

# A WATER-RELATED LAND USE INVENTORY REPORT OF THE KANAB CREEK/VIRGIN RIVER BASIN

PREPARED BY

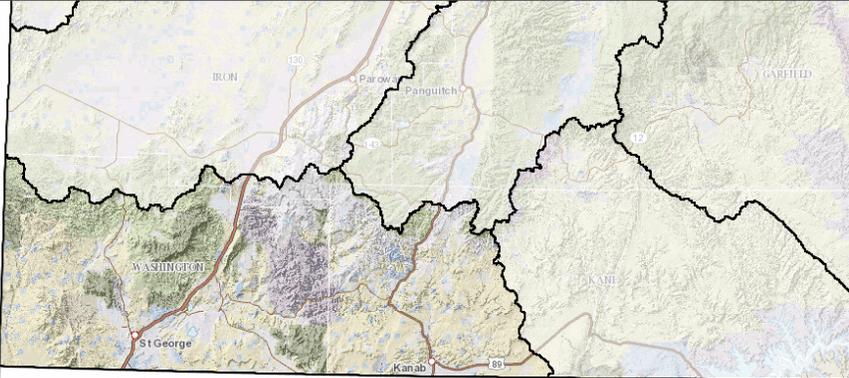
UTAH DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER RESOURCES

COMPILED MARCH 2014

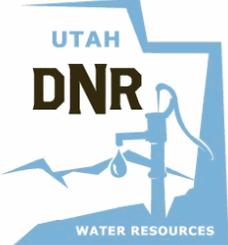
## Kanab Creek/Virgin River Basin 2013 Inventory Report

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Title Page Introduction Basin Summary Precipitation



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This report was prepared by Aaron Austin, GIS Analyst. The land use data summarized in this report were gathered under the direction of Todd Adams, Deputy Director, and supervised by John Holman, 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 summarized by Adam Clark, GIS Analyst. Additionally, select members of the Planning and Development Staffs assisted with the collection of the data.

This report was reviewed by

Todd Adams, Deputy Director

John Holman, Section Chief, Technical Services

Eric Klotz, Section Chief, Water Conservation & Education

Todd Stonely, Section Chief, River Basin Planning

### Kanab Creek/Virgin River Basin 2013 Inventory Report

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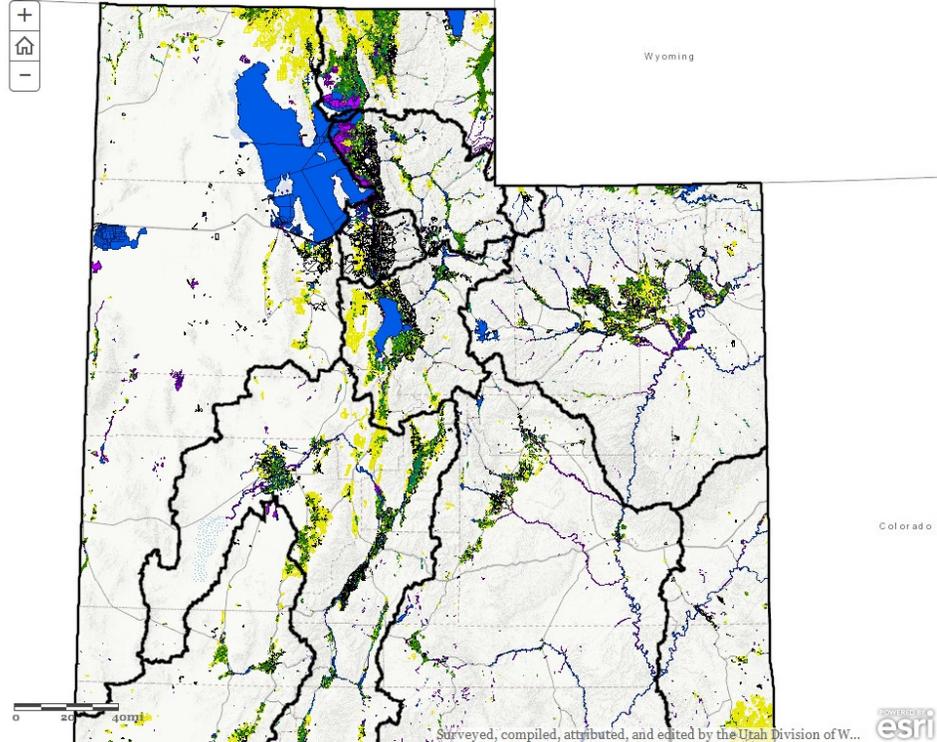
The Water-Related Land Use Program



#### 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, wet/open water areas, dry land agriculture and urban 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 used by many other state and federal agencies.



