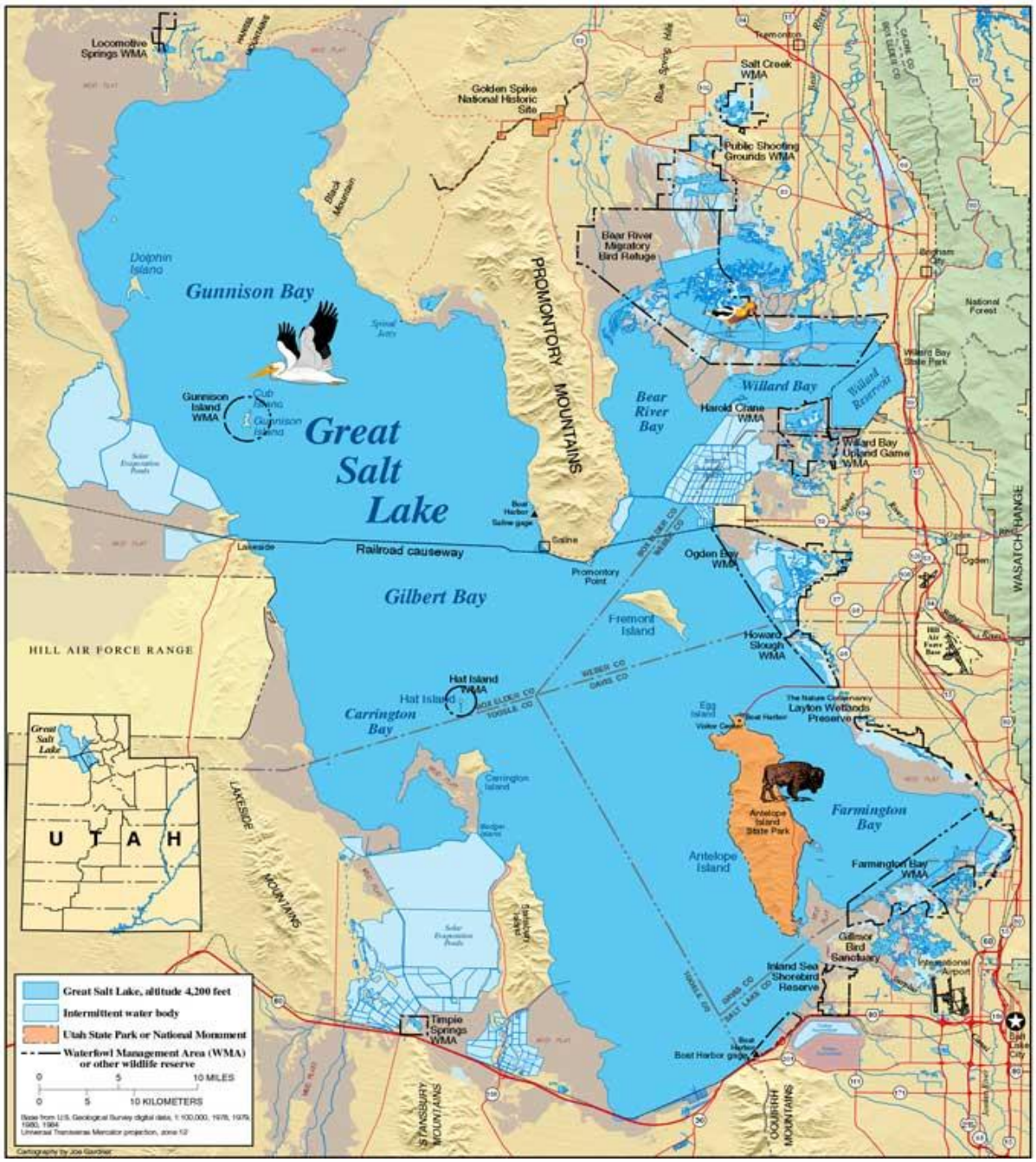

Figure 2. Map of Great Salt Lake and Vicinity

1.3 Regional Economic Setting

The geographic scope of this report is the State of Utah. The Great Salt Lake is located in the north of the state, and is proximate to the largest city (Salt Lake City) and the major population centers of the state.

The analysis in this report focuses on impacts associated with economic activity tied to the Great Salt Lake on the overall economy of the State of Utah.

The analysis in this report is one of "economic significance." This type of analysis is distinct from an "economic impact" analysis in that it does not have as its goal to measure some "change" in income and employment that would be associated with a specific change in one or more industries. Rather, a significance analysis shows the relative share of economic activity within a predefined region that can be tied to a certain industry or activity. In this report, that activity is all recreational and industrial uses of the GSL Ecosystem.

The following sections describe in general terms the size and characteristics of the Utah Economy, along with showing recent trends in key economic indicators for the state.

1.3.1 State of Utah Economic Setting and Trends

Table 3 shows a comparison of Utah and U.S. economic trends across a broad range of socioeconomic statistics. Overall, population, employment, and personal income have all increased much more rapidly in Utah than in the U.S. as a whole over the period 1970-2009. In 2010, Utah unemployment (7.7%) was lower than for the entire U.S. (9.6%), while average earnings per job and per capita income also substantially lagged the national averages.

While the overall profile of employment and earnings in the State of Utah is substantially similar to that of the U.S., the percent of Federal land in the state (64%) is over three times the average nationwide (20.6%).

Table 3. Summary Socioeconomic Trends for the State of Utah, Compared to the U.S. (Source: Sonoran Institute Economic Profile System).

Summary	Utah	U.S.
Trends		
Population % change, 1970-2009	161.3%	50.6%
Employment % change, 1970-2009	256.9%	90.4%
Personal income % change, 1970-2009	340.4%	164.4%
Prosperity		
Unemployment rate, 2010	7.7%	9.6%
Average earnings per job, 2009 (2010 $s)	$42,464	$51,526
Per capita income, 2009 (2010 $s)	$32,102	$40,285
Economy		
Non-Labor % of total personal income, 2009	31.9%	35.5%
Services % of total private employment, 2009	82.3%	84.0%
Government % of total employment, 2009	14.3%	14.2%
Use Sectors^		
Timber % of total private employment, 2009	*0.4%*	0.7%
Mining % of total private employment, 2009	1.0%	0.5%
Fossil fuels (oil, gas, & coal), 2009	*0.6%*	0.4%
Other mining, 2009	*0.3%*	0.1%
Agriculture % total employment, 2009	1.2%	1.5%
Travel & Tourism % total private emp., 2009	13.7%	14.9%
Federal Land*		
Federal Land % total land ownership	63.9%	20.6%
Forest Service %	14.8%	8.7%
BLM %	41.9%	8.5%
Park Service %	3.6%	1.3%
Military %	3.3%	0.9%
Other %	0.2%	1.1%
Federal land % Type A**	11.3%	21.7%
Federal payments % of gov. revenue, FY07	1.6%	na
Development		
Residential land area % change, 1980-2000	22.0%	32.1%
Wildland-Urban Interface % developed, 2000	4.8%	13.9%

Table 4 shows the distribution of employment and average annual wages across economic sectors for Utah in 2010. In 2010 the average annual wage in Utah was $39,400. The economic sector that compared most favorably to this average was mining (including fossil fuels) which had an average wage of about $70,000, or 78% greater than the overall statewide average. The services sector, leisure and hospitality services, by comparison had the lowest average annual wage of $15,900, or 60% lower than the statewide annual average.

Table 4. State of Utah 2010 Employment and Wages, by Economic Sector

Employment & Wages by Industry, 2010 (2010 $s)

	Employment	% of Total Employment	Avg. Annual Wages	% Above or Below Avg.
Total	1,150,514		$39,397	
Private	946,118	82.2%	$38,932	-1.2%
Non-Services Related	190,320	16.5%	$47,560	20.7%
Natural Resources and Mining	14,843	1.3%	$57,319	45.5%
Agriculture, forestry, fishing & hunting	4,400	0.4%	$27,110	-31.2%
Mining (incl. fossil fuels)	10,442	0.9%	$70,053	77.8%
Construction	65,237	5.7%	$42,077	6.8%
Manufacturing (Incl. forest products)	110,240	9.6%	$49,491	25.6%
Services Related	755,798	65.7%	$36,759	-6.7%
Trade, Transportation, and Utilities	226,986	19.7%	$35,265	-10.5%
Information	28,033	2.4%	$52,447	33.1%
Financial Activities	67,997	5.9%	$49,712	26.2%
Professional and Business Services	150,322	13.1%	$47,131	19.6%
Education and Health Services	140,717	12.2%	$37,514	-4.8%
Leisure and Hospitality	110,602	9.6%	$15,901	-59.6%
Other Services	31,064	2.7%	$25,771	-34.6%
Unclassified	77	0.0%	$54,767	39.0%
Government	204,395	17.8%	$41,548	5.5%
Federal Government	37,654	3.3%	$60,337	53.2%
State Government	54,725	4.8%	$47,198	19.8%
Local Government	112,016	9.7%	$32,472	-17.6%

As noted above, unemployment in the state of Utah has consistently been lower than in the nation as a whole. Table 5 shows monthly estimated unemployment for Utah for the period January 2007 through August 2011.

Table 5. State of Utah Seasonal Unemployment Rates, 2007-August 2011.

Seasonal Unemployment Rate, 2006-2011

Unemployment Rate (%)	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2007	2.7%	2.7%	2.5%	2.4%	2.4%	2.8%	2.8%	3.0%	2.6%	2.7%	2.6%	2.8%
2008	3.3%	3.4%	3.4%	3.0%	3.2%	3.7%	3.8%	4.1%	3.6%	3.9%	4.3%	5.0%
2009	6.2%	6.8%	7.0%	6.7%	6.9%	7.5%	7.4%	7.5%	7.1%	7.2%	7.2%	7.6%
2010	8.4%	8.6%	8.3%	7.7%	7.5%	7.8%	7.8%	7.9%	7.2%	7.3%	7.3%	7.2%
2011	8.2%	8.1%	7.6%	7.0%	7.3%	7.8%	7.7%	7.6%				

1.3.2 State of Utah 2010 Economic Structure: Output, Income, and Employment

The regional economic significance model utilized within this report is the IMPLAN Input-Output Model (MIG 2011). Construction of this model utilized the most recently available data on the overall structure of the Utah economy. This most recent data is for the 2010 calendar year. Figure 3 shows the allocation of total employment within Utah in 2010. The largest sector for employment is the services sector with 53% of total jobs.

