

# Strawberry River Watershed Restoration Plan

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This plan was created under the direction of Friends of Strawberry Valley.

# Strawberry River Watershed Restoration Plan

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## INTRODUCTION

This watershed planning tool is intended to help local communities, watershed organizations, and agencies operating within the Strawberry River Watershed to develop and implement plans to meet water quality standards and protect water resources. In addition, the Strawberry River Watershed Restoration Plan (SRWRP) will provide a cohesive strategy for implementing needed water quality improvements for the watershed such that state water quality standards are restored and maintained in the Strawberry River and tributaries.

The U.S. Environmental Protection Agency (EPA) regulations require that states develop Total Maximum Daily Loads (TMDL) for those watersheds that have impaired beneficial uses. TMDLs for the Strawberry River watershed were approved in 2007 and mainly target high levels of total phosphorus (TP) in the river system. TP exceedences and low dissolved oxygen (DO) led to impairments of the cold-water fishery beneficial uses of the reservoir.

The need to decrease the pollutant loads in the Strawberry River watershed involves both point and non-point source load reductions. Point source pollution loads originate from a specific point of origin, whereas non-point sources require a broader view at the watershed scale. The intent in producing this plan is to address all of the significant sources of pollution that are causing water quality impairment in the watershed and identify sound practices that will restore and maintain water quality in the watershed once implemented.

EPA requires that each State utilizing CWA section 319 funds develop watershed plans that include nine key elements. These elements can be found at <http://www.epa.gov/region9/water/nonpoint/9elements-WtrshdPlan-EpaHndbk.pdf>. EPA must approve watershed plans prior to using 319 funds to address non-point source pollution and plans must include stakeholder and public input during their development.

The SRWRP covers the entire Strawberry River watershed (14060004 HUC) from its confluence with the Duchesne River to the headwaters in the Uinta Mountains. The area covered under the plan is large in scale but projects are based on a smaller sub-watershed scale (12 digit HUC). Developing and implementing the SRWRP is an iterative process and is managed as such. In the initial phase of development, the plan only focuses on a few sub-watersheds; however as other sub-watersheds become priorities, this plan will be updated to include them.

# Strawberry River Watershed Restoration Plan

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## 1.0 Watershed Management Plan Purpose

The mission of the Strawberry River Watershed Plan is to establish and implement socially, environmentally, and economically sustainable watershed management standards and practices that will provide good water quality of the Strawberry River watershed. The goals of this plan are to develop a set of recommendations that will improve stream habitat, improve recreational opportunities, and help local stakeholders achieve objectives in the Strawberry Reservoir TMDL. Implementation of these recommendations will help foster activities that create a balance between the local community and its ecosystems.

Friends of Strawberry Valley (FOSV) served as the oversight committee during the plan development. Discussions were held describing the process of assembling the 319 and Utah State NPS planning grant proposals and the tasks ahead in the watershed management planning process. FOSV started in April 2012 to lead and plan implementation activities. The steering committee met once a month from March 2013 to June 2013 to finalize the plan. Organizations represented include:

Friends of Strawberry Valley (FOSV)

Central Utah Water Conservation District (CUWCD)

Duchesne County (DC)

Wasatch County (WC)

Duchesne County Water Conservation District (DCWCD)

Wasatch County Water Conservation District (WCWCD)

National Resource Conservation Service (NRCS)

Trout Unlimited (TU)

Uintah Basin Watershed Council (UBWC)

United States Forest Service (USFS) – Uintah Wasatch Cache National Forest

Utah Association of Conservation Districts (UACD)

Utah Department of Agriculture and Food (UDAF)

Utah Division of Water Quality (UDWQ)

Utah Division of Wildlife Resources (UDWR)

# Strawberry River Watershed Restoration Plan

Utah Farm Bureau Federation (UTFB)

Utah State University (USU) Extension

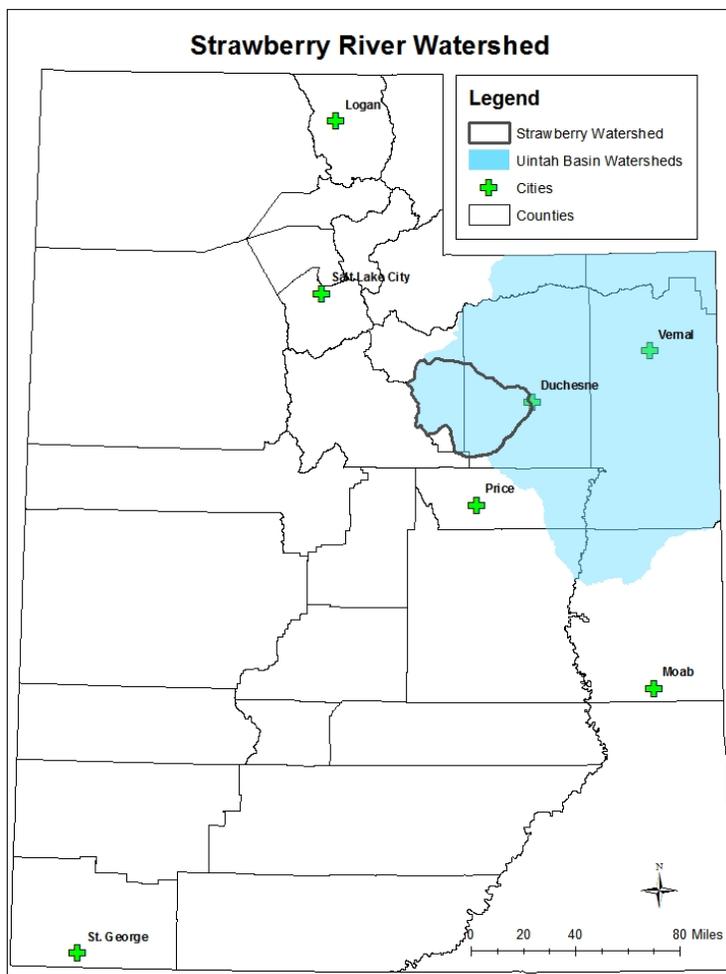
Strawberry Water Users

## 2.0 Watershed Description

### 2.1 Watershed Boundaries

The Strawberry River watershed drains approximately 1,155 mi<sup>2</sup> (739,444 acres) in northeastern Utah located in the Uintah Basin (Figure 1). The watershed is bounded by the Uintah Mountains to the north, the Wasatch Mountains to the west, and the Colorado Plateau to the south and west. It occupies approximately 536 mi<sup>2</sup> of Wasatch County, 619 mi<sup>2</sup> of Duchesne County.