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#### 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 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).

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 used satellite data, USGS Digital Orthophoto Quadrangles (DOQs), National Agricultural

Imagery Program (NAIP), and other digital images in a heads-up digitizing mode for this process. This allowed the division to use multiple technicians for the digitizing process.

Digitizing was done as line and polygon files using ArcView 3.2 with a satellite image, DOQ or NAIP image as a background with other layers added for reference. Boundary files were created in logical groups so that the process of edge-matching along quad lines was eliminated and precision increased. Subsequent inventories were digitized in the ArcMap 9.x software versions.

#### Present Methodology

Using the latest statewide NAIP Imagery and ArcGIS 10, all boundaries of individual agricultural fields, urban areas, and significant riparian areas are precisely digitized.

Once the process of boundary digitizing is done, the polygons are loaded onto tablet PCs. Field crews are then sent to field check the crop and irrigation type for each agricultural polygon and label the shapefiles accordingly. 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.

Once processed and quality 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 4.3 million acres of dry and irrigated agricultural land. This represents about 8 percent of the total land area in the state.

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.

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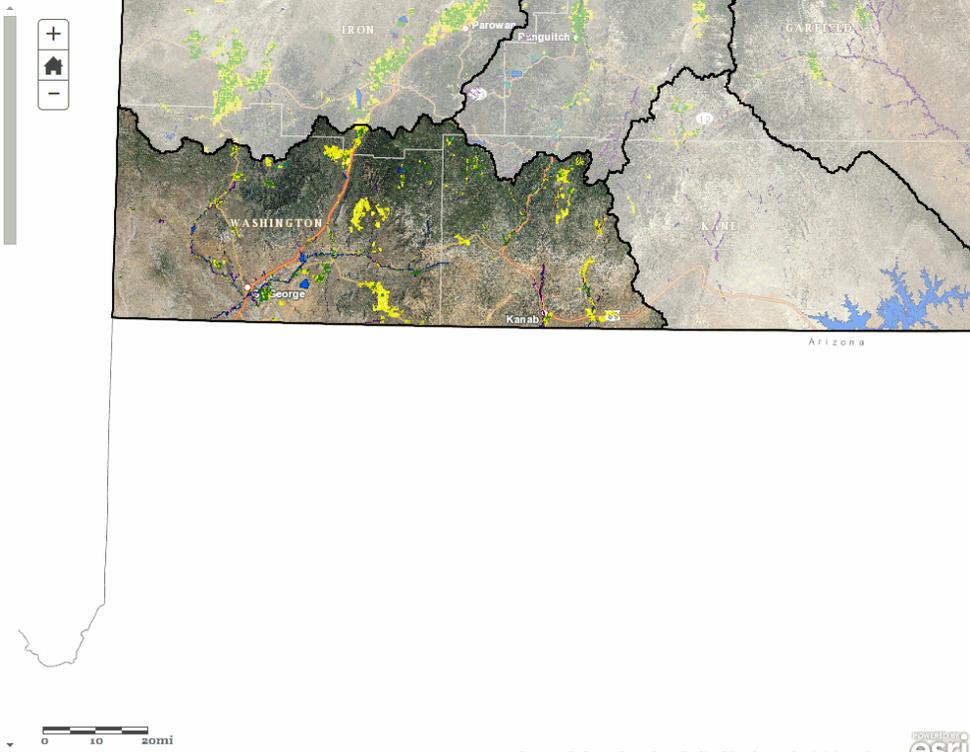
Kanab Creek/Virgin River 2013  
Basin Summary



### Basin Description

The Utah portion of Kanab Creek/Virgin River Basin covers approximately 3,485 square miles of the southwest corner of Utah. This represents about 4.1% of the land area of the State. Utah's portion of the basin extends from the Utah/Arizona state line on the south to the Bull Valley and Harmony Mountains to the north. On the west, the basin extends from the Utah/Nevada state line east to the divide between Johnson Wash and Kaibab Gulch Tributaries. The basin spans most of Washington County and part of Iron and Kane counties.