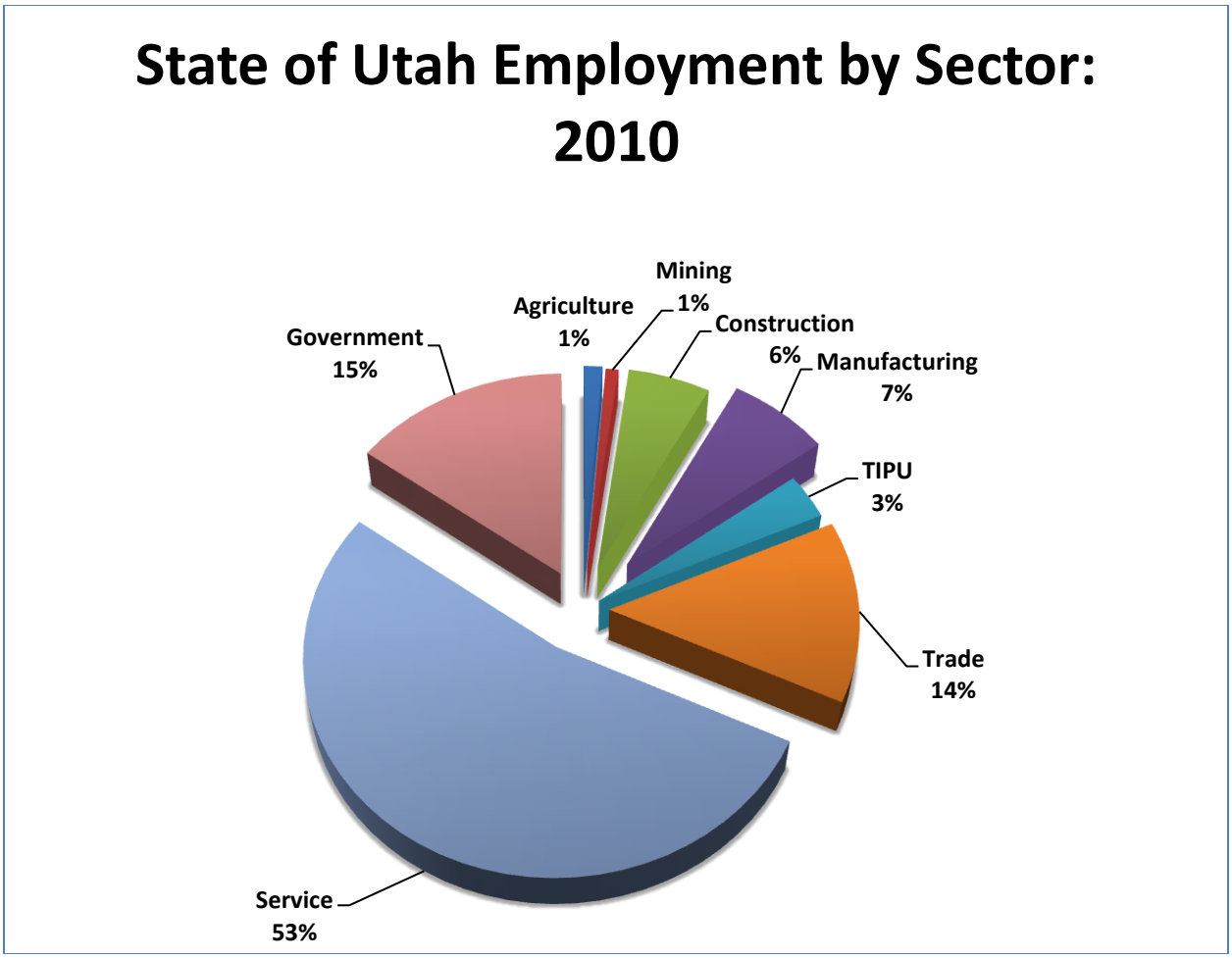

Figure 3. Distribution of Utah Employment by Sector of the Economy. (Source: 2010 IMPLAN Data) (TIPU includes Transportation, Information and Public Utilities)

Figure 4 shows the 2010 distribution of total Utah economic output across economic sectors. It is interesting to note that some sectors with relatively low employment levels have a much larger share of total economic output. The most striking example is manufacturing with 7% of employment but 25% of total output. Sectors with a lower share of total economic output than their share of total employment are services, government, and wholesale and retail trade.

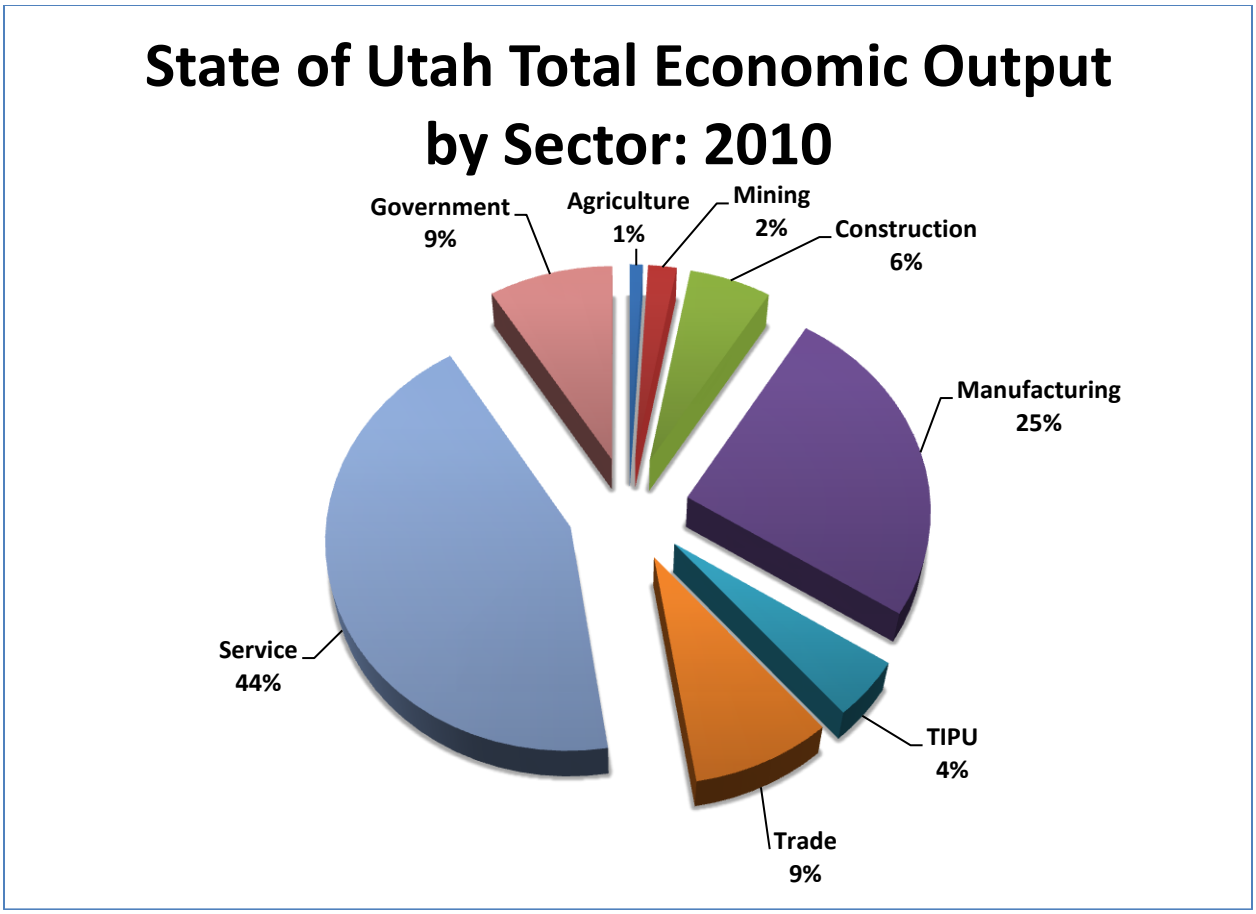

Figure 4. Distribution of Total Utah Economic Output across Sectors of the Economy.

1.4 Classification of Great Salt Lake Ecosystem Services and Values

The National Research Council in their 2005 publication "Valuing Ecosystem Services: Toward Better Environmental Decision Making" provided a general overview of the benefits that derive from ecosystem services. Figure 5 outlines the uses and benefits associated with the GSL Ecosystem within the National Research Council typology.

As can be seen in Figure 5, several kinds of services, or uses, derive from the GSL Ecosystem. One dichotomy is between on-site or direct use and passive use. Direct use includes seeing and hunting waterfowl, boating, wildlife watching as well as industrial use of the lake. However, individuals who have no expectation to ever visit the GSL may still place a value on knowing that the Great Salt Lake has a complete ecosystem supporting a wide range of species and activities. Such values are termed passive use values and are not dependent on direct on-site use. Several of the possible motives for nonuse values were first described by (Weisbrod, 1964) and (Krutilla, 1967), and include existence and bequest values. Existence values can derive from

merely knowing that a given natural environment or population exists in a viable condition. Bequest values are associated with the knowledge that a resource will be available for future generations

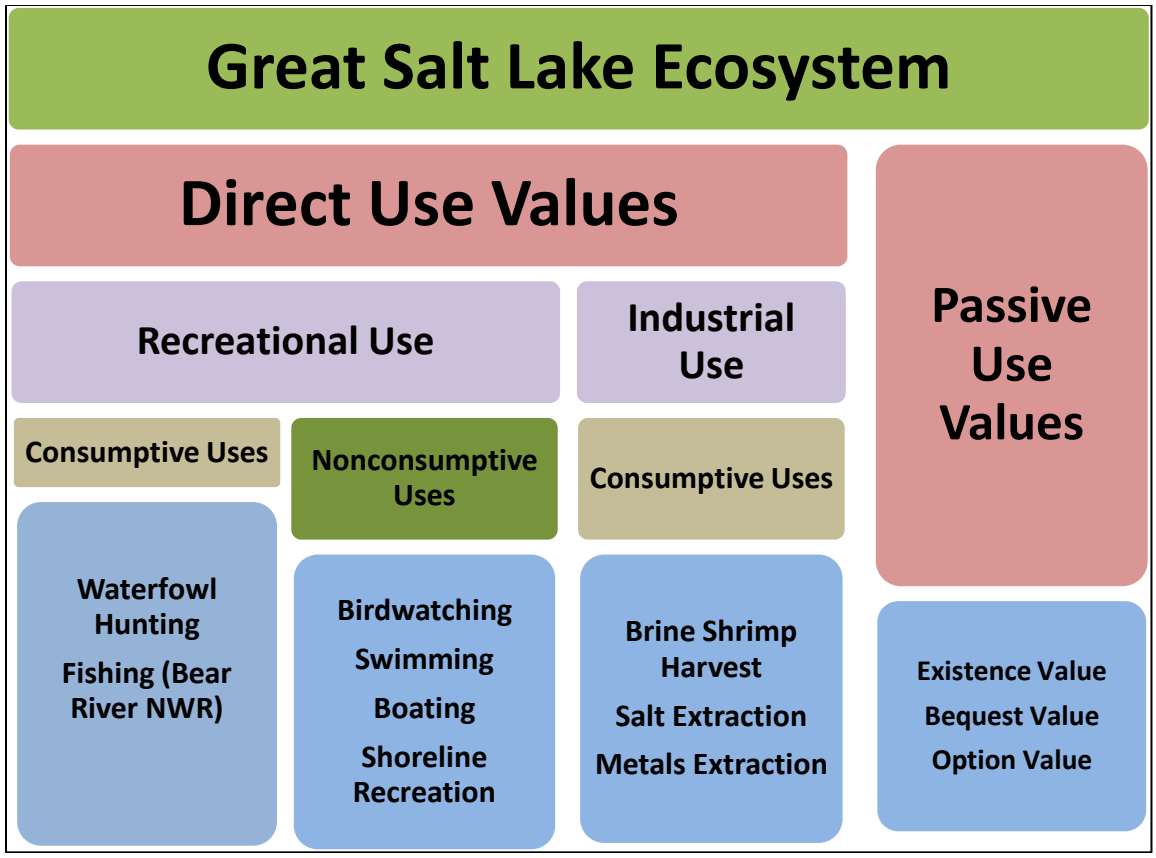

Figure 5. Classification of Great Salt Lake Ecosystem Services

While direct use services may or may not have associated developed markets for them, non-use services are exclusively non-market services. When non-use and direct use values are estimated together, the estimate is referred to as total valuation. This concept was first introduced by (Randall & Stoll, 1983) and has been further developed by (Hoehn & Randall, 1989).