**Figure 1. Location of Strawberry River Watershed Boundaries.**



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## 2.2 Hydrology

The hydrology of the Uintah Basin is dominated by spring runoff and from brief, intense storms that occur in late summer. Several large reservoirs in the basin have altered the natural hydrology of these major rivers by reducing spring peak and providing higher minimum flows during summer and winter months. Water diversions from agricultural, municipal, and industrial uses have also altered the natural hydrology of the basin by reducing stream flows below diversion points.

The National Hydrography Dataset, created by the EPA and the USGS, indicate six different stream types in the Strawberry River watershed (Figure 2). Most of the streams were classified as intermittent streams (Table 1). Intermittent streams flow only for short periods during the year, and flow events are usually initiated by rainfall. Mainstem rivers and streams are classified predominantly as perennial stream flow. In addition, headwaters at higher elevations have perennial flow due to snowmelt and precipitation, while streams at lower elevations are generally intermittent and flow only after local rainstorms. Most of the canals, ditches, and pipelines are associated with perennial streams and rivers throughout the watershed to utilize snowmelt and precipitation for stockwater and irrigated crop production.

**Table 1. Summary of Stream Types in Strawberry River Watershed.**

<b>Stream Type</b>	<b>Stream Length (mi)</b>	<b>Percent (%)</b>
Intermittent Stream/River	2,206	75
Perennial Stream/River	547	19
Artificial Path	140	5
Canal	38	1
Pipeline (Aqueduct)	19	< 1
Connector	16	< 1
Total	2,966	100

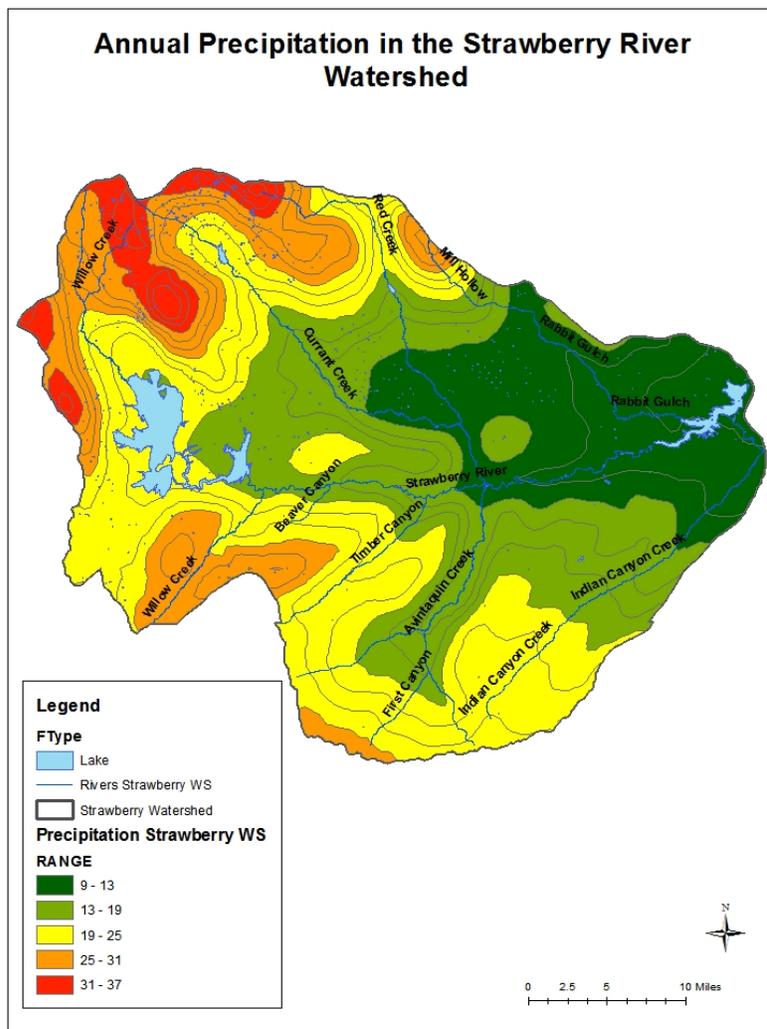


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## 2.3 Climate / Precipitation

Average annual precipitation throughout the Uinta Basin totals approximately 8.5 inches, but varies greatly with elevation and location relative to the mountain ranges that border to the west and north. Average annual precipitation varies from less than 13 inches near Starvation Reservoir to about 37 inches in the adjacent Uinta Mountains. Snowfall characterizes winter precipitation, while thunderstorms dominate during the summer when a flow of warm, moist air from the Gulf of Mexico prevails. The Uinta Basin gets little precipitation from frontal systems coming from the northwest or west because fronts weaken as they descend the slopes of the Wasatch Range or the Uinta Mountains. Precipitation distribution estimates are presented in Figure 3.