Elevations vary from heights of 10,375 feet at Black Mountain in the Cedar Mountains and 10,365 feet at Signal Peak in the Pine Valley Mountains to



Surveyed, compiled, attributed, and edited by the Utah Division of W



## Basin Description

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Elevations vary from heights of 10,375 feet at Black Mountain in the Cedar Mountains and 10,365 feet at Signal Peak in the Pine Valley Mountains to lows of 2,297 feet and 2,461 feet where the Beaver Dam Wash and Virgin River cross the Utah/ Arizona state line. Notable features of the basin include Zion National Park, Snow Canyon State Park and Coral Pink Sand Dunes State Park and a portion of Grand Staircase- Escalante National Monument.

Agriculture within the basin is found predominantly in and around the areas of Hurricane, La Verkin, Kanab and St. George. Additional acreage is regularly farmed near Alton, Kanarrville, Orderville and along the water courses of the basin.

## Data Collection

The Division inventoried water-related land use in the Kanab Creek/Virgin River Basin during the summer of 2013. Previous inventories were done in 1991, 2001 and 2007. In 2013, the division

inventoried roughly 133,415 acres of land in the Kanab Creek/Virgin River Basin. This represents about 6 percent of the total land area in the entire basin.

#### Data Summary

Of the roughly 133,415 acres inventoried in 2013, 17,924 were irrigated lands (including land that was sub-irrigated), 28,818 were non-irrigated (including land that was fallow and idle), 10,206 were wet/open water areas (including reservoirs and mountain lakes), 61,296 were residential/industrial areas (including farmsteads and rural housing) and 15,171 were other non-irrigated lands.

Summary Table -total basin acreage for irrigated lands, non-irrigated lands, wet/open water areas, and residential/industrial are presented by county. Note: County numbers are only the basin portion of the county.

