Water-Related
Land Use
Inventories

UTAH

Utah Lake Basin 2008 Inventory

UTAH DNR WATER RESOURCES

A Water-Related Land Use Inventory Report of the Utah Lake Basin

Prepared by:

Utah Department of Natural Resources
Division of Water Resources

Report Compiled:
June 2011

ACKNOWLEDGMENTS

This report was prepared by Eric Edgley, Technical Services Manager. The land use data summarized in this report were gathered under the direction of Todd Adams, Assistant Director, and supervised by Eric Edgley, Section Chief, Technical Services, Utah Division of Water Resources.

The Technical Services Staff was chiefly responsible for the collection, preparation and analyses of the data. The data were error-checked and graphics prepared by Aaron Austin (GIS Analyst) and summarized by Barbara Perry (GIS Analyst). Additionally, other members of the Planning and Development Staffs assisted with the collection of the data.

This report was reviewed by

Dennis J. Strong, Director
Todd Adams, Assistant Director
Eric Edgley, Section Chief, Technical Services
Eric Klotz, Section Chief, Water Conservation & Education
Todd Stonely, Section Chief, River Basin Planning

Dennis J. Strong, Director

TABLE OF CONTENTS

UTAH LAKE BASIN
WATER-RELATED LAND USE INVENTORY

INTRODUCTION

Authority

In the 1963 general session, the Utah State Legislature charged the Division of Water Resources with the responsibility of developing a State Water Plan. This plan is to coordinate and direct the activities of state and federal agencies concerned with Utah's water resources. As a part of this objective, the Division of Water Resources collects water-related land use data for the entire state. This data includes the types and extent of irrigated crops as well as information concerning phreatophytes[I], wet/open water areas, dry land agriculture and residential/industrial areas.

The data produced by the water-related land use program are used for various planning purposes. Some of these include: determining cropland water use, evaluating irrigated land losses and conversion to urban uses, planning for new water development, estimating irrigated acreages for any area, and developing water budgets. Additionally, the data are utilized by many other state and federal agencies.

Previous Methods

The land use inventory methods used by the division in conducting water-related land use studies have varied with regard to the procedures used and the precision obtained. During the 1960s and 70s, inventories were prepared using large format vertical -aerial photographs supplemented with field surveys to label boundaries, vegetation types, and other water use information.

After identifying crops and labeling photographs, the information was transferred onto a base map and then planimetered[II] or "dot-counted" to determine the acreage. Tables for individual townships and ranges were prepared showing the amount of land in each land use category within each section. Data were then available for use in preparing water budgets.

In the early 1980s, the division began updating its methodology for collecting water -related land use data to take advantage of the rapidly growing fields of Remote Sensing and computerized Geographic Information Systems (GIS).

For several years during the early 1980's, the division contracted with the University of Utah Research Institute, Center for Remote Sensing and Cartography (CRSC), to prepare water-related land use inventories. During this period, water-related land use data was obtained by using high altitude color infrared photography and laboratory interpretation, with field checking.

In March 1984, several division staff members visited the California Department of Water Resources to observe its methodology for collecting water-related land use data for state water planning purposes.

Based on its review of the California methodology and its own experience, the division developed a water-related land use inventory program. This program included the use of 35mm slides, United States Geological Survey (USGS) 7-1/2 minute quadrangle maps, field-mapping using base maps produced from the 35mm photography and a computerized GIS to process, store and retrieve land use data.

Areas for survey were first identified from previous land use studies and any other available information. The identified areas

were then photographed using an aircraft carrying a high quality 35mm single lens reflex camera mounted to focus along a vertical axis to the earth. Photos were taken between 6,000 and 6,500 feet above the ground using a 24mm lens. This procedure allowed each slide to cover a little more than one square mile with approximately 30 percent overlap on the wide side of the slide and 5 percent on the slide's narrow side.

The slides were then indexed according to a flight-line number, slide number, latitude and longitude. All 35mm slides were stored in files at the division offices and cataloged according to township, range and section, and quadrangle map location.