**Figure 3. Annual Precipitation (inches) in the Strawberry River Watershed.**



# Strawberry River Watershed Restoration Plan

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## 2.4 Surface Water Resources

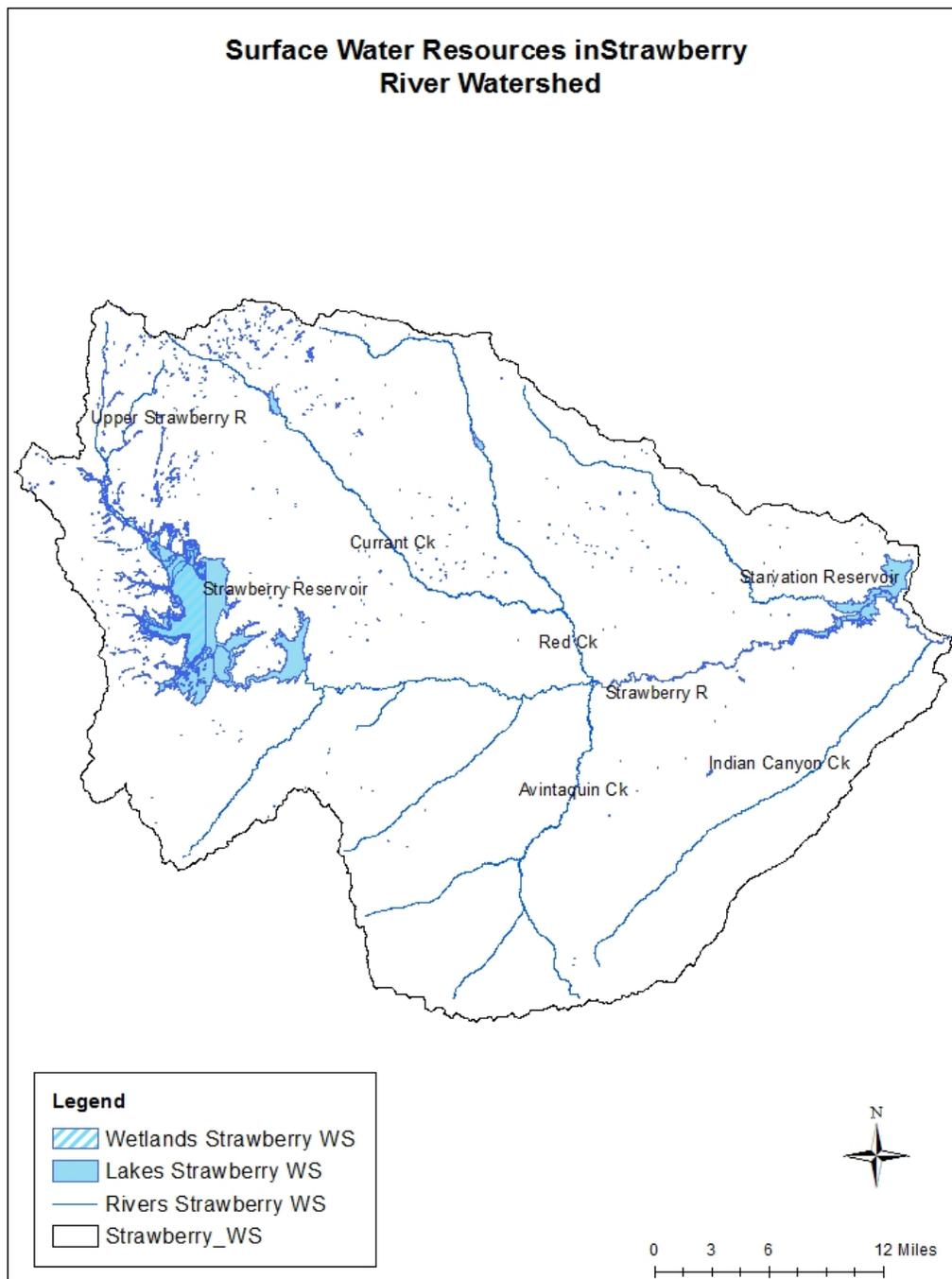
Surface water resources in the Strawberry River Watershed include any rivers, wetlands, or lakes located within the watershed. Figure 4 shows that there are approximately 2,700 river miles, both perennial and intermittent. All the major rivers, Avintaquin Creek, Currant Creek, Red Creek, and Indian Canyon Creek flow into the Strawberry River, which begins from the south slopes of the Uinta Mountains and then flows into the Duchesne River below Starvation Reservoir near the town of Duchesne. The hundreds of lakes and reservoirs in the Strawberry River Watershed constitute over 22,000 surface area acres. The major ones include Strawberry Reservoir (17,163 acres), Starvation Reservoir (2,825 acres), and Currant Creek Reservoir (420 acres).

Strawberry Reservoir was created in 1922 by the USBR to provide irrigation water from the Colorado River Plateau to the Bonneville Basin and serve as a source of hydroelectric power. The reservoir was enlarged in 1974 by Soldier Creek Dam, which is about 7 miles below the original Strawberry Dam. This new dam raised the water surface level by 45 feet. The Strawberry Aqueduct and Collection System diverts flows of several tributaries of the Duchesne River to the Strawberry Reservoir. It provides 44,000 acre feet of in-stream flows for fishery mitigation annually. For more information on the project see the USBR webpage: [http://www.usbr.gov/projects/Project.jsp?proj\\_Name=Strawberry+Valley+Project](http://www.usbr.gov/projects/Project.jsp?proj_Name=Strawberry+Valley+Project).

The development of Starvation Reservoir was managed by the Central Utah Project, which develops water within the Uinta Basin for irrigation and municipal use, as well as providing flood control, recreation, and wildlife benefits. Starvation Dam and Reservoir was constructed on the Strawberry River in 1970. It stores surplus winter and spring flows of the Duchesne River via the Knight Diversion and Strawberry River. For more information see: <http://www.cupcao.gov/bonneville/scs.html>.

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Figure 4. Surface Water Resources in the Strawberry River Watershed.