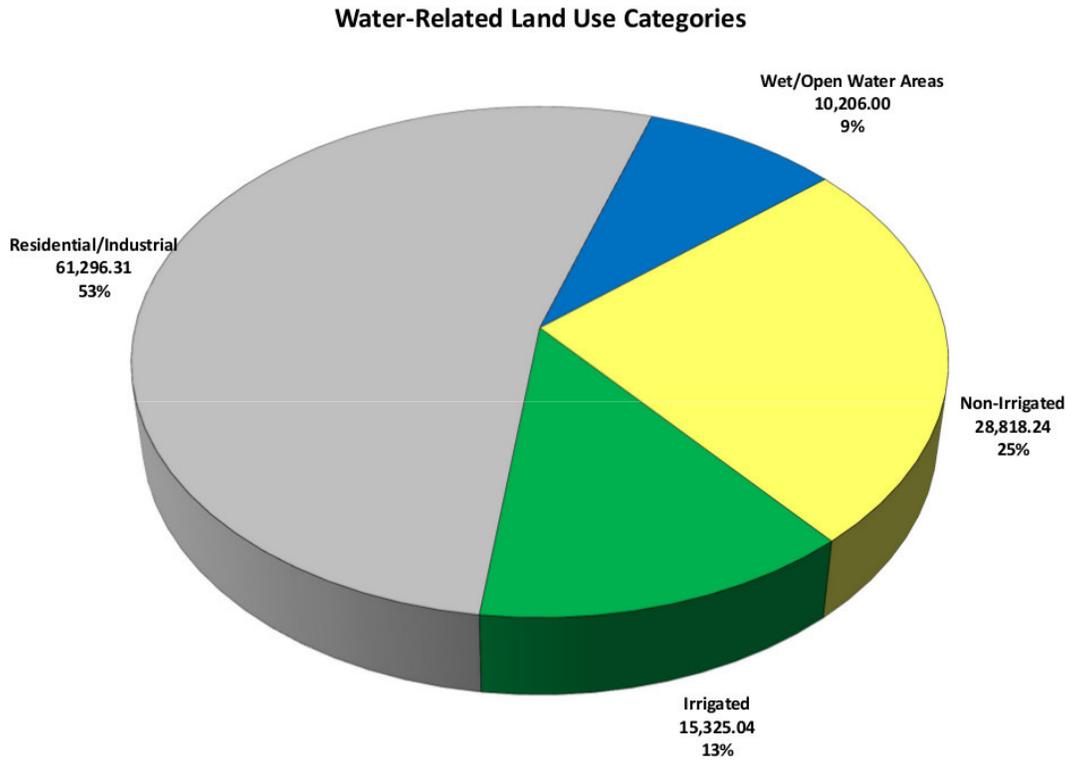
KANAB CREEK/VIRGIN RIVER BASIN LAND USE 2013 (Acres)					
Category	Cover	IRON	KANE	WASHINGTON	Total
<b>Surface-Irrigated</b>					
	Alfalfa	161.08	1590.82	2723.15	4,475.05
	Corn	0.00	1.26	430.22	431.48
	Grain	0.00	119.50	461.13	580.64
	Grass Hay	50.61	529.60	1028.27	1,608.48
	Oats	0.00	81.71	177.51	259.22
	Orchard	1.46	25.60	489.50	516.56
	Other Horticulture	0.00	15.02	8.25	23.27
	Other Vegetables	0.00	1.39	27.71	29.09
	Pasture	427.96	2256.08	4243.29	6,927.33
	Sorghum	0.00	1.43	259.60	261.03
	Turf Farms	0.00	0.00	205.17	205.17
	Vineyard	0.00	0.00	7.73	7.73
	<b>Irrigation Method</b>				
	<i>Flood</i>	370.98	1912.58	4928.96	7,212.53
	<i>Sprinkle</i>	270.13	2709.81	5132.57	8,112.51
	<b>Subtotal</b>	641.11	4622.40	10061.53	15,325.04
<b>Sub-Irrigated</b>					
	GrassHay-subirrigated	0.00	2.33	29.73	32.07
	Pasture-subirrigated	432.00	1130.49	1004.89	2,567.38
	<b>Subtotal</b>	432.00	1132.82	1034.63	2,599.45
<b>Non-Irrigated</b>					
	Dry Alfalfa	43.59	13.65	148.48	205.73
	Dry Fallow	0.00	0.00	763.05	763.05
	Dry Grain/Seeds	102.50	0.00	177.17	279.67
	Dry Idle	25.85	385.91	1479.03	1,890.80
	Dry Pasture	1442.68	3965.19	12892.92	18,300.79
	Dry Safflower	0.00	10.64	0.00	10.64
	Fallow-Irrigated Land	0.00	55.56	467.33	522.89
	Idle-Irrigated Land	394.32	2736.47	3713.87	6,844.66
	<b>Subtotal</b>	2008.95	7167.43	19641.86	28,818.24
<b>Other Non-Irrigated</b>					
	Range Pasture	1035.80	6244.57	7889.87	15,170.23
<b>Wet/Open Water Areas</b>					
	Evaporation Pond	0.00	4.36	0.67	5.03
	Lakes & Ponds	55.21	13.25	99.29	167.75
	Reservoirs	43.43	417.03	2996.85	3,457.31
	Riparian	111.43	1838.40	3010.38	4,960.20
	Sewage Lagoon	0.00	115.25	228.10	343.34
	Streams	0.00	72.09	1200.28	1,272.37
	<b>Subtotal</b>	210.06	2460.37	7535.57	10,206.00
<b>Residential/Industrial</b>					
	Urban	972.73	4513.09	53644.23	59,130.05
	Urban Grass/Parks	0.00	123.44	2042.83	2,166.27
	<b>Subtotal</b>	972.73	4636.53	55687.06	61,296.31
<b>Total Land Use/Land Cover</b>		<b>5,300.64</b>	<b>26,264.12</b>	<b>101,850.52</b>	<b>133,415.28</b>

Summary Tables - Excel or Google Spreadsheet download link of Basin Tables 1991 to 2013