Some values associated with the lake ecosystem can be estimated from market data. This includes money spent for recreation as well as the market value of production from industrial uses. However, some significant values associated with use of the lake ecosystem are not exchanged in markets and must be estimated using valuation methodologies specifically designed for valuing services not traded in traditional markets. The values associated with these services are referred to as non-market values. Examples of specific non-market values at issue for this study include the value of the waterfowl hunting experience, the value of the bird watching experience, and the value of use of the lake to assimilate industrial or public treatment facility waste.

A comprehensive economic evaluation of the contribution of the GSL Ecosystem needs to include two accounting frameworks. One is regional economics or economic significance, focused on identifying cash expenditures that drive income and job levels in the regional economy. The other is a net economic value framework that includes all potential benefits from a broader social (usually national) perspective. The latter necessarily includes nonmarket and indirect benefits, such as the benefits wildlife viewers and hunters derive from their recreational activity, over and above their actual expenditure. Both perspectives are important for policy discussions and generally both accounting frameworks are utilized in evaluating public decisions, for example through an EIS process or in informing public opinion.

1.5 Great Salt Lake Ecosystem Services Analyzed in Report

Table 2 outlines the specific ecosystem services provided by the Great Salt Lake that the authors of this report were tasked with analyzing. These services (or activities) include:

- ✓ Direct and Indirect Recreation (including recreation, Tourism, Wildlife Viewing and Hunting)
- ✓ Industrial Use (including Mineral Extraction Industry)
- ✓ Aquaculture (Harvest of Brine Shrimp Eggs)

A review of both the industrial uses of the lake environment, as well as the available information on the recreational uses of the lake, allowed the construction of a larger and more inclusive description of activities considered in this report (Figure 6).

Figure 6 shows five groups of ecosystem services examined in this report. Each of these groups is responsible for economic benefits to the State of Utah. Lake harvest is the aquaculture harvest of brine shrimp eggs from the unique lake environment. The minerals group includes the extraction and processing of salt, magnesium chloride, magnesium metal, titanium sponge, and sulfate of potash. The recreation group includes hunting, bird watching, boating, swimming, and general recreation. Waste assimilation refers to the use of the lake to dilute and assimilate effluent from both public sewage treatment plants, as well as industrial uses. Finally, "adjacent ecosystem services" refers to a mix of uses of Utah state land leases that are not captured within the other groups.

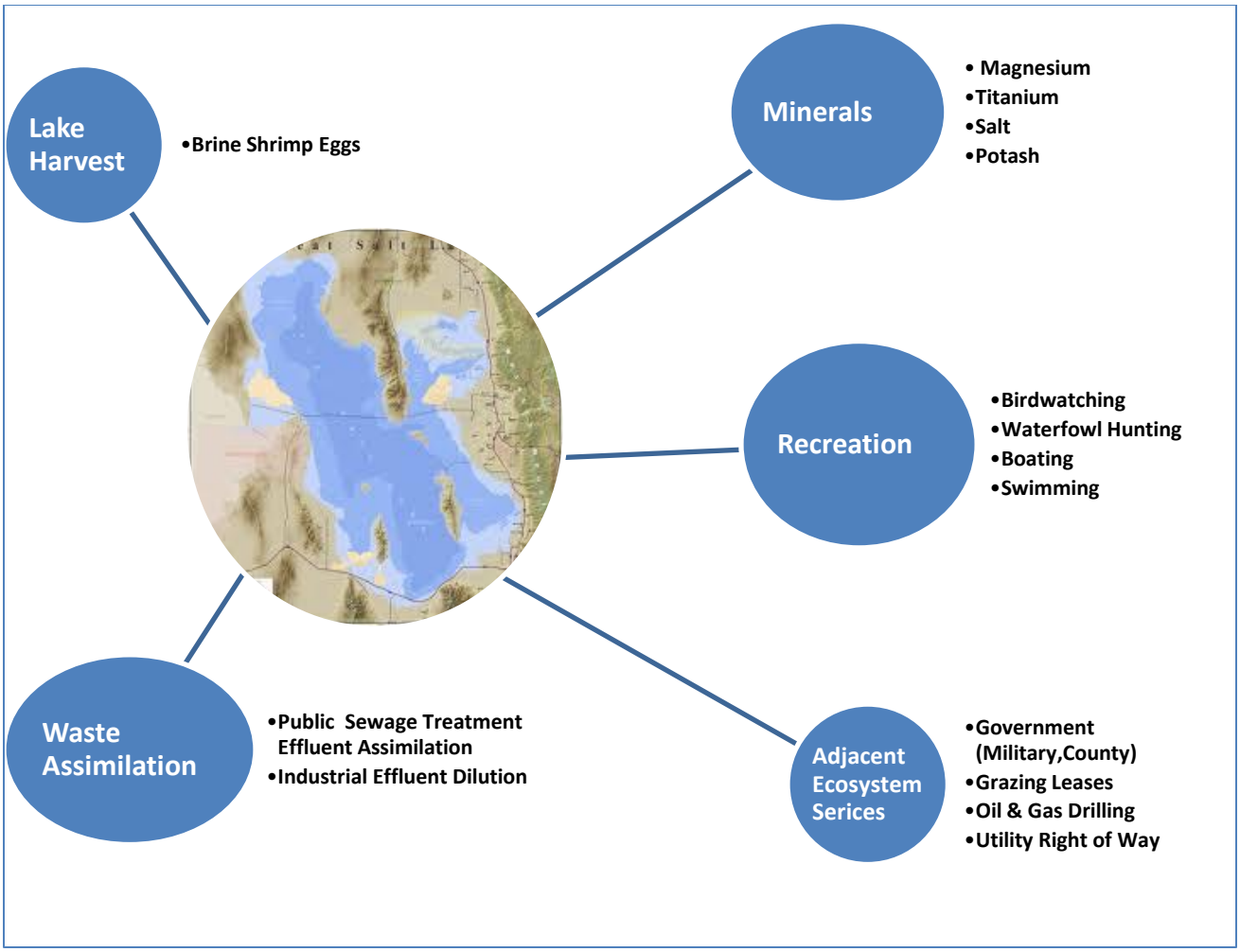

Figure 6. Scope of Economic Activities and Ecosystem Services Examined

As shown in Table 6, the regional economic significance analysis within this report focuses on the industrial, aquaculture, and recreational activities. The net economic analysis estimates focus primarily on the recreation and waste assimilation ecosystem services.

Table 6. Description of Ecosystem Values Addressed in Report, by Accounting Framework

Ecosystem Services Group	Estimation of Economic Significance to Utah Economy	Estimation of "Net Economic Value" of Services
Lake Harvest (Brine Shrimp)	YES	NO
Mineral Extraction	YES	NO
Recreation	YES	YES
Waste Assimilation	NO	YES
Adjacent Ecosystem Services	Limited	Limited

There are a number of sources for excellent discussions of both industrial and recreational activity within the GSL Ecosystem. The "Great Salt Lake Comprehensive Management Plan Revision" (Utah DNR-DFFSL, 2011) provides a comprehensive discussion of the recreational activities as well as industrial activities on or around the lake. The document also provides information on recreational, and some industrial use levels. In addition to the 2011 DNR report, the 2002 DNR publication "Great Salt Lake: an Overview of Change" (Utah DNR 2002) also provides historical context for GSL brine shrimp industry as well as the mineral extraction industries.

The focus of this report is on economic analysis, thus only brief descriptions of the specific economic services provided by the GSL ecosystem are provided below for general context. For more extensive background on these activities within the GSL Ecosystem, the reader is referred to the information sources provided in references section of the report.

1.5.1 Industrial Services

Industrial services provided by the GSL Ecosystem examined in this analysis include the mineral extraction and processing industries. Mineral extraction activities on the Great Salt Lake fall into several distinct products: Salt (Sodium Chloride), Magnesium products (Magnesium Chloride or Magnesium metal and associated products such as titanium), and Potassium (sulfate of potash).

Mineral Extraction Industry[1]

Salt

Large amounts of industrial and commercial salt are produced from the GSL Ecosystem. Several large companies, including Morton, Cargill, Broken Arrow and GSL Minerals produce a variety of salt products include salt cake, detergent fillers, as well as salt products used in making paper and ceramics, in chemical processing, in the production of vinyl, plastics, synthetic fibers, and for salting winter roads.

The salt products from the GSL are extracted by use of solar evaporation. The solar evaporation facilities on the GSL constitute by far the largest production capacity for solar-evaporated salt in North America.

Magnesium

U.S. Magnesium Corporation of Salt Lake City produces all of the primary magnesium (Mg) metal in the U.S. and provides 14% of the world supply. Magnesium chloride is found naturally in the lake and chemical reactions split magnesium metal from the chlorine. The largest single

[1] The discussion of mineral activity on the GSL is adapted from the State of Utah's Great Salt Lake Ecosystem Program website http://wildlife.utah.gov/gsl/industries/index.php

consumption of magnesium is for the production of aluminum beverage cans. Other uses include production of other metals (such as titanium) for aircraft, automobile sheets, crankcases, computers, cell phones, hand tools, pyrotechnics, motor oil, and pharmaceuticals. In addition to U.S. Magnesium, ATI Titanium has a large production facility on the GSL that produces Titanium sponge using GSL magnesium in the production process.

Production of magnesium chloride on the GSL is generally done through solar evaporation. The primary magnesium chloride product is produced both as a liquid brine and as magnesium chloride flake.

Potassium

Potash, or sulfate of potassium (SOP), is one of the most commonly used commercial fertilizers in the world. SOP is primarily used as a specialty fertilizer for increasing the yield and quality of high-value chloride-sensitive crops. GSL is now the largest solar producer of SOP in the world. GSL Minerals produces SOP at its extensive GSL operation. This operation is the largest SOP production facility of any kind in North America.

1.5.2 Aquaculture Services

Brine Shrimp Industry[2]

Commercial brine shrimp activity on the Great Salt Lake focuses on harvesting Artemia cysts (brine shrimp eggs). These eggs are processed by the local industry so they can be hatched on-demand by commercial aquaculture operations around the world. The young, live brine shrimp (nauplii) are fed to larval stage fish and shrimp that are produced for human consumption.

The brine shrimp egg harvest permits (Certificates of Registration or CORs) are held by 17 different companies. In 2006, most of those companies formed the Great Salt Lake Brine Shrimp Cooperative to achieve operational efficiencies to effectively compete against the numerous, low-cost foreign sources and producers in China, Russia and several other countries in that region. GSL brine shrimp cysts represent between 35 and 45 percent of the world supply.

Both the brine shrimp resource in the Great Salt Lake and the brine shrimp egg harvest are closely monitored and regulated by the Utah State Division of Wildlife Resources (DWR). The harvest season begins on October 1. During the season, DWR regularly (weekly) samples the lake to determine the number of cysts per liter. If the cyst count falls below a certain sustainable level, the harvest may be suspended or even closed for the year. Otherwise, the season ends on January 31.