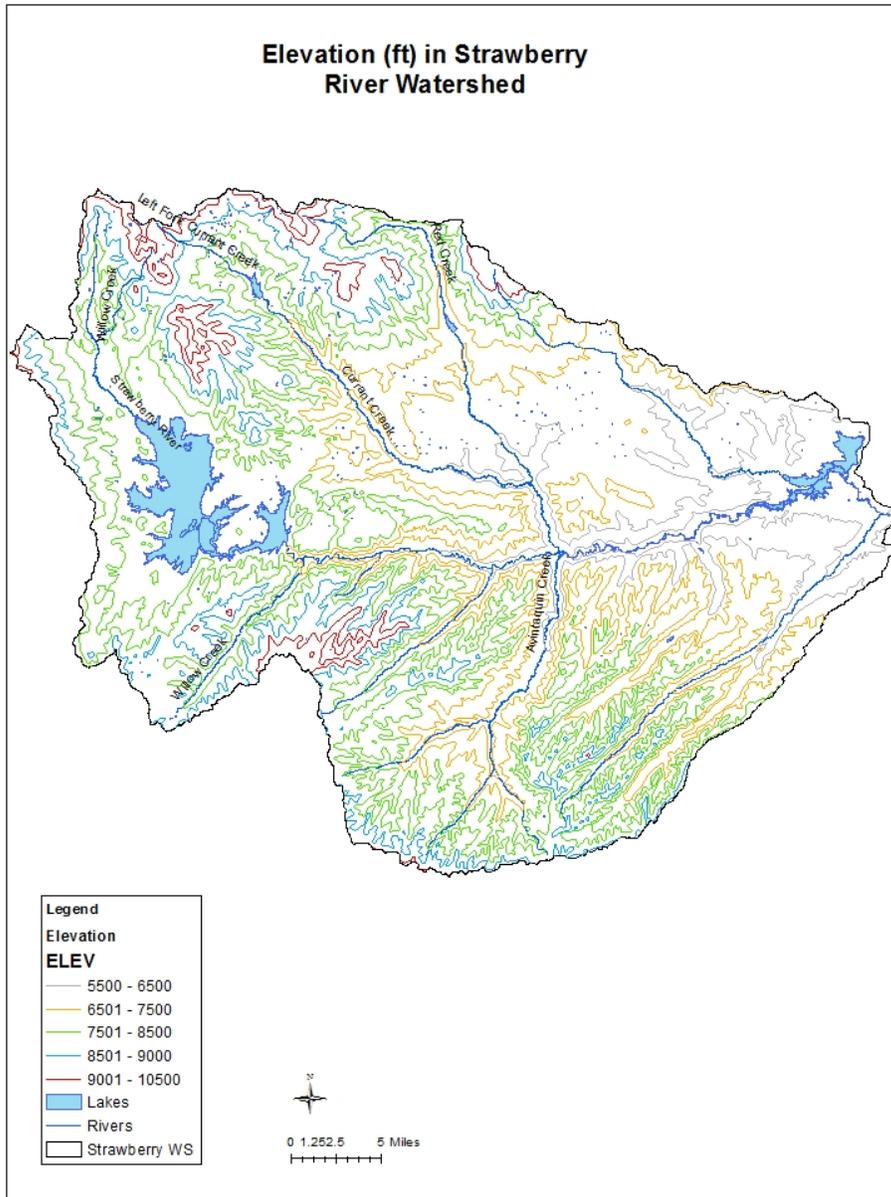


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## 2.5 Topography / Elevation

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by elevation. Figure 5 displays the general topography in the Strawberry River watershed. Elevation ranges from 10,335 feet (3,150 meters) above sea level in the headwaters of Willow Creek and Left Fork Currant Creek to 5,500 feet (1,676 meters) around the Starvation Reservoir.