<https://drive.google.com/file/d/0B8agagPrSa5xRXFVMVZ0TDREcGc/edit?usp=sharing>

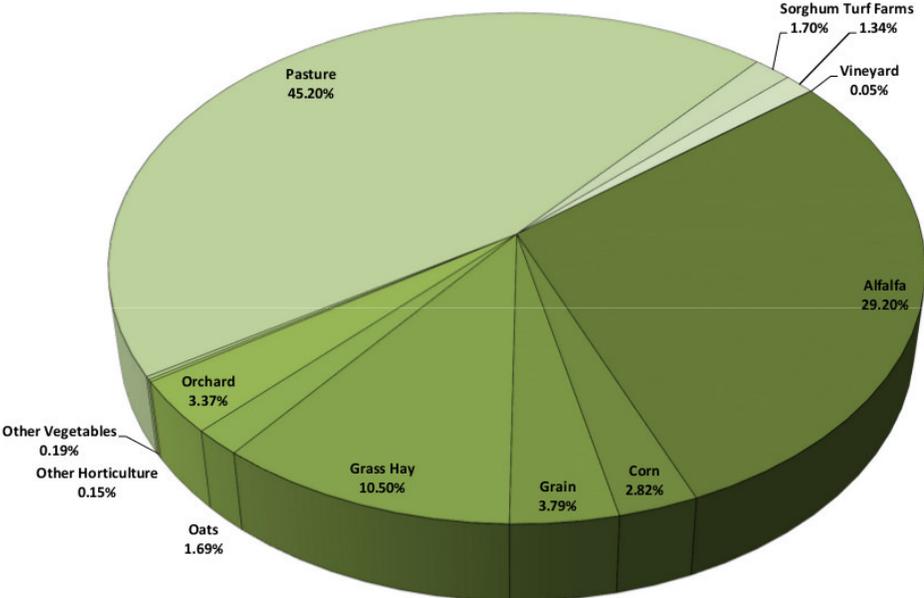
<https://docs.google.com/spreadsheets/cc?key=0AsagagPrSa5xdFV3dkdQdUg1dnpVbFE2WTVIbW5RNXc&usp=sharing>

Land Use Category Pie Chart - delineates four categories of water-related land use by percentage and acreage.



Irrigated Cropland Pie Chart - represents data from the surface irrigated and sub-irrigated cropland categories. The data are broken down into 10 different subcategories.

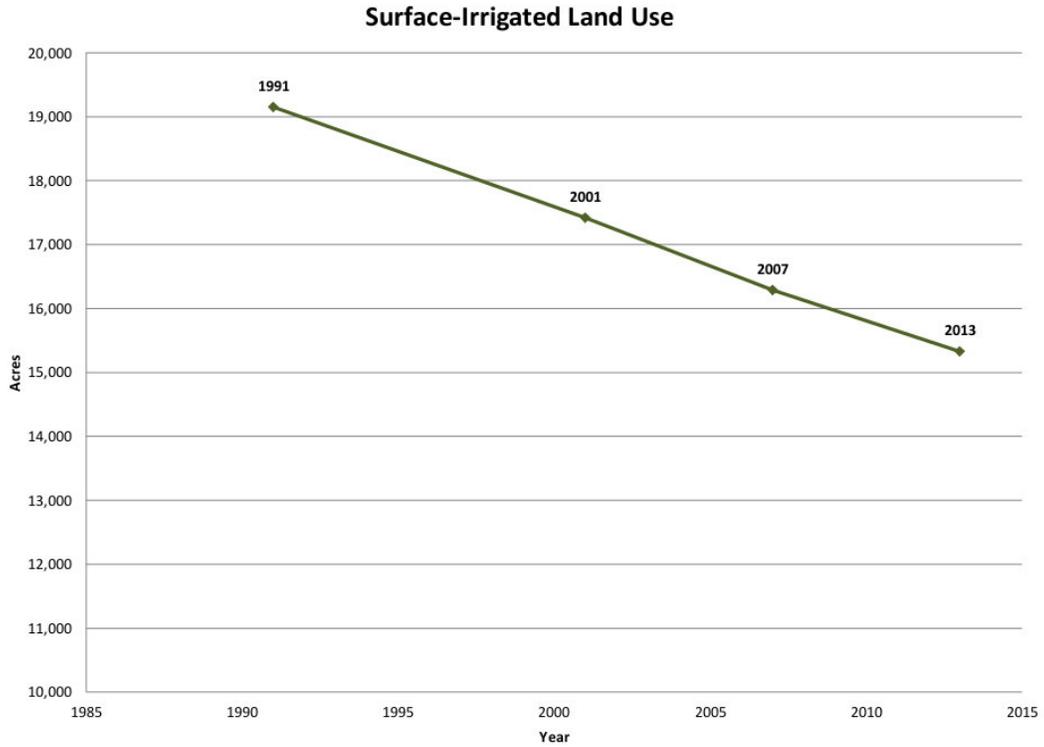
**Breakdown of Irrigated Cropland**



Surface-Irrigated Comparison Chart - compares surface-irrigated acreage totals from all inventories.