[2] The description of the GSL brine shrimp harvest was adapted from the "Great Salt Lake Comprehensive Management Plan Revision" (Utah DNR-DFFSL, 2011) and from industry data and sources.

The industry provides daily reports to the state on the total pounds harvested, which includes moisture and raw biomass (e.g. eggs, empty shells, brine fly casings, feathers, plant material, etc.). This raw harvest varies greatly from season to season (see Table 14 and Figure 9). It is estimated that no more than 10 to 15 percent of the harvest weight is sold, while the rest represents moisture and other raw biomass.

1.5.3 Recreational Services

The GSL Ecosystem provides a variety of opportunities for recreational activity. These activities constitute a wide spectrum of water-based and land-based activities and include both large components of wildlife and non-wildlife activities. Evaluating the overall level of recreational use of the GSL is challenging due to the fact that recreation on and around the lake tends to be dispersed, and aside from isolated sites, visitor counts are not well quantified (Utah DSL 2011). However, even using conservative assumptions about overall recreational use levels, the GSL provides an economically important source of recreational opportunities to the region.

Waterfowl Hunting

As a stopping place for many species of migratory waterfowl, the GSL provides abundant opportunities for water fowl hunting. It is estimated that over 100,000 waterfowl hunting trips per year take place within the GSL Ecosystem (Duffield et. al 2011). These recreational trips are associated with both public lands (such as wildlife management areas) and private lands and private duck hunting clubs.

Birdwatching

Perhaps the most recognizable recreational activity on the GSL involves bird watching. This activity is associated with most recreational sites on and around the lake, and is an activity that continues to grow in popularity nationwide (USF&WS 2001). These are a number of events specific to bird watching on the lake, including the GSL Bird Festival.

Boating

These are a number of boat ramps around the GSL, two of which are open year-around (the ramps at GSL Marina State Park and Antelope Island State Park. Boating on the lake includes sailing, canoeing, and kayaking, as well air boats and other low draft motor boats. The GSL Marina has 320 slips, and park managers estimate nearly 50% of marina visitors engage in boating activities (Personal Comm. Dave Shearer, GSL Marina SP).

Swimming and General Recreation

In addition to hunting, boating, and bird or wildlife watching, visitors to the GSL engage in horseback riding, non-motorized bike riding, ATV riding, swimming, and picnicking. The area

of South Shore Beach was included in the GSL Marina State Park, and at one time had substantial visitor infrastructure and high levels of visitation. That infrastructure including restrooms, et. is no longer in existence, and current visitation to the South Shore Beach area (outside of the Saltair Resort as a concert venue), is minimal. The Black Rock site on the GSL likely has in the range of 10,000 visitors per year.[3]

1.6 Report Coverage of Economic Activities and Values and Sources of Information

This section describes the information and data sources used in the following analyses. The sources of information differed substantially between the industrial uses of the GSL Ecosystem and recreational uses of the area. For industrial uses, key economic data was gathered to the extent possible from representatives of the industries involved. It is a credit to these businesses (some of which are in direct competition) that they were largely willing to divulge sensitive data on employment levels, production levels, prices, and sales. A condition of providing the authors with this data was that results for the two major industry groups (brine shrimp, and mineral production) be presented in aggregate form, rather than as business-specific data.

For recreational activities in the GSL Ecosystem, searches were made for individual (and compilations of estimates of recreational use, expenditures, and net economic values either directly associated with or comparable to the GSL setting. Information utilized included publications by the State of Utah, the USF&WS, economic reports and journal articles, as well as personal contacts with park, refuge, and state personnel.

1.6.1 Industrial Production Activities

Table 7 outlines the specific sources of data used in estimating total direct industrial output and employment for the brine shrimp and mineral extraction sectors of the GSL Ecosystem economy. Overall, all major businesses were willing to speak in at least narrow ranges and general terms about their businesses' employment and production levels and the average prices of their products. Some businesses went much further and provided detailed data on annual sales, employment, payroll, and taxes.

Information from Business SEC filings, annual reports, publicly available State of Utah reports, and publicly available industry production and price data was also used as a consistency check for the industry supplied data. Table 7 shows that overall based on the information provided by GSL-area businesses, and supplemented with additional industry and government data, the quality of the information gathered on the production value of industries surrounding the GSL is judged to be high. Nearly all production value and employment estimates were either directly supplied or generally confirmed by the business contacted.

[3] Personal Communication, Dave Shearer, Manager, GSL Marina. January 20, 2012

Table 7. GSL Industry Economic Data Sources and Quality

Industry / Product	Sources of Data	Assessment of Data	Percent of Values inferred from non-industry sources	Quality of the final estimates
Brine Shrimp	Industry Contacts	Complete	0%	Very High
Salt (NaCl)	Industry Contacts, State of Utah Data, Industry Publications	Largely Complete	<10%	High
Magnesium Chloride (MgCl2)	Industry Contacts, USGS Publications, Industry Publications, SEC Filings	Largely Complete	<5%	High
Magnesium	Industry Contacts	Complete	0%	Very High
Sulfate of Potash	SEC Filings, Industry Contacts	Complete	0%	Very High
Titanium Sponge	Industry Contacts, Company Publications, Industry Price Data	Complete	0%	High

1.6.2 Recreational Activities

For purposes of economic modeling, recreational activities were divided into four general categories: Waterfowl hunting, bird watching, boating, and general recreation. Use data was largely derived from a combination of Utah State Parks visitation data, Descriptions of GSL recreational use contained within UT DNR (2011), data from the Bear River Migratory Bird Refuge, and the report "Utah Waterfowl Hunting" (Duffield et. al 2011).

Challenges associated with compiling this data included guarding against double counting use between waterfowl hunting used and other estimates of recreational use, as well as attempting to be comprehensive while working with divergent and somewhat non-consistent data sources. The diffuse nature of much GSL recreation means that basing recreational use estimates only on available use data should provide a conservative estimate of actual annual recreational use levels on or around the lake.

Table 8. GSL Ecosystem Recreational Use Data Sources.

Recreational Activity	Sources of Use Data	Sources of Expenditure Data	Sources of NEV Data
Waterfowl Hunting	Duffield et. al (2011)		
Bird watching	Utah Division of State Parks	U.S. Fish and Wildlife Service (2001)	U.S. Fish and Wildlife Service (2001)
Boating	UTAH DNR (2011)	Utah State Parks	U.S. Fish and Wildlife Service (2006)
Swimming/General Recreation	USF&WS Per. communication	Utah DNR (2011)	U.S. Fish and Wildlife Service (2006)

1.6.3 Other Ecosystem Services

In addition to industrial and recreational value, the GSL Ecosystem also provides substantial value to the residents of the State of Utah through dilution and waste processing by natural systems. Data on these values were provided through a Utah Division of Water Quality 2010 report on avoided costs associated with publicly-owned treatment works being able to discharge higher nutrient levels into the lake due to the unique ability of the system (and brine shrimp population) to process those nutrients (CH2MHILL 2010), and by Utah DNR (2011). Estimates of general values of industrial waste assimilation (other than from public sewage systems) were based on Gibbons (1986).

Table 9. Other GSL Ecosystem Services Sources of Data

Ecosystem Service	Sources of Use Data	Sources of Value Estimates
Public System Sewage Disposal	Utah Division of Water Quality	Utah Division of Water Quality
Industrial Effluent Disposal	Utah Department of Natural Resources	Gibbons (1986)
Grazing Leases	Utah Department of Natural Resources	Utah Department of Natural Resources
Oil and Gas Production	Utah Department of Natural Resources	N/A

2.0 Baseline Regional Economic Significance of the Great Salt Lake

This section describes the basis and derivation of estimated direct economic value (production value or visitor expenditures) that are used in the Section 3 regional IMPLAN economic significance model. These values represent the most basic level of economic activity tied to the ecosystem services that flow from the GSL; expenditures made by recreational visitors to the lake and the value of industrial, commercial, or aquaculture production from the lake (generally measured in product sales).

The direct use values discussed in this section represent estimates of the direct spending within the state of Utah related to recreating on or around the GSL (for recreational activities), and the total annual value of production (sales) and employment for industrial and aquaculture uses of the GSL Ecosystem. For estimation of direct recreational spending in the State of Utah tied to the lake, estimates of average visitor spending per trip within Utah were taken from the USF&WS Survey of Hunting, Fishing, and Wildlife-Associated Recreation for Utah (USF&WS 2006). Estimates of direct production value were obtained directly from the major businesses producing products from the GSL Ecosystem resources.

2.1 Direct Recreational Expenditures Tied to the Great Salt Lake

Figure 7 shows the linkages between recreational use of the GSL Ecosystem and economic activity and value. Visitors to the lake spend money on their visits. That spending may be limited to a few gallons of gas and a picnic lunch for someone living nearby, or might involve long distance travel, spending on lodging restaurants and other travel and vacation-related expenditures for someone visiting from out-of-state, or out-of-country.

The following two sections discuss estimated total direct use levels and expenditure levels for waterfowl hunting and non-hunting recreational use of the GSL Ecosystem.

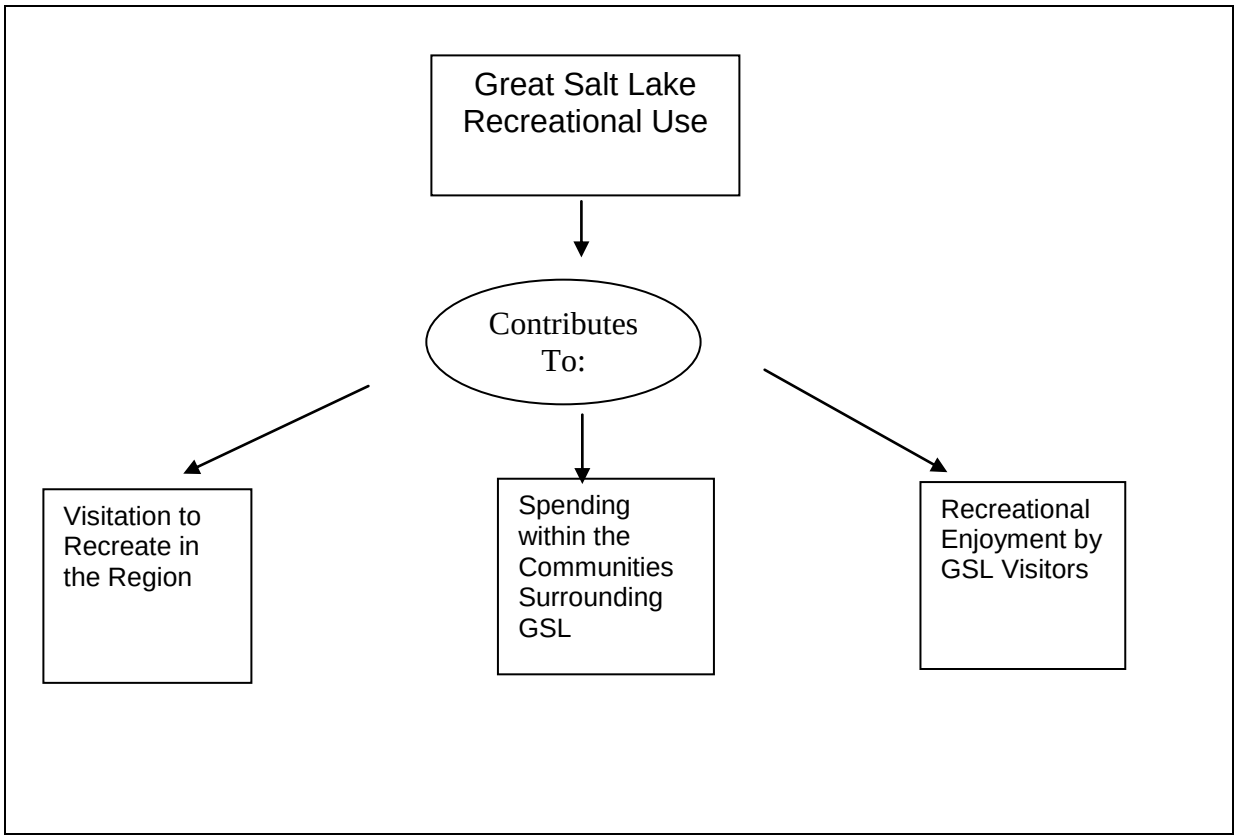

Figure 7. Linkage of Great Salt Lake Recreation to Positive Economic Values.