**Figure 5. Elevation (feet) in the Strawberry River Watershed.**

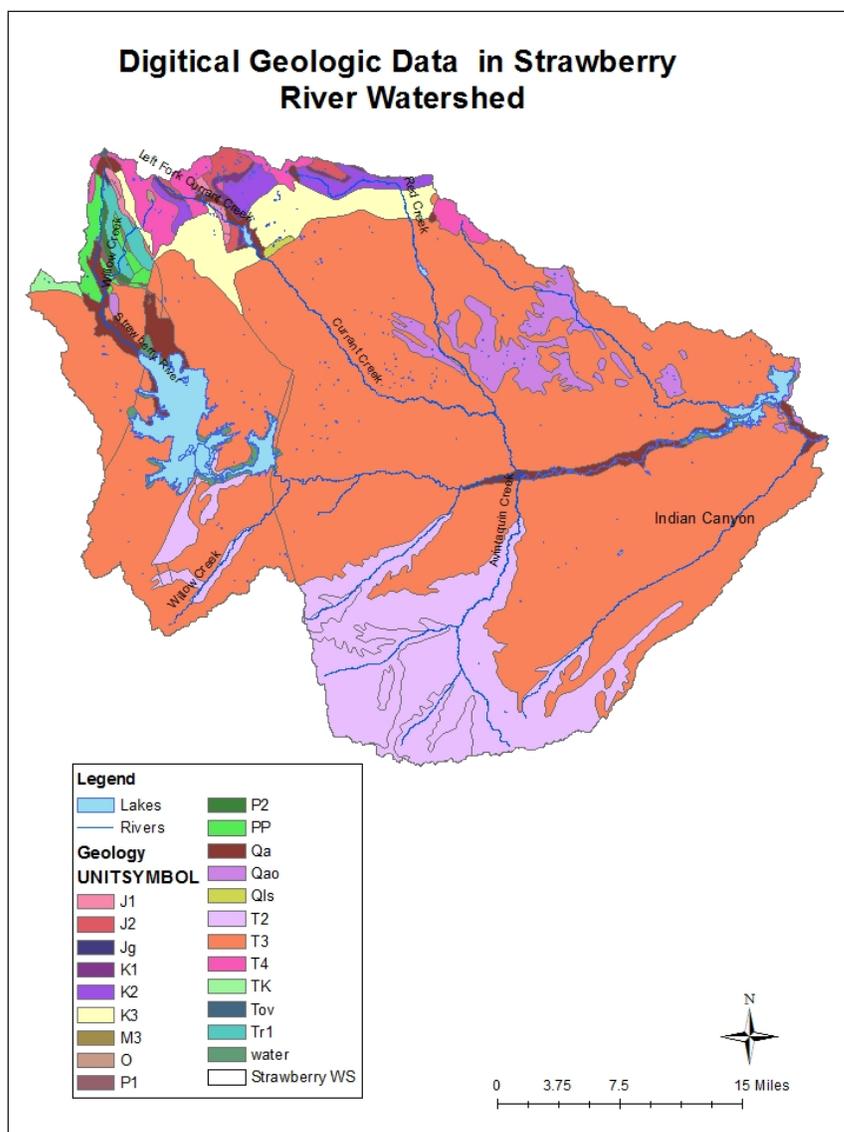


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## 2.6 Geology

Utah Geologic Survey (UGS) has digitized geologic data for the entire State of Utah. This data can be downloaded from: <http://geology.utah.gov/maps/gis/index.htm>. The main geologic formations in the Strawberry River Watershed are Duchesne, Uinta, Bridger, and Crazy Hollow (T3) which comprises 66% of the formations surveyed, and then Green River and Fowkes (T2) at 15%. See Table 2 for the breakdown of the entire survey. Figure 6 displays the geologic data visually.

**Figure 6. Geologic Data in the Strawberry River Watershed.**



## Strawberry River Watershed Restoration Plan

**Table 2. Geologic Data Breakdown in the Strawberry River Watershed.**

<b>Unit Symbol</b>	<b>Unit Name</b>	<b>Area (mi<sup>2</sup>)</b>	<b>%</b>
T3	Duchesne River, Uinta, Bridger, Crazy Hollow and other Fms	769.6	66
T2	Green River, Fowkes and other Fms	170.7	15
K3	Mesaverde Group, Price River, Kaiparowits, Echo Cyn and other Fms	39.2	3
Qao	Surficial older alluvium and colluvium	38.4	3
Water	Water	34.1	3
Qa	Surficial alluvium and colluvium	28.8	2
T4	Salt Lake Fm and other valley-filling alluvial, lacustrine, and volcanic units	21.1	2
Tr1	Moenkopi, Dinwoody, Woodside, Thaynes and other Fms	17.0	1
K2	Indianola, Mancos, Frontier, Straight Cuffs, Iron Springs and other Fms	15.0	1
PP	Oquirrh Group, Wells, Weber, Ely, Callville and other Fms	9.0	1
J2	Morrison Fm	6.9	1
K1	Dakota, Cedar Mountain, Kelvin and other Fms	3.9	0
J1	Summerville, Entrada, Carmel, Arapien, Twin Creek and other Fms	3.3	0
TK	Evanston, North Horn, Currant Creek, Canaan Peak, and other Fms	2.3	0
P2	Kaibab, Toroweap, Park City and other Fms	1.6	0
Qls	Surficial landslide deposits	1.0	0
P1	Cedar Mesa, Diamond Creek, Arcturus and other Fms	0.9	0
M3	Chainman, Manning Canyon, Doughnut and other Fms	0.3	0
O	Fish Haven, Swan Peak, Garden City, Eureka and other Fms	0.3	0
Jg	Glen Canyon Group (Navajo, Kayenta, Wingate, Moenave Fms) and Nugget Ss	0.2	0
ToV	Volcanic rocks	0.1	0
Total		1,163.6	100.0%

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## 2.7 Vegetation

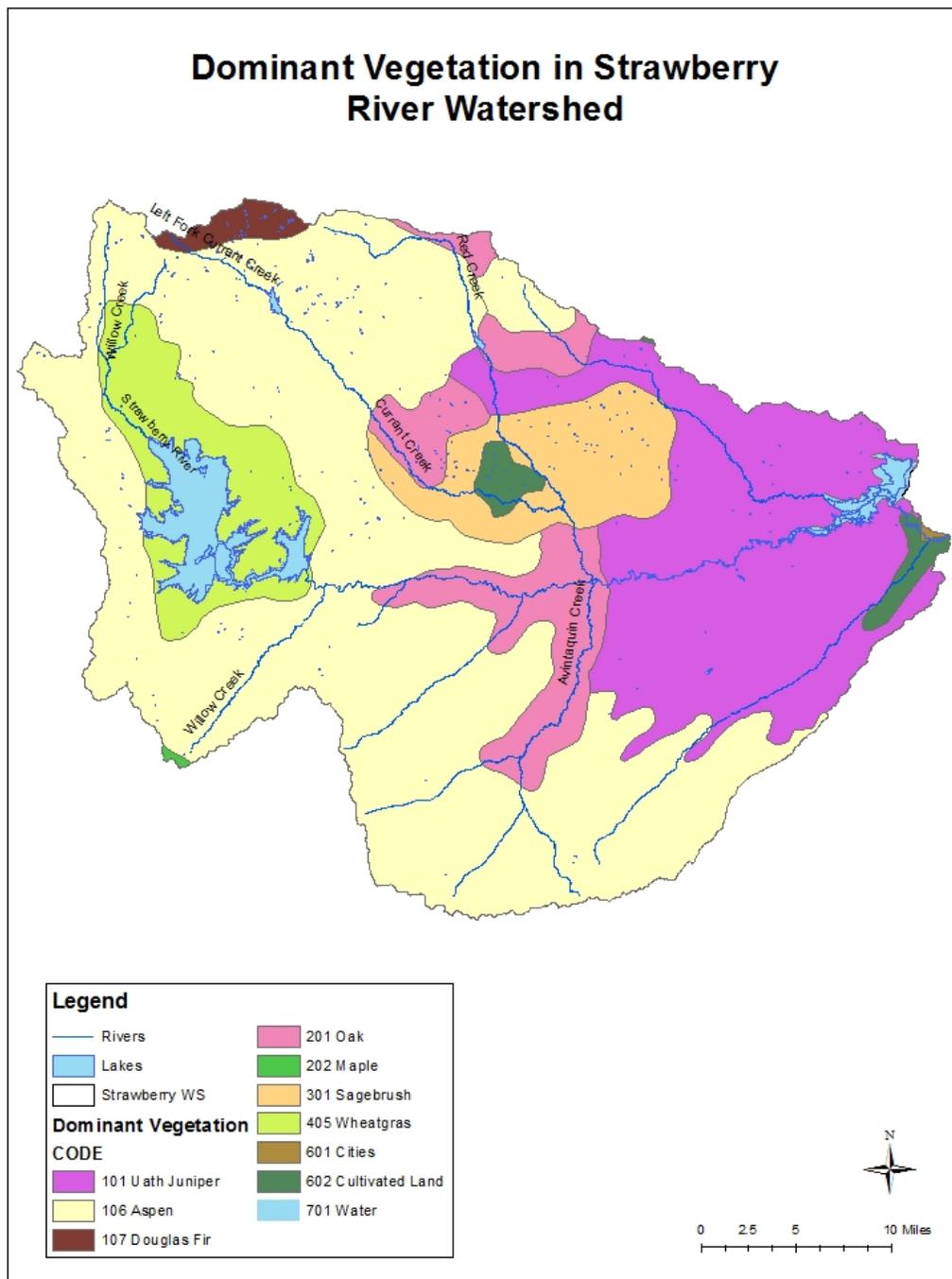
Vegetation data were gathered from the Gap Analysis Project (GAP) completed for the State of Utah. GAP classifications for the Strawberry River watershed are summarized in Table 3 and displayed in Figure 7. Aspen accounted for 51% of total watershed land cover, Utah Juniper 22%, and Oak at 9%.