Water-related land use areas were then transferred from the slide to USGS 7-1/2 minute quadrangle maps using a standard slide projector with a 100-200mm zoom lens. This step allowed the technician to project the slide onto the back of a quadrangle map. The image showing through the map was adjusted to the map scale with the zoom lens. Field boundaries and other water-use boundaries were then traced on the 7-1/2 minute quadrangle map.

Next, a team was sent to use the map in the field to check the boundaries and current year land use field data on the 7-1/2 minute quadrangles.

The final step was to digitize and process the field data using ARC/INFO software developed by Environmental Systems Research Institute (ESRI).

Present Methodology

Starting in 2000 with the land use survey of the Uintah Basin, the division further improved its land use program by using digital data for the purposes of outlining agricultural and other land cover boundaries. The division uses satellite data, USGS Digital Orthophoto Quadrangles (DOQs), National Agricultural Imagery Program (NAIP), and other digital images in a heads-up digitizing[III] mode for this process. This allows the division to use multiple technicians for the digitizing process.

Digitizing is done as line and polygon files using ArcMap 9/10 or ArcView 3.2 with a satellite image or DOQ image as a background with other layers added for reference. Boundary files are created in logical groups so that the process of edge-matching along quad lines is eliminated and precision is increased. All boundaries of individual agricultural fields, urban areas, and significant riparian areas are precisely digitized.

Once the process of boundary digitizing is done, boundary line files are converted to polygons and loaded onto tablet PCs. Field crews are then sent to label and field check the boundary file as well as the crop or land cover type for each polygon. Each tablet PC is attached to a GPS unit for real-time tracking to continuously update the field crew's location during the field labeling process. This improved process has saved the division much time and money and even greater savings will be realized as the new statewide field boundaries are completed. When the time comes to re-inventory a basin, existing boundaries will be used and will only be modified in areas where they have actually changed.

Once processed and checked, the data is filed in the State Geographic Information Database (SGID) maintained by the State Automated Geographic Reference Center (AGRC). Once in the SGID, the data becomes available to the public. At this point, the data is also ready for use in preparing various planning studies.

In conducting water-related land use inventories, the division attempts to inventory all lands or areas that consume or evaporate water other than natural precipitation. Areas not inventoried are mainly desert, rangeland and forested areas.

Wet/open water areas and dry land agriculture areas are mapped if they are within or border irrigated lands. As a result, the numbers of acres of wet/open water areas and dry land agriculture reported by the division may not represent all such areas in a basin or county.

During land use inventories, the division uses 11 hydrologic basins as the basic collection units. County data is obtained from the basin data. The water-related land use data collected statewide covers more than 2,700,000 acres of dry and irrigated agricultural land. This represents about 5 percent of the total land area in the state.

UTAH LAKE BASIN
WATER-RELATED LAND USE DATA

Basin Description

The Utah Lake Basin covers about 3,040 square miles and comprises all of Utah county as well as parts of Juab, Sanpete, Wasatch and Summit counties. The Traverse Mountains to the north, Wasatch Front to the east, Mt. Nebo Wilderness to the south, and Oquirrh Mountains to the west generally define the boundary of the drainage.

Elevations within the Utah Lake Basin range from 4,475 feet at the Jordan Narrows to 11,928 feet above mean sea level at Mt. Nebo in the south end of the drainage. Mt. Timpanogos on the Wasatch Front peaks at 11,749 feet while the Oquirrh Mountains on the west of the basin rise to more than 10,600 feet. The Traverse Mountains peak at about 6,700 feet.

Due to the wide range in elevation, a wide range of climates also exists within the basin. Temperatures in the basin have reached -30° F in the winter and more than 100° F in the summer. Precipitation in the basin ranges from 12 to 16 inches on the valley floors to 60 inches in the higher elevations of the Wasatch Range. It is one of Utah's wettest basins, receiving an average of 23 inches of precipitation annually[1]. Most of the basins precipitation falls on the Wasatch Range in the form of snow in the winter months.