2.1.1 Direct Waterfowl Hunting Expenditures

There is a longstanding tradition of hunting waterfowl in the Greater Salt Lake Area. A 2011 report on Utah Waterfowl hunting values (Duffield, et al. 2011) described the results of a 2011 economic survey of GSL area waterfowl hunters.

In the survey, Utah waterfowl hunters were asked a number of questions regarding the amount they spent on their most recent hunting trip, and where they spent that money. Additionally, hunters were asked to what equipment purchases they had made of waterfowl hunting equipment in 2010 in the Salt Lake Area. Table 10 shows the calculation of estimated total 2010 waterfowl hunter spending in the Salt Lake City Area and in the state. The estimates in Table 10 are based on information from both a Public hunter sample and Private Duck Club member survey expenditure questions. While Private Club hunters are estimated to comprise less than 2.5% of Utah Duck Stamp holders, this group hunts on average more days per year, and spends nearly three times the amount per day as do non-club hunters. For this reason, separate expenditure estimates were generated using the Public hunter sample with no club members included, and the Private Club sample. These estimates of hunter trip and equipment spending are combined to

estimate total waterfowl hunting trip expenditures in the SLC area, and in the state, as well as total 2010 hunting-related equipment spending in the SLC area.

Overall, it is estimated that Utah waterfowl hunters from the public sample spent an average of $180 per trip (day) on their 2010-11 hunting trips. This estimate is similar to other studies of waterfowl hunting expenditures (Grado, Kaminski, Munn, & Tullos) (Lewis, Leitch, & Meyer, 1998) (Adams, Leifester, & Herron, 1997). It is estimated that Private Club hunters spent an average of $563 per day for their 2010 waterfowl hunting trips.

The Utah Division of Wildlife Resources estimates that Duck and Goose hunters in the state hunted approximately 210,000 days during the 2010-11 waterfowl season.[4] Overall in 2010 it is estimated that waterfowl hunters spent $26.5 million in direct hunting trip expenditures and $35.4 million in other hunting equipment expenditures in the Salt Lake City Area. The estimated 2010 total is $61.9 million in waterfowl hunting-related spending in the year in the local SLC area.

Table 10. Estimated Utah Waterfowl Hunter Direct Expenditures, by Location (2010 estimates)

Spending Area	Expenditures per day per Hunter		Estimated Expenditures		Total Spending
	Public Sample	Club Members	Public Sample	Club Members	
A) Trip Spending					
Spending per day in the SLC Area	$104	$402	$20,295,000	$6,231,000	$26,526,000
Spending per day in Utah outside the SLC Area	$75	$162	$14,636,000	$2,507,000	$17,143,000
Total Spending	$180	$563	$34,931,000	$8,738,000	$43,669,000
B) Equipment Spending					
2010 Equipment purchases in SLC Area	$2,287	$3,703	$32,590,000	2,777,000	$35,367,000
C) 2010 SLC Area Spending					
Total Estimated 2010 Waterfowl Hunting-related Spending in the SLC Area					***$61,893,000***

[a] Total active hunter numbers for Utah are for 2009, the most current year for which estimates are available. Source: (Raftovitch, Wilkins, Richkus, Williams, & Spriggs, 2010).

[4] Pers. Comm. Justin Dolling, Utah Division of Wildlife Resources. July 18, 2011.

2.1.2 Boating, Bird watching, Shoreline Recreation, and Other Recreation Expenditures

As discussed above, estimates of total use levels at GSL recreation sites are not comprehensive and somewhat overlapping. Accurate visitor counts are available, however, from the three Utah state parks located on or around the lake. These three parks had a reported total recreational visitation of 861,000 visitor days in 2010 (Table 11)(Utah State Parks 2011).

Table 11. Utah State Park Visitation for Parks on the Great Salt Lake: 2003-2010

	2003	2004	2005	2006	2007	2008	2009	2010
Antelope Island State Park	268,732	255,155	272,381	250,886	281,266	256,901	273,510	280,351
Great Salt Lake State Marina	139,254	87,170	57,966	138,763	250,478	214,127	213,289	239,956
Willard Bay State Park	206,968	138,868	297,038	325,933	192,224	171,589	304,441	340,645
Total	614,954	481,193	627,385	715,582	723,968	642,617	791,240	860,952

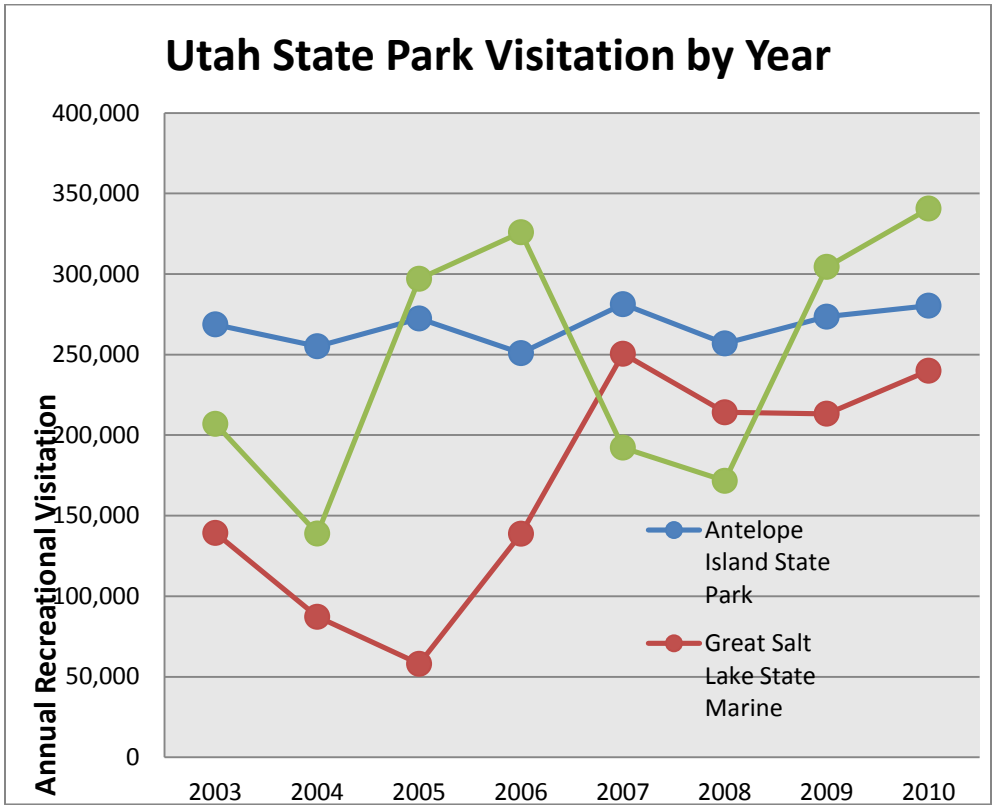

Figure 8. Comparative Plot of GSL Utah State Park Visitation: 2003-2010

In addition to the recreational use of Utah state parks located on the GSL, it is estimated that the USF&WS Bear River Migratory Bird Refuge receives approximately 85,000 visitors per year, 10% to 20% of which are waterfowl hunting trips.[5]

The 2011 Draft GSL Comprehensive Management Plan Revision (Utah DNR 2011) includes recreational use estimates and information for several GSL sites, including Farmington Bay WMA (95,700 2010 visits of which 25,500 were waterfowl hunting trips). The Draft GSL Plan Revision notes one substantial data gap in recreational use at South Shore Beach / Saltair. Estimates of use at this site are not currently gathered. However, prior to 1997 data showed that combined visitation to the GSL Marina SP and the entire South Shore Beach Area exceeded 600,000 visits annually. Conversations with GLS Marina management indicate that the South Shore Beach area no longer has the visitor infrastructure to support significant recreational use, and visitor use of the beach is now minimal. However, the Black Rock site supports approximately 10,000 visitors annually.[6]

As estimates of waterfowl hunting trip expenditures are developed separately from estimates for non-hunting recreation, we have adjusted estimated and reported total recreational use of several sites to remove a share of use assumed to be attributable to waterfowl hunting. These adjustments are based on data and information from the 2011 Utah waterfowl Hunting Study (Duffield, et. al 2011), Bear River MBR data, and Utah DNR (2011) information.

Overall, it is estimated that a conservative estimate of total 2010 recreational visitation to areas on and surrounding the GSL is 990,000 visits. For the sake of valuing this recreation, visit estimates are assumed to equal visitor days.

Estimation of total direct recreational visitor spending in Utah is based on estimates of spending per day for wildlife watching in Utah (USF&WS 2006), Estimates from the GSL Marina Management Plan (2007), and Utah State Parks Economic Toolkit Information. In total, it is estimated that direct recreational spending in Utah by visitors to the GSL Ecosystem totals $51.6 million annually at current visitation levels. While there is uncertainty associated with this estimate due to the different data sources it relies on, the estimate is based on conservative expenditure assumptions and largely on actual reported state and Federal visitor use levels. Thus the estimate likely provides a conservative estimate to direct non-hunting recreational expenditures.

Table 12. Estimated Total Annual GSL Recreational Visitor Days and Direct Spending

Recreational Visitor Days	Total Estimated Annual Direct Spending in Utah	Areas Included
990,000 Visitor Days	$51.6 million	Utah State Parks Wildlife Management Areas Bear River Bird Refuge

[5] Personal Communication, Cathi Stopher, Educational and Visitor Services Manager. Jan. 11, 2012.
[6] Personal Communication, Dave Shearer, Manager GSL Marina. Jan. 20, 2010.

2.2 Direct Economic Activity of Industrial Production in the Great Salt Lake Ecosystem

The total value of production from mineral extraction activities was estimated based on reported annual sales (value of production), as well as reported total volume and price data supplied largely by the GSL mineral businesses. The estimates in Table 13 represent a snapshot in time. Several GSL operators have recently expanded or have expansion plans. To the extent that future production levels of key products such as SOP, Magnesium and Titanium sponge change significantly, the reported values would also change. It should also be noted that (as is the case in any commercially marketed product) the total product value is dependent on commodity market prices that can vary significantly year-to-year.

Overall it is estimated that total annual production value of the GSL-tied mineral extraction industry is in the range of $685 million, and these businesses employ 1,970 full and part-time employees.

Table 13. Estimated Total Annual Production Value of GSL Mineral Producers.