**Table 3. Dominant Vegetation in the Strawberry River Watershed**

Code	Vegetation Type	Area (mi2)	%
106	Aspen	590.6	51
101	Utah Juniper	253.1	22
201	Oak	98.9	9
405	Wheatgrass	82.8	7
301	Sagebrush	74.8	6
701	Water	33.9	3
602	Cultivated Land	16.9	1
107	Douglas Fir	11.3	1
202	Maple	0.7	0
601	Cities	0.6	0
Total		1,163.6	100%

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Figure 7. Dominant Vegetation in the Strawberry River Watershed.



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## 2.8 Exotic / Invasive Species

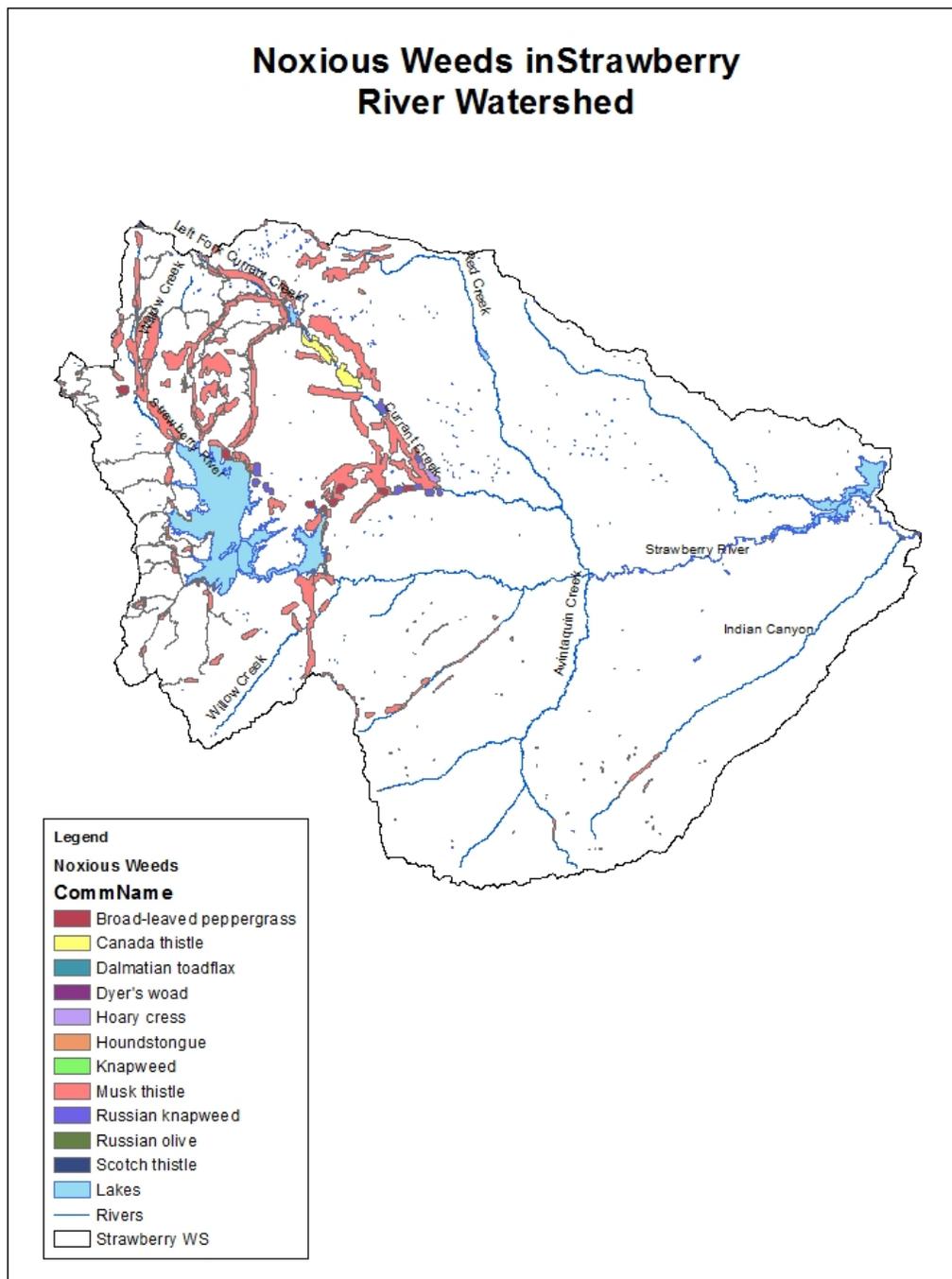
The most common noxious weeds in this watershed are Musk Thistle (35,494 acres) and Canadian Thistle (3,385 acres) based on a survey conducted from 2000 to 2005. Musk Thistle was mainly found along the Upper Strawberry River and both noxious weeds are found along Currant Creek. Currently, BLM-Vernal is working on mapping the presence of Tamarisk and Russian olive in the Uinta Basin. That data will be included in this plan once it becomes available.