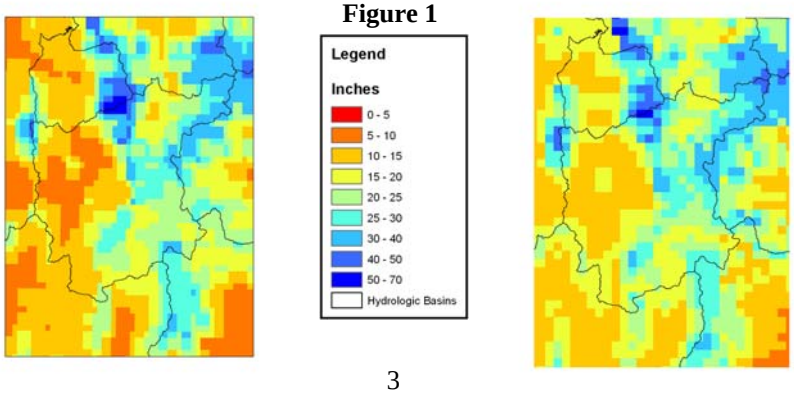
In recent years, agricultural lands have begun to dwindled due to the rapid population expansion and development in the basin. As of 2008, the state of Utah population estimate reached 2,757,779. In that same year, about 14 percent of the state lived in the Utah Lake Basin (391,000). The majority of that population resides at the base of the Wasatch Front between Alpine and Spanish Fork. The basin's largest cities are Provo (pop. 121,330) and Orem (pop. 94,725).