Statistic	Value	Industries Included
Total Sales	$ 685 million	Sulfate of Potash (SOP) Magnesium Titanium sponge Salt Magnesium Chloride
Total Employees	1,970 Full and Part-time	

2.3 Direct Economic Activity Tied to Great Salt Lake Aquaculture

Harvest of brine shrimp eggs from the GSL is variable from year-to-year (Table 14 and Figure 9). For this reason, the information provided on the total estimated annual value of the brine shrimp harvest was provided as an average of the most recent four years activity.

Table 14 . Brine Shrimp Raw Biomass Harvest Levels: 1985-2011

Harvest year	Total pounds	Harvest year	Total pounds
1985–1986	298,035	1998–1999	4,606,352
1986–1987	1,887,300	1999–2000	2,631,853
1987–1988	7,012,775	2000–2001	19,963,087
1988–1989	6,806,415	2001–2002	18,287,569
1989–1990	10,268,232	2002–2003	25,729,490
1990–1991	8,927,818	2003–2004	5,007,709
1991–1992	13,532,797	2004–2005	6,821,167
1992–1993	10,172,399	2005–2006	9,716,700
1993–1994	8,864,092	2006–2007	17,344,187
1994–1995	6,485,954	2007–2008	14,817,210
1995–1996	14,749,596	2008–2009	19,646,933
1996–1997	14,679,498	2009–2010	19,441,730
1997–1998	6,113,695	2010–2011	23,720,326

Industry representatives report that total sales of brine shrimp products have averaged nearly $34 million annually over the past four years. The industry currently has an estimated annual payroll of over $8 million and employs 92 full time and 280 part time workers throughout the year. Finally the industry pays an estimated $3.6 million annually in state and local taxes, fees and royalties (Table 15).

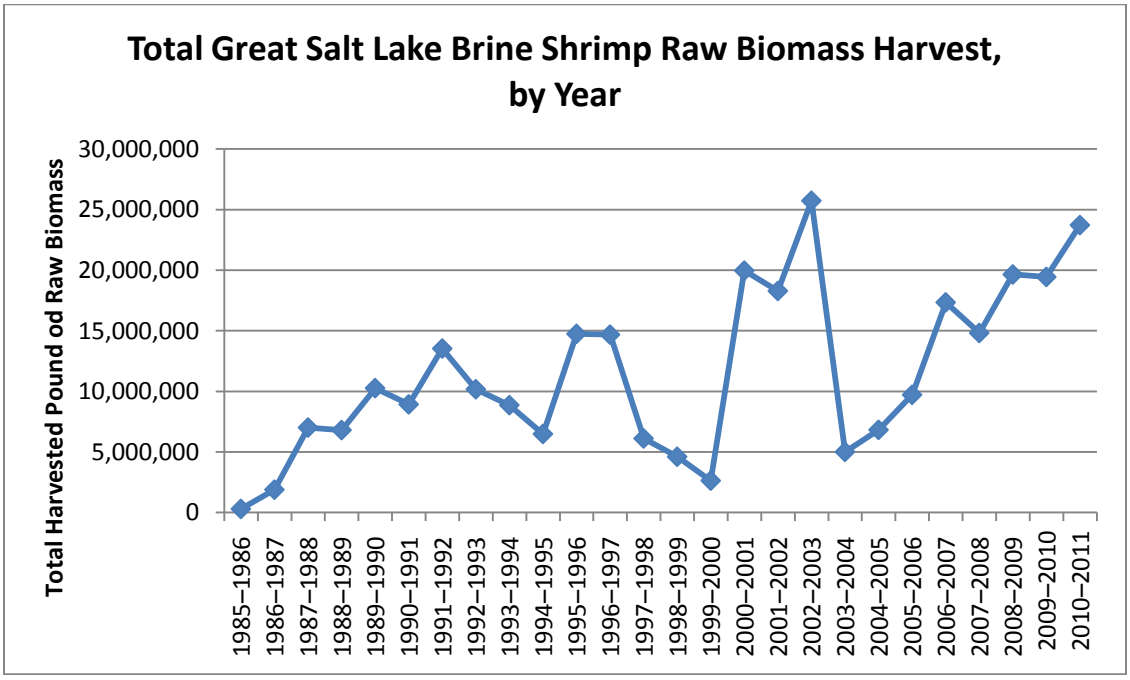

Figure 9. Plot of Brine Shrimp Raw Biomass Harvest: 1985-2011

Table 15. Great Salt Lake Brine Shrimp Egg Businesses, Estimated Annual Direct Economic Significance Statistics. (Source: Industry data)

Statistic	Value
Total Sales	$ 33.9 million
Total Payroll	$ 8.1 million
Total Employees	92 Full-time 281 Part-time
State and Local Taxes and Royalties	$3.6 million

2.4 Economic Significance of Recreational, Industrial, and Aquaculture Uses of the GSL Ecosystem to the State of Utah

Sections 2.1 through 2.3 outline the estimation of direct economic significance of recreational, industrial, and aquaculture activities to the economy of the state of Utah. An analysis of regional economic significance takes these estimates as a starting point in estimating the total effects of that original direct economic activity on the economy.

When goods are sold within a local, state, or regional economy, those sales result in income for business employees and business owners. This is referred as a "direct effect" of the economic activity. In addition to the direct effects on employment and income however, the businesses involved (whether recreational, industrial, or aquaculture) also purchase items and supplies for their businesses within the local economy, thus supporting the employment and income of another group of people. These are called "indirect effects." A third effect is related to the economic activity that occurs when individuals employed either directly in the affected businesses or indirectly spend a portion of their earnings within the state. This round of spending supports what are called "induced effects" on income and employment. The sum of direct, indirect, and induced effects are the total effects or impacts associated with economic activity. (Figure 10)

While direct effects of economic activity tied to the GSL Ecosystem have been described above, estimation of indirect and induced effects is done with the use of an input-output model (MIG, 2010). The model uses comprehensive data on the structure and size of the Utah economy for a certain year (2010 in this case) to estimate the indirect and induced effects on the state economy (measured in employment and income) associated with a specified level of direct spending or production value within the economy.

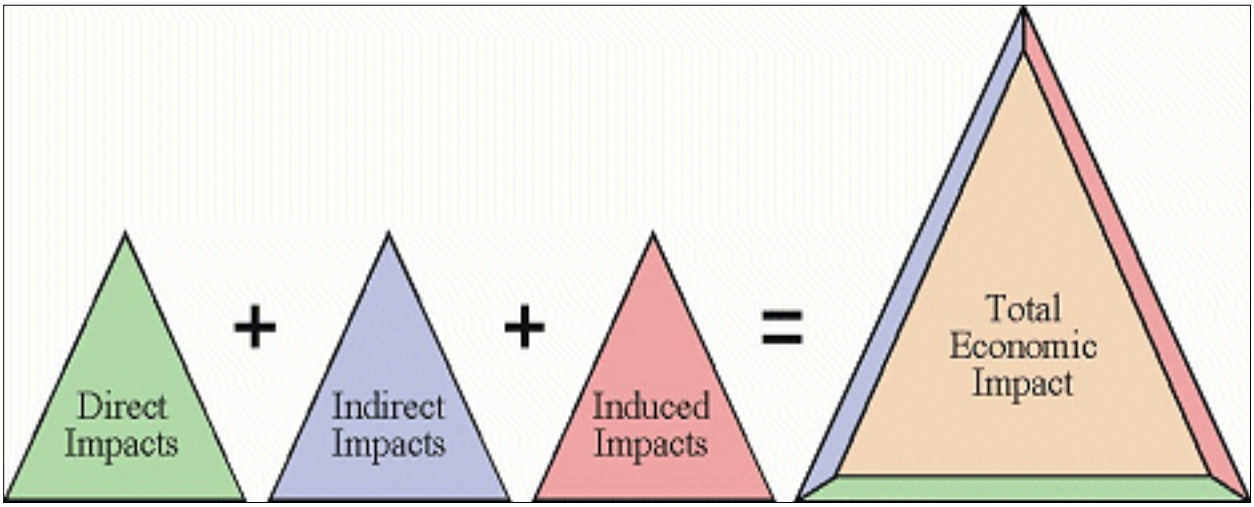

Figure 10. Relationship of Direct, Indirect, and Induced Economic Effects or Impacts.

Table 16 shows the results of the IMPLAN economic significance modeling. The table shows the estimated direct, indirect, and induced effects of GSL-related economic activity on the state of Utah in 2010 dollars. Overall, it is estimated that GSL-tied business activity is responsible for approximately $1.3 billion in economic activity in Utah per year. Lake-based economic activity is estimated to be responsible for 7,700 full and part time jobs in the state, and an estimated $375 million in labor income. Labor income includes both employee compensation and proprietor's income.

Table 16. Total Estimated Output, Income, and Employment Attributable to GSL Economic Activity.

Statistic	Direct Economic Effect	Indirect Economic Effect	Induced Economic Effect	Total Economic Effect
Total Economic Output (millions of 2010 $)				
Recreation Sector	74.6	27.8	33.5	135.8
Industrial Sector (Mineral)	685.2	217.7	227.9	1,130.8
Aquaculture (brine shrimp eggs)	33.9	8.0	14.8	56.7
TOTAL ALL SECTORS				*1,323.3*
Total Labor Income (millions of 2010 $)				
Recreation Sector	25.7	9.2	10.8	45.7
Industrial Sector	168.3	67.1	73.7	309.2
Aquaculture (brine shrimp eggs)	12.3	3.2	4.8	20.2
TOTAL ALL SECTORS				*375.1*
Total Employment (Full and Part-time Jobs)				
Recreation Sector	1,217	236	310	1,764
Industrial Sector	1,967	1,288	2,112	5,368
Aquaculture (brine shrimp eggs)	373	63	138	574
TOTAL ALL SECTORS				*7,706*

3.0 Net Economic Value of Recreational Use of the Great Salt Lake

Net economic value is measured as willingness to pay for a good or service over and above what one must actually spend in the market. There is a direct relationship between expenditures and net economic value, as shown in Figure 11 In the context of recreational visitation to the GSL, a demand curve for a typical lake visitor is shown in the figure. An individual visitor's demand curve gives the number of trips the visitor would take per year for each different cost per trip. The downward sloping demand curve represents marginal willingness to pay per trip and indicates that each additional trip is valued less by the visitor than the preceding trip. All other factors being equal, the lower the cost per trip (vertical axis) the more trips the person will take (horizontal axis). The cost of a recreational trip to a GSL site serves as an implicit price for the visit since a market price generally does not exist for this activity. In the context of recreation, the relationship between net economic value and expenditures is the basis for asserting that net economic value is an appropriate measure of the benefit an individual derives from participation in an activity and that expenditures are not the appropriate benefit measure. Expenditures are out-of-pocket expenses on items a recreational visitor purchases in order to make their trip. The remaining value, net willingness to pay (net economic value), is the economic measure of an individual's satisfaction after all costs of participation have been paid. Summing the net economic values of all individuals derives the value to society.

In the context of non-recreational activities, net economic value can be interpreted as the cost that is avoided by society due to ecosystem services provided by a resource. For example in the case of publicly-owned treatment facilities discharging into or proximate to the GSL, the lake is absorbing some costs of water treatment that the public would have to bear were the lake not available. Therefore, the net economic value to society associated with public discharge of waste into the lake can be measured by the costs of water treatment that are avoided by the public due to the presence of the lake and its ability to process nutrient waste.