<b>KANAB CREEK/VIRGIN RIVER BASIN LAND USE (Acres)</b>				
	<b>IRON</b>	<b>KANE</b>	<b>WASHINGTON</b>	<b>TOTAL</b>
<b>1991 Land Use Summary</b>				
Surface-Irrigated	929	5,456	12,763	<b>19,148</b>
Sub-Irrigated	0	147	60	<b>207</b>
Non-Irrigated	1,959	6,096	22,423	<b>30,479</b>
Other Non-Irrigated	0	0	0	<b>0</b>
Wet/Open Water Areas	13	1,419	6,510	<b>7,942</b>
Residential/Industrial	199	2,371	15,886	<b>18,457</b>
<b>Total Land Use</b>	<b>3,101</b>	<b>15,489</b>	<b>57,643</b>	<b>76,233</b>
<b>2001 Land Use Summary</b>				
Surface-Irrigated	701	5,944	10,777	<b>17,422</b>
Sub-Irrigated	0	0	507	<b>507</b>
Non-Irrigated	2,632	6,628	22,563	<b>31,823</b>
Other Non-Irrigated	0	0	0	<b>0</b>
Wet/Open Water Areas	945	7,380	29,725	<b>38,050</b>
Residential/Industrial	177	3,268	27,193	<b>30,637</b>
<b>Total Land Use</b>	<b>4,456</b>	<b>23,219</b>	<b>90,763</b>	<b>118,438</b>
<b>2007 Land Use Summary</b>				
Surface-Irrigated	626	5,261	10,401	<b>16,288</b>
Sub-Irrigated	225	1,035	804	<b>2,063</b>
Non-Irrigated	2,007	7,687	21,573	<b>31,267</b>
Other Non-Irrigated	606	4,394	8,995	<b>13,995</b>
Wet/Open Water Areas	89	2,394	7,535	<b>10,018</b>
Residential/Industrial	328	3,200	41,195	<b>44,723</b>
<b>Total Land Use</b>	<b>3,881</b>	<b>23,971</b>	<b>90,502</b>	<b>118,354</b>
<b>2013 Land Use Summary</b>				
Surface-Irrigated	641	4,622	10,062	<b>15,325</b>
Sub-Irrigated	432	1,133	1,035	<b>2,599</b>
Non-Irrigated	2,009	7,167	19,642	<b>28,818</b>
Other Non-Irrigated	1,036	6,245	7,890	<b>15,170</b>
Wet/Open Water Areas	210	2,460	7,536	<b>10,206</b>
Residential/Industrial	973	4,637	55,687	<b>61,296</b>
<b>Total Land Use</b>	<b>5,301</b>	<b>26,264</b>	<b>101,851</b>	<b>133,415</b>

Inventory Comparison Table - provides a comparison of acreage totals by survey year.



#### Data Access

ArcGIS Rest Service

<http://maps.dnr.utah.gov/arcgis/rest/services/WRE/UtahCurrentLanduse/MapServer>

Shapefile Downloads

<http://gis.utah.gov/data/planning/water-related-land/>

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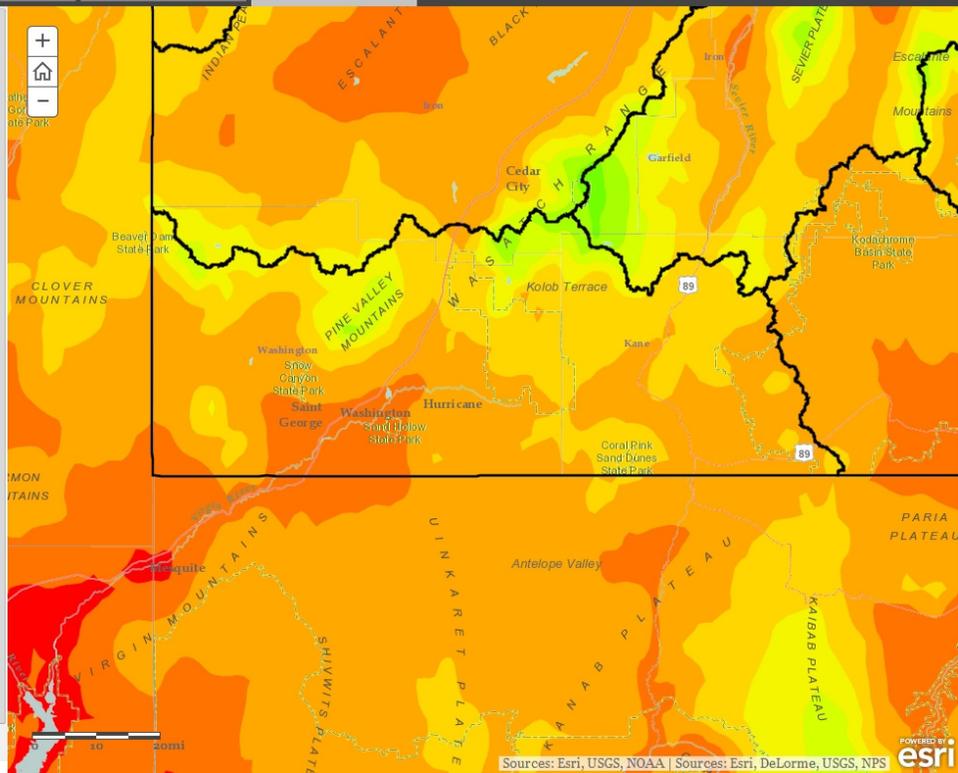
## Kanab Creek/Virgin River Precipitation