Data Collection

The Division inventoried water-related land use in the Utah Lake Basin dur-

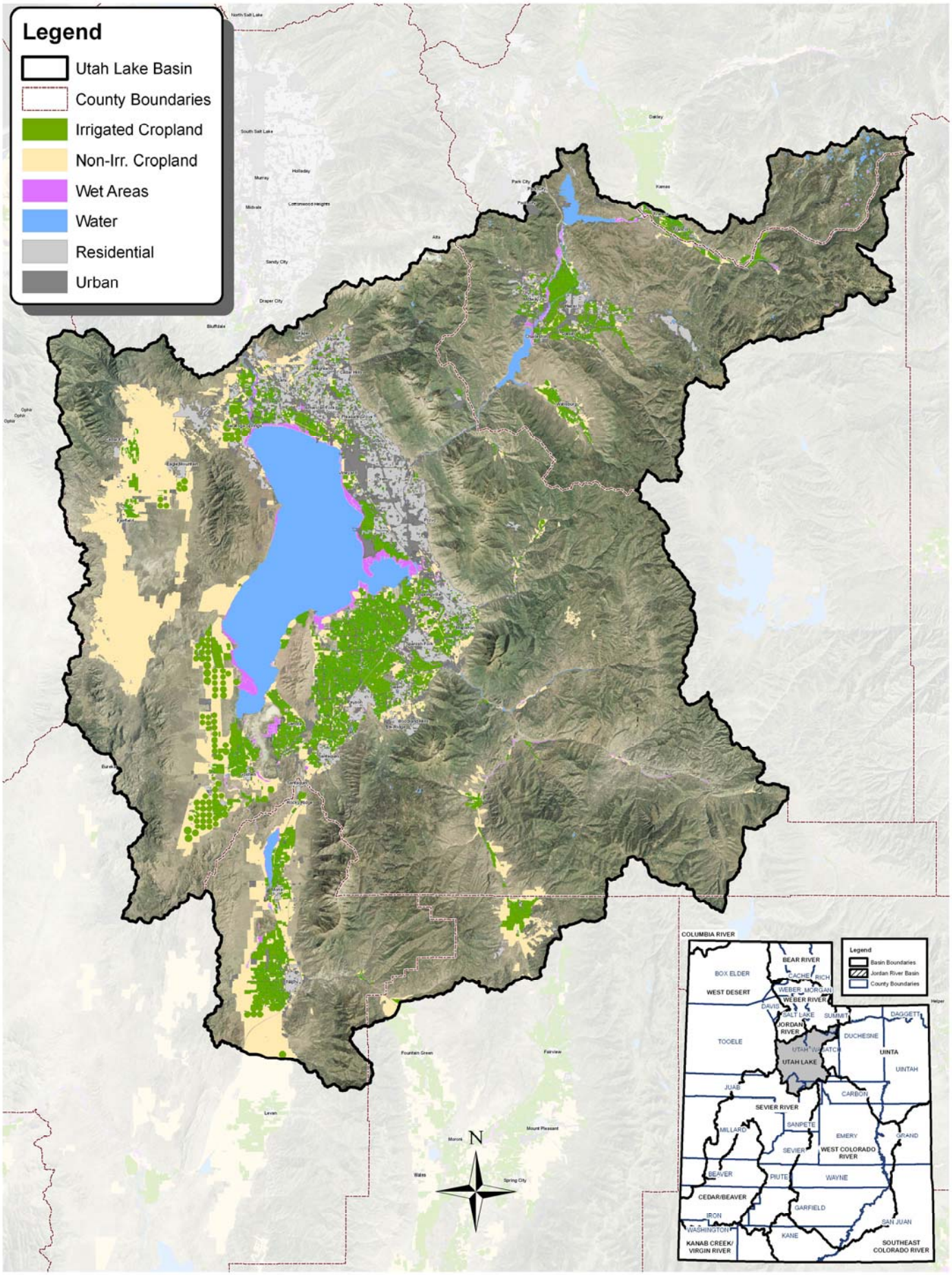
Figure 1

Annual Precipitation For 2008



Average Annual Precipitation 1971 to 2000

Figure 2 Mapped Water-Related Land Use in 2008 and Basin Location



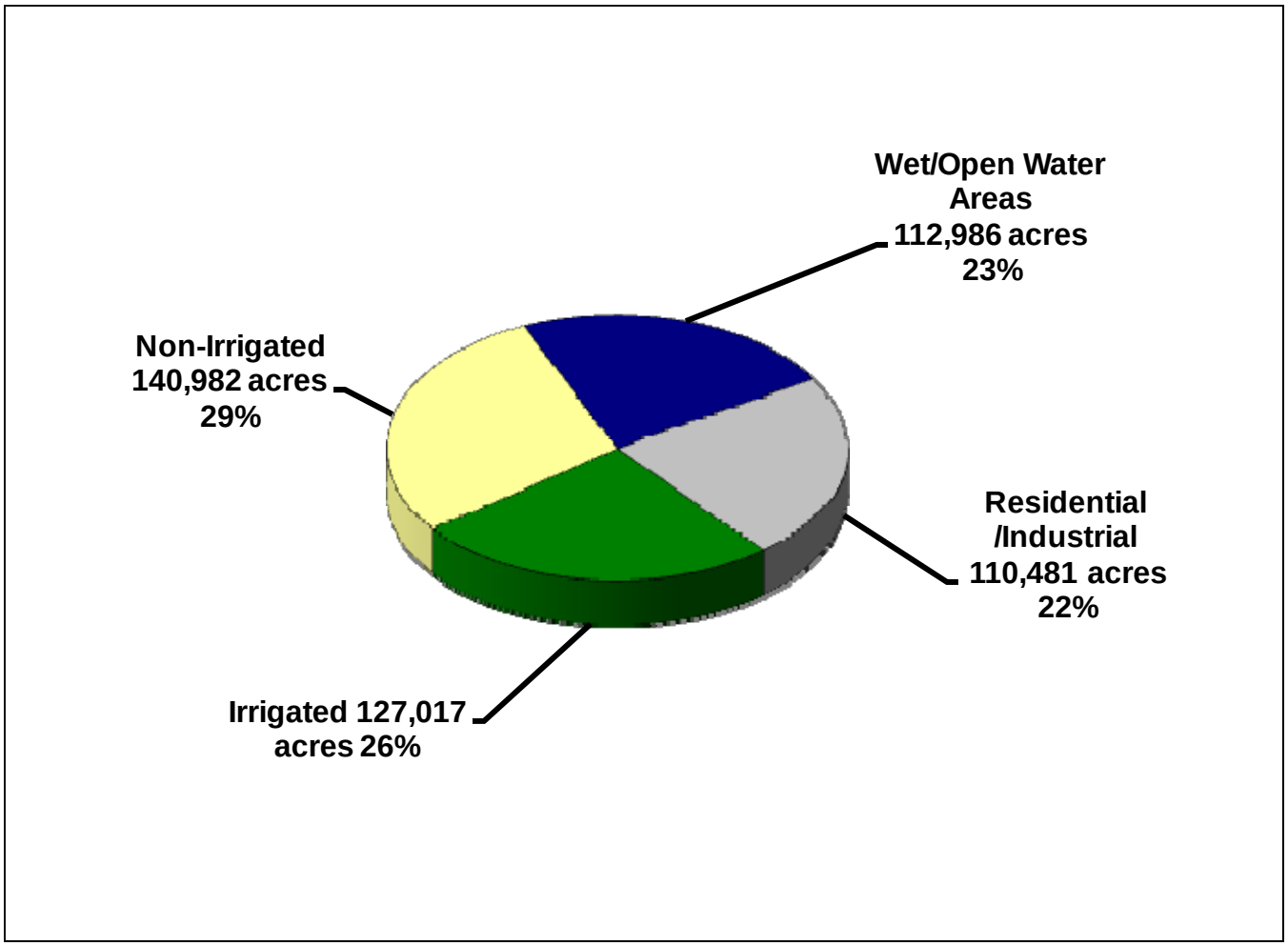
ing the summer of 2008. Previous inventories were done in 1988, 1995, and 2002. In 2008, the division inventoried nearly 492,000 acres of area in the Utah Lake Basin. This represents roughly 26 percent of the total land area in the entire basin. Figure 2 illustrates the water-related land use of the basin and shows that urban and agricultural land use is widespread throughout the basin.

Data Summary

Figure 3 shows four categories of water-related land use by percentage and acreage. Of the 268,000 agricultural acres inventoried in 2008, 127,017 acres were irrigated lands (including land that was sub-irrigated), and 140,982 were non-irrigated (including land that was fallow and idle). Other categories that were inventoried include: 112,986 acres of wet/open water areas (including reservoirs and lakes), and a majority of the acres (110,481) were residential/industrial areas (including farmsteads and rural housing).

The division has further classified the water-related land use within the basin. Figure 4 represents data from the surface irrigated and sub-irrigated cropland categories. The data are broken down into 10 different subcategories.

Figure 3 Delineation of Water-Related Land Use Categories within the Utah Lake Basin in 2008.



Total basin acreage for irrigated lands, non-irrigated lands, wet/open water areas, and residential/industrial are presented in Table 1. Table 2 provides a comparison of acreage totals by survey year.

Due to changes in methodology, improvements in imagery, and upgrades in software and hardware, increasingly more refined inventories have been made in each succeeding year of the Water-Related Land Use Inventory. While this improves the data we report, it also makes comparisons to past years difficult. Making comparisons between datasets is still useful; however, **increases or decreases in acres reported should not be construed to represent definite trends or total amounts of change up or down.** To estimate such trends or change, more analysis is required.

Figure 4 Breakdown of Irrigated Cropland within the Utah Lake Basin in 2008.