**Table 4. Noxious Weeds Found in the Strawberry Watershed.**

<b>Common Name</b>	<b>Acres</b>	<b>Common Name</b>	<b>Acres</b>
Musk Thistle	35,494	Scotch Thistle	218
Canadian Thistle	3,385	Russian Olive	104
Broad-leaved Peppergrass	1,299	Houndstongue	68
Russian Knapweed	1,276	Dalmatian Toadflax	7
Hoary Cress	298	Dyer's Woad	1

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Figure 8. Noxious Weeds Found in the Strawberry River Watershed from 2000 - 2005.



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## 2.9 Protected Species

Several species are protected in the Strawberry River watershed. USFWS has broken out these species by county (Tables 5 and 6). These lists were updated in April 2013. Bonytail, Colorado pikeminnow, Humpback chub, Least chub, and Razorback sucker are not found in Wasatch County but water depletions from any portion of the occupied drainage basins may adversely affect these species or their critical habitat and must be evaluated with regard to the criteria described in the pertinent fish recovery programs.

Bonytail, Colorado pikeminnow, Humpback chub, and Razorback sucker are not found in Duchesne County but water depletions from any portion of the occupied drainage basins may adversely affect these species or their critical habitat and must be evaluated with regard to the criteria described in the pertinent fish recovery programs. The Black-footed ferret in Duchesne County is considered an experimental population and thus non-essential. The Mexican Spotted Owl has suitable habitat in southern Duchesne County, including Nine Mile and Argyle Canyons.

More information can be found at: <http://www.fws.gov/utahfieldoffice/endspp.html>

**Table 5. Federally Protected Species in Wasatch County.**

Federal Status	Common Name	Scientific Name
Endangered	Bonytail	<i>Gila elegans</i>
	Colorado pikeminnow	<i>Ptychocheilus lucius</i>
	Humpback chub	<i>Gila cypha</i>
	Razorback sucker	<i>Xyrauchen texanus</i>
Threatened	Canada lynx	<i>Lynx canadensis</i>
	Ute ladies' -tresses	<i>Spiranthes diluvialis</i>
Candidate	Greater sage-grouse	<i>Centrocercus urophasianus</i>
	Least chub	<i>Iotichthys phlegethontis</i>
	Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>

## Strawberry River Watershed Restoration Plan

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**Table 6. Federally Protected Species in Duchesne County.**

Federal Status	Common Name	Scientific Name
Endangered	Barneby ridge-cress	<i>Lepidium barnebyanum</i>
	Black-footed ferret	<i>Mustella nigripes</i>
	Bonytail	<i>Gila elegans</i>
	Colorado pikeminnow	<i>Ptychocheilus lucius</i>
	Humpback chub	<i>Gila cypha</i>
	Razorback sucker	<i>Xyrauchen texanus</i>
	Shrubby reed-mustard	<i>Schoenocrambe suffrutescens</i>
Threatened	Canada Lynx	<i>Lynx canadensis</i>
	Mexican spotted owl	<i>Strix occidentalis lucida</i>
	Pariette cactus	<i>Sclerocactus brevispinus</i>
	Uinta Basin hookless cactus	<i>Sclerocactus wetlandicus</i>
	Ute ladies'-tresses	<i>Spiranthes diluvialis</i>
Candidate	Greater sage-grouse	<i>Centrocercus urophasianus</i>
	Western yellow-billed cuckoo	<i>Coccyzus americanus occidentalis</i>
Proposed	Grahams's beardtongue	<i>Penstemon grahamii</i>

### 2.10 Water Related Land Use

A detailed spatial database of water related land use is available from the Utah Department of Natural Resources, Division of Water Resources. The database provides information on various land uses associated with water diversion and irrigation practices. Data was collected in the Strawberry River Watershed in 2006. The data show that a total of 28,078 acres, or approximately 4% of the watershed area, is devoted to water related land uses in the Strawberry River watershed. Distinct water related land use types for the watershed and their associated areas are given in Table 7.

Figure 9 shows that water related land use is typically located along valley floors and major stream corridors and is predominantly associated with irrigation and reservoir impoundments.

Irrigated and non-irrigated lands account for 16% and 5%, respectively, of total water related land uses in the watershed. Most of the irrigation water related land use occurs between Currant Creek and Red Creek.