This section of the report develops estimates of total net economic value associate with both recreational and industrial use of the GSL Ecosystem.

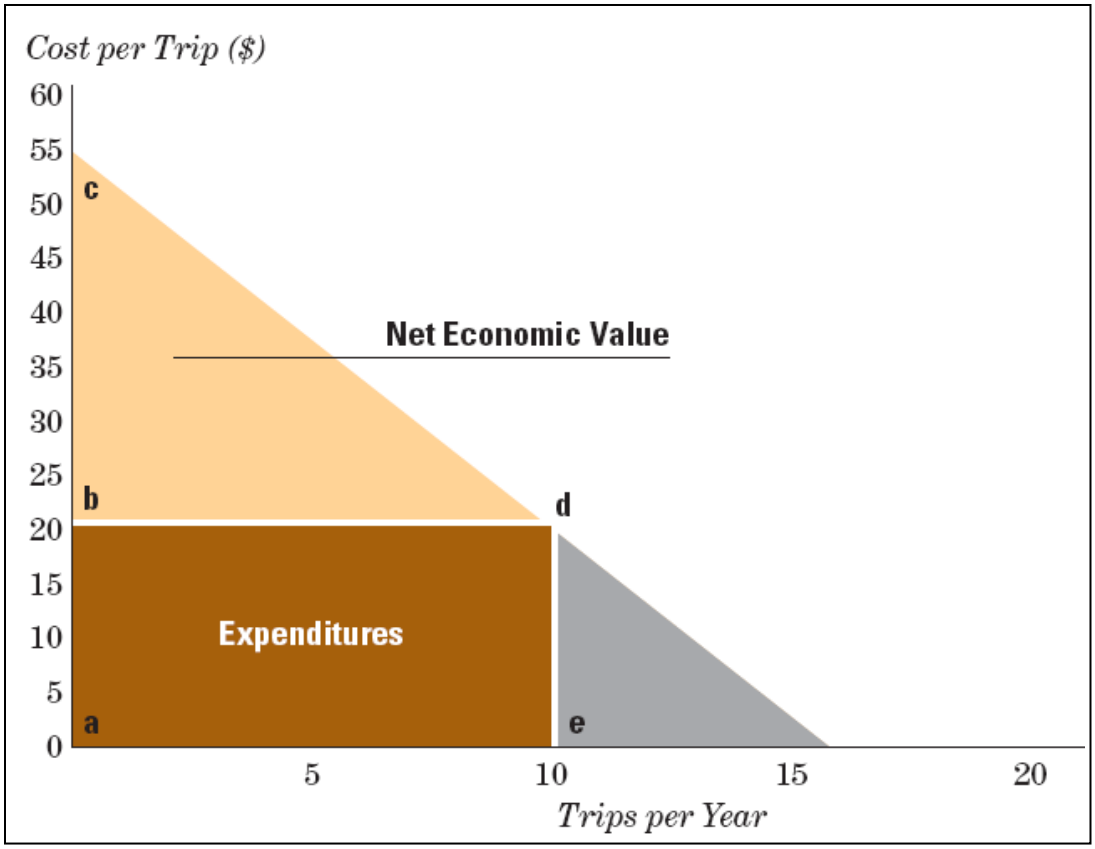

Figure 11.Relationship Between Expenditures and Net Economic Value for Park Visitors (source: USFWS 2001)

3.1 Net Economic Value of Waterfowl Hunting around the Great Salt Lake

The 2001 Utah Waterfowl Hunting Survey (Duffield, et.al 2011) included estimates of net economic value to waterfowl hunters to the GSL. The study used a contingent valuation survey method to elicit WTP values from hunters. The contingent valuation method (CVM) uses survey techniques to determine the values which people would place on traditionally nonmarket goods and services if markets did exist for these commodities. In the study, the value of a day spent waterfowl hunting in Utah was measured through the use of contingent valuation. This is the value, or benefit, a hunter derives from hunting that is over and above what they must actually spend on their hunting trip.

The waterfowl hunting trip contingent valuation question included in the Utah survey asked hunters about their willingness to pay an additional amount in expenses to have made their trip to hunt waterfowl in Utah.

Table 17 shows the median WTP to take the hunters' most recent trip. The median WTP, which is the amount at which 50% of individual's WTP are above and 50% below, for the Public

Hunter Sample is estimated at about $76 per trip (day). For the Private Duck Club Member Sample the Median WTP is $131 per day. The median WTP is a conservative estimate of WTP as it is often less than the mean WTP because of the influence of a relatively low percentage of individuals who are willing to spend quite high amounts for their trips.

The estimated $76/day NEV from the Duffield study of Public Sample hunters is in the same range as other studies findings (adjusted to 2010 dollars(Adamowicz, Phillips, & Pattison, 1986) (Duffield & Neher, 1991). Given the estimated 210,000 waterfowl hunting trips in Utah in 2010, the median WTP estimates for waterfowl hunting trips implies that total annual WTP is on the order of $16.8 million. This value is over and above the amount actually spent for hunting in the state. Utah Division of Wildlife resources estimated that in the 2010-11 waterfowl season, approximately 57% of statewide duck and goose hunting days occur in the vicinity of the Great Salt Lake.[7] Based on this allocation it is estimated that the total NEV to hunters associated with hunting waterfowl in the vicinity of the GSL during the 2010-11 season is approximately $9.5 million. This estimate is likely conservative in two respects. First, the measure of central tendency used is median WTP, which often is less than the estimated overall mean WTP. Secondly, the estimate assumes that Club Members spend the same proportion of their days hunting in the GSL area as do non-club members. Since club membership is specifically tied to the GSL, this likely understates that actual percentage of total Utah trips by this group taken to the GSL area.

It should also be noted, however, that the annual NEV estimate of $9.5 million only reflects the additional value hunters place on a specific use (waterfowl hunting) of this resource.

Table 17. Estimated Net Willingness to Pay per Person for a Utah Waterfowl Hunting Trip: Public Hunter Sample and Private Duck Club Member Sample.

Statistic	Public Hunter Sample	Private Duck Club Member Sample	Total
Estimated Median WTP per Hunter Day	$75.76	$130.90	--
Estimated Days Hunted 2010-	194,500	15,500	210,000
Total Estimated NEV-Utah Waterfowl Hunting 2010-11	$14,735,000	$2,029,000	$16,764,000
Total Estimated NEV-Great Salt Lake Area	$8,420,000	$1,159,000	$9,579,000

[7] Utah Division of Wildlife resources estimates that 64% of duck and combined duck-goose days are in the GSL vicinity, and 50% of goose-only days are in the GSL vicinity. The weighted average for all duck and goose hunting in 2010-11 is 57% of total days.

3.2 Net Economic Value of other Lake-Based Recreation

The U.S. fish and Wildlife Service estimated that the net economic value per day of wildlife watching in the state of Utah for Utah residents was $27. As bird watching is cited as constituting a large share of recreational use of the GSL, this estimate was used for all non-hunting GSL recreational use. Based on this USFWS estimate per day of wildlife watching, the 2010 net economic value of recreational visitation to the GSL Ecosystem is $34.7 in 2001 dollars or $43.1 million in current (2010) dollars.

Table 18. Estimated Net Economic Value of Non-Hunting Recreation in the GSL Ecosystem.

Recreational Visitor Days	Total Estimated Annual Net Economic Value	Areas Included
990,000 Visitor Days	$26.3 million	Utah State Parks Wildlife Management Areas Bear River Bird Refuge

3.3 Net Economic Value of Industrial and Public Utility Use of the GSL Ecosystem

This discussion of net economic values associated with non-recreational uses of the GSL focuses on the use of the lake for dilution and absorption of nutrients from publicly-owned treatment works (POTW). As noted previously, use of a resource to assimilate waste (whether it be air, water, or some other emissions) allows those discharging the waste to avoid the cost of dealing with the waste product in another, more costly manner.

The following section discusses two specific cases of waste dilution and processing specific to the GSL Ecosystem: publicly-owned sewage treatment facilities, and other industrial/municipal discharge into the lake.

3.3.1 Net Economic Value Associated with Publicly Owned Treatment Works

In 2010 the Utah Division of Water Quality published a report entitled “Statewide Nutrient Removal Cost Impact Study” (CH2MHILL 2010). This study developed cost estimates for the publicly owned treatment works (POTW) in the state of Utah to meet different, higher water quality discharge standards. There are 12 POTWs that discharge treated waste either into or proximate to the GSL. There is a unique biological process within the GSL, in which the brine shrimp population feeds off of discharged nutrients and biologically “treats” the discharged

nutrients. This allows nutrient concentrations higher than would typically be allowed for a typical western U.S. cold water stream and lake system to be discharged into and effectively processed by the GSL. Were these discharges occurring into a typical Western cold water riparian system, it is likely that the current POTWs would need to be upgraded to a higher Tier 2N or even Tier 1N discharge standard.[8]

Table 19 shows the report's estimates of the net present value over 20 years of the costs associated with updating these 12 treatment works to Tier 2N and Tier 1N standards. Using the lower cost Tier 2N standard, the annual avoided cost to the treatment works (and implicitly their users) is estimated at $10.3 million in 2010. For the Tier 1N standards the annual avoided cost over 20 years is estimated at $58.9 million

Table 19. Estimated 20-year Net Present Value of Costs of Meeting Tier 2N and Tier 1N Discharge Standards for Public Sewage Treatment Plants discharging into or Proximate to the Great Salt Lake

POTW	Net Present Value Cost to Achieve Tier 2N Standards (million 2010 $)	Net Cost to Achieve Tier 1N Standards (million 2010 $)
BRIGHAM CITY	2.65	22.98
CENTRAL DAVIS	8.23	31.58
CENTRAL VALLEY	34.73	200.53
CENTRAL WEBER	11.85	184.28
MAGNA	2.6	26.47
NORTH DAVIS	37.99	111.78
SALT LAKE CITY	49.29	162.17
SOUTH DAVIS - NORTH	12.32	46.25
SOUTH DAVIS - SOUTH	6.09	24.72
SOUTH VALLEY	1.02	122.91
TOOELE CITY	0.19	16.2
TREMONTON	1.59	14.16
Total 20-year net present value	**168.55**	**964.03**
Annual Avoided Cost at 2% real discount rate	**$10.3 million**	**$58.9 million**

[8] Personal communication, Leland Myers, Manager, Central Davis Sewer Improvement District, November 2011.