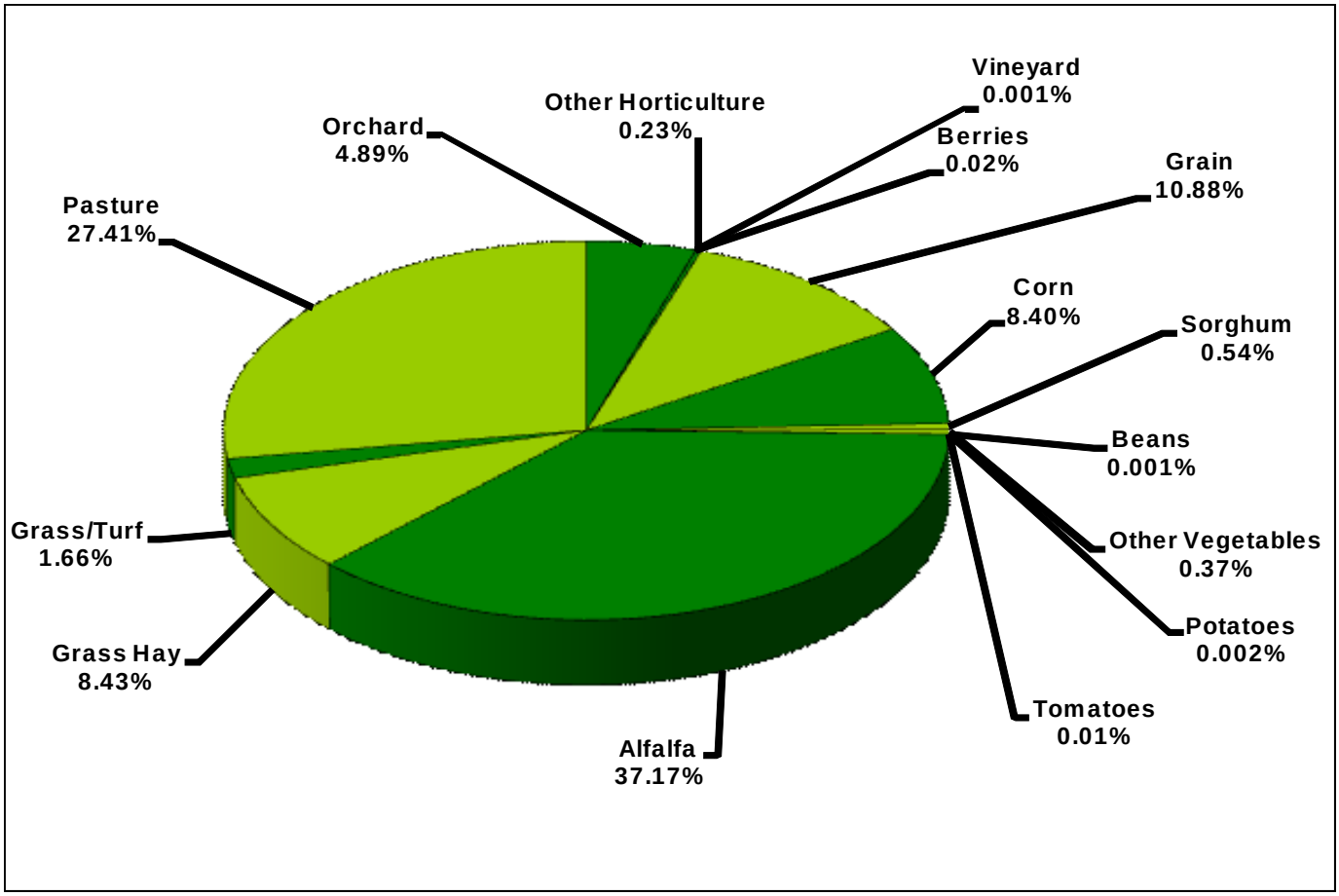


Table 1 Utah Lake Basin Land Use Summary of Land Cover by County for 2008

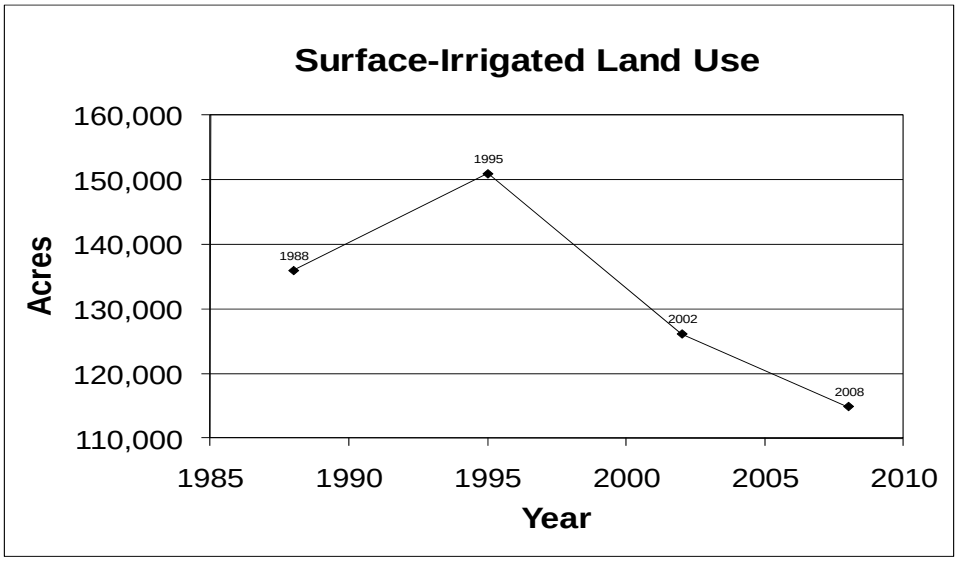
UTAH LAKE BASIN LAND USE 2008 (Acres)							
Category	Cover	Juab	Sanpete	Summit	Utah	Wasatch	Total
Surface-Irrigated		County	County	County	County	County	
	Orchard	22	0	0	5,594	0	5,617
	Vineyard	0	0	0	1	0	1
	Berries	0	0	0	18	0	18
	Other Horticulture	211	0	0	33	18	262
	Grain	2,082	494	95	9,553	273	12,497
	Corn	1,058	0	0	8,584	6	9,648
	Sorghum	113	0	0	508	0	621
	Other Vegetables	3	0	0	416	1	421
	Potatoes	0	0	0	3	0	3
	Beans	0	0	0	1	0	1
	Tomatoes	0	0	0	11	0	11
	Alfalfa	7,882	1,218	436	27,994	5,158	42,689
	Grass Hay	200	602	503	6,319	2,056	9,679
	Grass/Turf	0	0	0	1,902	3	1,905
	Pasture	1,915	324	1,022	20,974	7,243	31,478
	Irrigation Method						
	Flood	2,293	236	1,655	47,812	5,192	57,188
	Sprinkle	11,195	2,401	400	34,099	9,567	57,663
	Subtotal	**14,488**	**2,637**	**2,056**	**81,911**	**14,759**	**114,851**
Sub-Irrigated							
	Pasture-subirrigated	2,311	37	102	8,457	805	11,712
	Grass Hay-subirrigated	156	0	0	189	109	455
	Subtotal	**2,467**	**37**	**102**	**8,646**	**914**	**12,167**
	Irr. Total (Surface & Sub)						**127,017**