Climate WMS Layers from the National Atlas of the United States

- 5.0 or Less
- 5.1 - 10.0
- 10.1 - 15.0
- 15.1 - 20.0
- 20.1 - 25.0
- 25.1 - 30.0
- 30.1 - 35.0
- 35.1 - 40.0
- 40.1 - 50.0
- 50.1 - 60.0
- 60.1 - 70.0
- 70.1 - 80.0
- 80.1 - 100.0
- 100.1 - 120.0
- 120.1 - 140.0
- 140.1 - 180.0
- 180.1 or Greater

### Climate

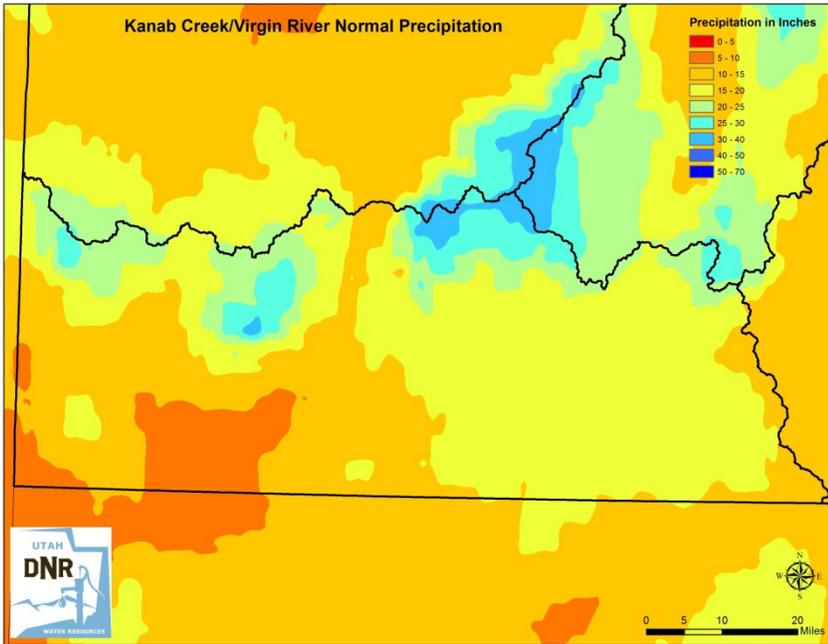
The climate varies widely with the physiography of the basin. Average annual precipitation ranges from approximately 6.9 inches at points south of St. George to around 33.4 inches near Brian Head at the western edge of the Markagunt Plateau. In 2007, annual precipitation values for the Kanab Creek/Virgin River Basin ranged from approximately 6.3 inches in low lying areas to 26.3 inches in the mountains. The basin average in 2007 was about 11.9 inches, which is about 76% of the 30 year average from 1971 to 2000 which was approximately 15.7 inches. Figure 1 compares precipitation in 2007 to the average



## Climate

The climate varies widely with the physiography of the basin. Average annual precipitation ranges from approximately 7.4 inches at points south of St. George to around 34.6 inches near Brian Head at the western edge of the Markagunt Plateau. In 2013, annual precipitation values for the Kanab Creek/Virgin River Basin ranged from approximately 4.2 inches in low lying areas to 27.9 inches in the mountains. The basin average in 2013 was about 11.6 inches, which is about 70% of the 30 year average from 1981 to 2010 which was approximately 16.6 inches.

### Kanab Virgin Normal Precipitation



### Kanab Virgin 2013 Precipitation