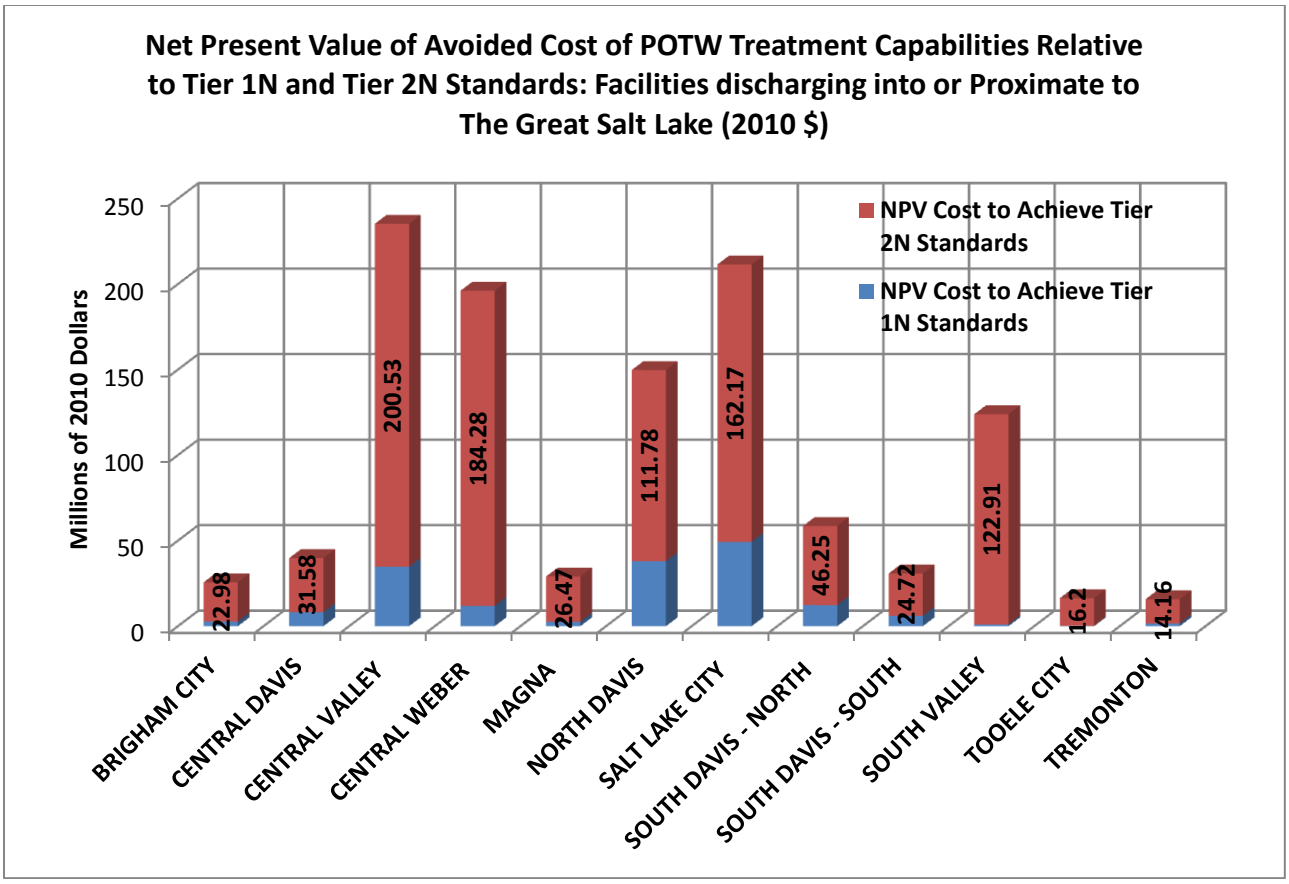

Figure 12. Plot of 20-year NPV estimates for meeting Higher Water Quality Standards

3.3.2 Net Economic Value Associated with Industrial and other Discharges into the Great Salt Lake

The GSL receives permitted direct discharge of municipal and industrial wastewater of nearly 150-200 million gallons per day.[9] While there is some evidence that the value of water for assimilation of BOD is relatively low (Gibbons 1986), it is not without value to the entities that make use of the resource in this way. Due to the unique biological setting of the GSL and the lack of specific estimates in the economics literature related to values associated use of this type of resource for Biological Oxygen Demand (BOD) dilution, no specific estimates of the value of this ecosystem service is presented in this analysis. Rather it is simply noted that the volume of current industrial and municipal wastewater (non-POTW) discharge into the lake is large, and values to the industries and municipalities making those discharges in terms of avoiding alternative costs of disposal/treatment are likely substantial.

[9] Personal communication, Leland Myers, Manager, Central Davis Sewer Improvement District, January, 2012,

4.0 Additional Linkages between the Great Salt Lake and Utah Economic Activity and Value

The previous discussion and analysis has centered on the largest and most obvious sources of economic activity associated with activities on or around the Great Salt Lake. While these activities, which include mineral extraction and processing, aquaculture, and recreation, constitute the vast majority of GSL-based economic activity, it is also important to note other smaller uses of the ecosystem.

4.1 Grazing

While State of Utah leasing of livestock grazing lands surrounding the GSL includes a small number of AUMs (animal unit months) of grazing, There is substantial livestock use on private lands, particularly on the north shore of the lake.[10] These livestock/agricultural uses of the ecosystem, demonstrate the diversity of economic uses associated with the greater GSL Ecosystem. Overall, however, the economic significance of livestock grazing within the context of other uses of the GSL Ecosystem is minimal.

4.2 Oil and Gas Production

While there are current permits for oil and gas production currently issued through the Utah DSL, contacts within the department report that none of these lessees are currently producing oil or gas from their leases.[11] With no current production from permitted oil and gas wells in the area, the economic significance of this activity at present does not extend beyond any minimal lease payments to the State of Utah.

4.3 Lake Effect Snow

One aspect of the Great Salt Lake Basin that has a not-fully understood impact on the local area economy is what is termed "lake effect" snow (or precipitation). The "lake effect' occurs when storms form due to the water in the GSL being warmer than the air above. The result is often locally heavy precipitation. This "lake effect" snow is often cited as a source of the world-famous ski area snows in Cottonwood Canyon above Salt Lake City.[12] Other sources suggest that the majority of "lake effect" snow falls before it arrives at the Wasatch Front, and thus rather than enhancing the local economy through improved snow conditions at ski areas, the "lake effect" has a primarily negative impact on economic activity through storm damage and associated business and municipal losses.[13]

[10] Personal Communication, Randall Kauffman, Utah Division of Forestry, Fire, and State Lands.
[11] Personal Communication, Laura Ault, Forest legacy Coordinator, Utah Division of Foresty, Fire and State Lands.
[12] For example, http://www.utahskiing.org/ accessed Jan 18, 2012.
[13] Precipitation effects are discussed in the Isaacson et al. chapter in Utah DNR (2002) at page 199.

5.0 Possible Passive Use Values Associated with the Great Salt Lake

The Great Salt Lake is a unique resource within a unique setting. This central feature of the northern Utah landscape likely has significant economic value even to members of the public who have no intention to ever visit the area or make direct use of the resource. These values are often called "passive use" values, and can be associated with a number of motivations. These motivations include wanting to preserve a resource for future generations (bequest value), wanting to preserve the option of visiting the area at some undefined time in the future (option value), and simply wanting to preserve a resource for the value derived from knowing it exists (existence value). Estimating the baseline level of those values are difficult and costly, and no recent existing studies provide estimates on the value Americans place on protection the GSL.

Estimation of the values households associate with the GSL ecosystem can be generally approximated, in the absence of direct survey-based studies, from other similar situations such that of Mono Lake in Northern California, the Flathead River and Lake System in Montana, and other similar studies.

While values associated with protected natural resources vary widely across the resource being valued, these previous studies and estimates can be used to provide reasonable ranges of the values associated with protecting the GSL ecosystem through use of benefit transfer methods.

Perhaps the key concern regarding the GSL Ecosystem is about water quality and quantity. Several large scale studies have explored the issue of the passive use values U.S. households place on protection of water quality and quantity and their impacts on ecosystems. However, the most similar case involved California's Mono Lake (Loomis 1989). The Mono Lake estimates as well as other passive use value estimates for water resources in the west are included for comparison. These values which range from $10 to $125 per year per household indicate the public consistently values high profile natural resources highly.

No passive use valuation studies have been done for the Great Salt Lake Ecosystem. However, using the inflation-adjusted value per household estimated for Mono Lake (Loomis 1989) of $125, and the approximately 830,000 Utah households, suggests the passive use value associated with preservation of the Great Salt Lake Ecosystem could be in the range of $100 million annually for Utah households.

Table 20. Comparison of Passive Use Studies and values for Water Resources in the West.

Characteristic	Sutherland & Walsh (1981) (Flathead R. and Lake.)	Brown and Duffield (1995) (Montana R. Instream Flow Protection)	Schultze et al. (1993) (Clark Fork River Cleanup)	Loomis (1989) (Mono Lake, CA lake level protection)
Resource impacted	Flathead R. & L. water quality	Instream flow levels in MT rivers	Upper Clark Fork River and associated resources	Mono Lake water levels
Population impacted	MT households	MT, E. WA households	MT households	CA households
Involve endangered species?	Yes	Yes	No	No
Estimated Passive Use Value per household (study year $)	$46.47 / year	$6.70 / year	$49.00 / year	$70.68 / year
Estimated Passive Use Value per household (2010 dollars)	$110.52 / year	$9.64 / year	$73.94 / year	$125.00 / year

6.0 Summary of Economic Significance and Values

Sections 2-5 of this report present a broad spectrum of measures of economic significance and value associated with activities directly tied to the Great Salt Lake Ecosystem and the services that ecosystem provides. These measures have been presented within two different accounting frameworks: regional economic significance and net economic value. Table 21 shows once again the total estimated regional economic significance of industrial, aquaculture, and recreational activities tied to the use of the Great Salt Lake Ecosystem. Overall, these uses account for $1.32 billion in total economic output, $375 in total labor income, and 7,700 full and part-time jobs annually.

Table 21. Total Estimated Output, Income, and Employment Attributable to GSL Economic Activity.

Statistic	**Direct Economic Effect**	**Indirect Economic Effect**	**Induced Economic Effect**	**Total Economic Effect**
Total Economic Output (millions of 2010 $)				
Recreation Sector	74.6	27.8	33.5	135.8
Industrial Sector (Mineral)	685.2	217.7	227.9	1,130.8
Aquaculture (brine shrimp eggs)	33.9	8.0	14.8	56.7
TOTAL ALL SECTORS				*1,323.3*
Total Labor Income (millions of 2010 $)				
Recreation Sector	25.7	9.2	10.8	45.7
Industrial Sector	168.3	67.1	73.7	309.2
Aquaculture (brine shrimp eggs)	12.3	3.2	4.8	20.2
TOTAL ALL SECTORS				*375.1*
Total Employment (Full and Part-time Jobs)				
Recreation Sector	1,217	236	310	1,764
Industrial Sector	1,967	1,288	2,112	5,368
Aquaculture (brine shrimp eggs)	373	63	138	574
TOTAL ALL SECTORS				*7,706*

Table 22 summarizes the estimated annual net economic value associated with recreation and discharges into the lake (both POTW and industrial/municipal). In total, for these activities, it is estimated that annual net economic value equals $46 to $95 million. The large range in these estimates reflects the difference between the NEV of POTW discharges being valued at avoidance of Tier 2N standards or of Tier 1N standards. It should be noted that there may also be NEV associated with other activities not estimated in this analysis, such as the value of Utah state permits for industrial or commercial activities in the ecosystem. Estimation of these potential values, however, was beyond the scope of this analysis.

Table 22. Estimated Total Annual Net Economic Value Associated with GSL Activities.

Economic Activity	**Estimated Total Annual Net Economic Value**
General Recreation (non-hunting)	$26.3 million
Waterfowl Hunting	$9.6 million
Publicly-owned Treatment Works Discharges	$10.3 to $58.9 million
Other Industrial/Municipal Discharges	Not estimated but positive
Total Annual Value	**$46.2 to $94.8 million**

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