Non-Irrigated							
	Fallow	706	0	0	16,411	19	17,136
	Idle	3,045	326	125	22,692	1,722	27,910
	Dry Grain/Seeds	1,670	0	0	14,830	0	16,500
	Safflower	0	0	0	15	0	15
	Dry Alfalfa	91	0	21	129	55	296
	Dry Pasture	6,186	2,482	193	17,210	1,488	27,560
	Dry Idle	5,195	0	125	29,055	273	34,649
	Subtotal	**16,893**	**2,809**	**464**	**100,341**	**3,557**	**124,065**
Other Non-Irrigated							
	Range Pasture	4,320	2,764	0	9,565	268	**16,917**
Wet/Open Water Areas							
	Wet Flats	0	0	0	111	49	161
	Riparian	550	0	467	10,467	2,043	13,527
	Streams	2	0	153	804	448	1,407
	Reservoirs	1,468	10	703	770	5,463	8,414
	Ponds & Lakes	0	0	138	88,726	157	89,021
	Sewage Lagoon	137	0	0	190	109	437
	Evaporation Pond	0	0	0	20	0	20
	Subtotal	**2,157**	**10**	**1,461**	**101,088**	**8,270**	**112,986**
Residential/Industrial							
	Farmsteads	439	246	31	6,713	714	8,144
	Residential	2,119	569	620	54,348	9,318	66,974
	Urban Turf Areas	170	0	15	5,346	955	6,486
	Commercial/Industrial	1,727	30	220	23,770	3,131	28,878
	Subtotal	**4,455**	**846**	**886**	**90,177**	**14,118**	**110,481**
Total Land Use/Land Cover		**43,781**	**9,103**	**4,968**	**391,729**	**41,886**	**491,467**

Table 2 Comparison of Land Cover Totals by Inventory Year*

UTAH LAKE BASIN LAND USE (Acres)	
	Basin Total
1988 Land Use Summary	
Surface-Irrigated	135,946
Sub-Irrigated	6,318
Non-Irrigated	58,407
Other Non-Irrigated	0
Wet/Open Water Areas	98,700
Residential/Industrial	52,855
Total land use/Land Cover	**352,226**
1995 Land Use Summary	
Surface-Irrigated	150,952
Sub-Irrigated	4,438
Non-Irrigated	104,444
Other Non-Irrigated	0
Wet/Open Water Areas	114,497
Residential/Industrial	64,054
Total land use/Land Cover	**438,386**
2002 Land Use Summary	
Surface-Irrigated	126,109
Sub-Irrigated	10,303
Non-Irrigated	136,237
Other Non-Irrigated	0
Wet/Open Water Areas	109,693
Residential/Industrial	98,880
Total land use/Land Cover	**481,221**
2008 Land Use Summary	
Surface-Irrigated	114,851
Sub-Irrigated	12,167
Non-Irrigated	124,065
Other Non-Irrigated	16,917
Wet/Open Water Areas	112,986
Residential/Industrial	110,481
Total land use/Land Cover	**491,467**

* Please refer to the word of caution on page 6 regarding comparisons between datasets.

Figure 5 Surface Irrigated Land Use Comparison Graph



Data Access

GIS data used in this summary may be downloaded from the Utah AGRC. Current land use datasets are available as a statewide layer or by county and are offered in shapefile and geodatabase formats. To download the most recent dataset, Go to:

http://www.water.utah.gov/Planning/landuse/index.htm

For past GIS datasets, Please contact Technical Services at the Division of Water Resources

Past Land Use Reports for this area and a PDF of this report can be found at
http://www.water.utah.gov/planning/landuse/publ.htm
Metadata is available at
http://www.water.utah.gov/planning/landuse/gisdata.htm
Additional Jordan River Basin reports as well as many other reports can be found at
http://www.water.utah.gov/planning

REFERENCES

1. Utah State Water Plan, Utah Lake Basin (Draft),
Utah Division of Water Resources, Dec. 2010.

2. Prism Group, Oregon State University, http://prism.oregonstate.edu/
Maximum and Minimum precipitation calculated using Zonal Statistics tool with ESRI ArcInfo license
ftp://prism.oregonstate.edu//pub/prism/us_30s/grids/ppt/Normals/us_ppt_1971_2000.14.gz
ftp://prism.oregonstate.edu//pub/prism/us/grids/ppt/2000-2009/us_ppt_2008.14.gz

GLOSSARY

I. Phreatophyte - A deep-rooted plant that obtains water from a permanent ground supply or from the water table.

II. Planimetered or dot-counted - process to determine acreage by assigning an acreage value to a “dot” based on map scale and then counting the number of “dots” within a specific boundary.

III. Heads-up digitizing - Manual digitization by tracing a mouse over features displayed on a computer monitor, used as a method of vectorizing raster data.