## Strawberry River Watershed Restoration Plan

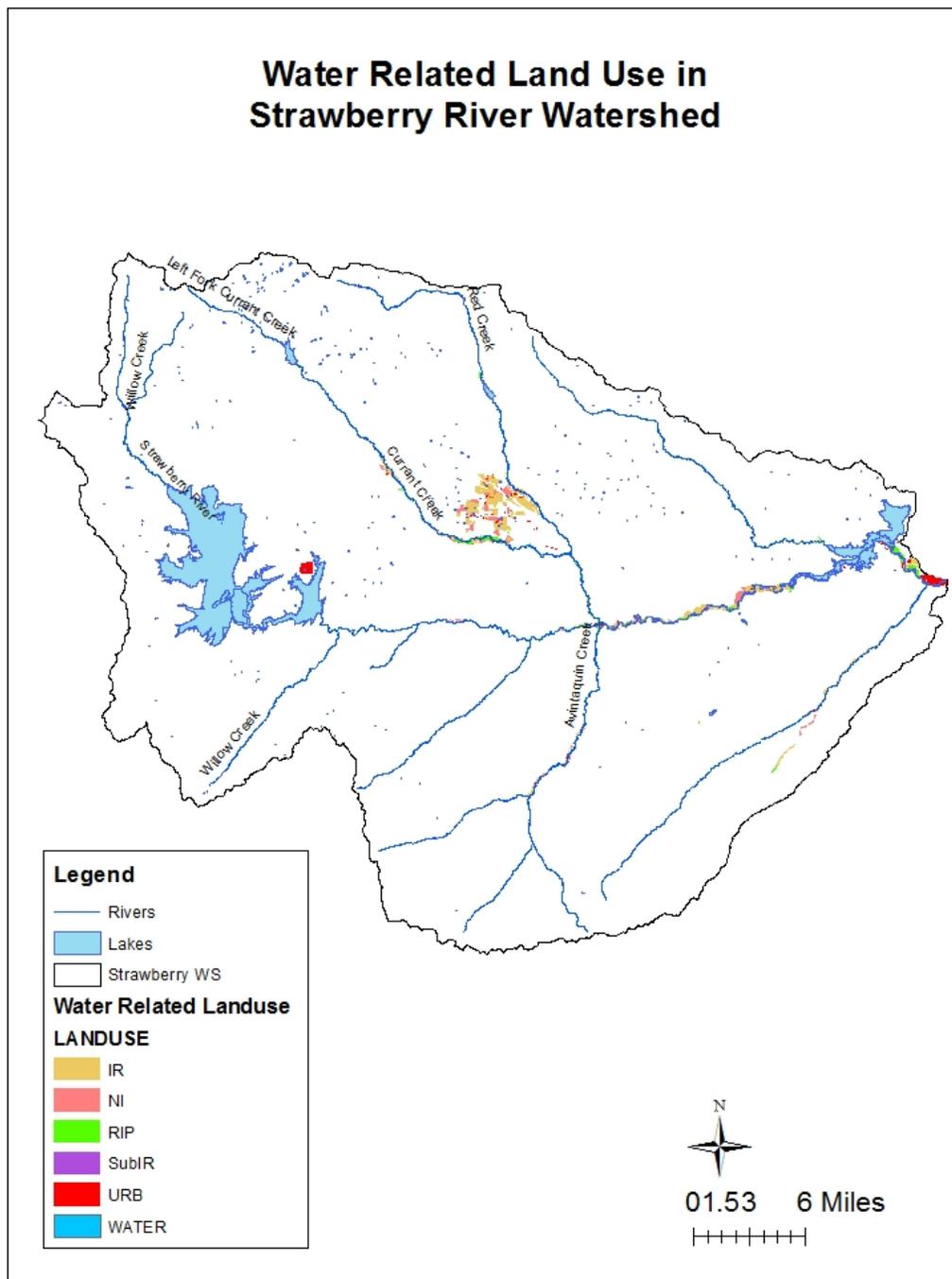
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**Table 7. Water Related Land Use in the Strawberry River Watershed.**

<b>Land Use</b>	<b>Type</b>	<b>Acres</b>	<b>Percent</b>
Irrigated 4,455 ac 16%	Pasture	1,939	44
	Alfalfa	1,505	34
	Grass Hay	1,011	23
Non-irrigated 1,439 ac 5%	Range Pasture	298	21
	Idle - Irrigated Land	915	64
	Fallow - Irrigated Lands	29	2
	Dry / Idle	199	14
Riparian 1,910 ac 7%	Riparian	1,910	100
Urban 1,063 ac 4%	Urban	969	91
	Urban Grass / Parks	94	9
Water 19,151 ac 68%	Lakes & Ponds	132	1
	Reservoir	18,673	98
	Streams	338	2
	Sewage Lagoon	5	0
	Evaporation Pond	3	0
Sub-irrigation 60 ac 0%	Pasture - subirrigated	60	100

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Figure 9. Water Related Land Use in the Strawberry River Watershed.



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## 2.11 Fisheries

The Strawberry River Watershed can logically be broken up into sections above and below the Soldier Creek Dam. Strawberry Reservoir and the tributaries above the Soldier Creek Dam have been chemically treated in the past, and the fish assemblage has been intensively managed for specific sportfish and biological control needs, creating a vastly different fish assemblage than found elsewhere in the watershed.

**Table 8. Fish Species Found in the Strawberry River Watershed (above Soldier Creek Dam).**

Category	Common Name	Scientific Name
Native Nongame Fish	Speckled dace	<i>Rhinichthys osculus</i>
	Mottled Sculpin	<i>Cottus bairdii</i>
	Mountain sucker	<i>Catostomus platyrhynchus</i>
Nonnative Game Fish	Bear Lake cutthroat	<i>Oncorhynchus clarki utah</i>
	Rainbow trout	<i>Oncorhynchus mykiss</i>
	Kokanee salmon	<i>Oncorhynchus nerka</i>
Nonnative Nongame Fish	Utah chub	<i>Gila atraria</i>
	Utah sucker	<i>Catostomus ardens</i>
	Redside shiner	<i>Richardsonius balteatus</i>

# Strawberry River Watershed Restoration Plan

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## 2.12 Landowners

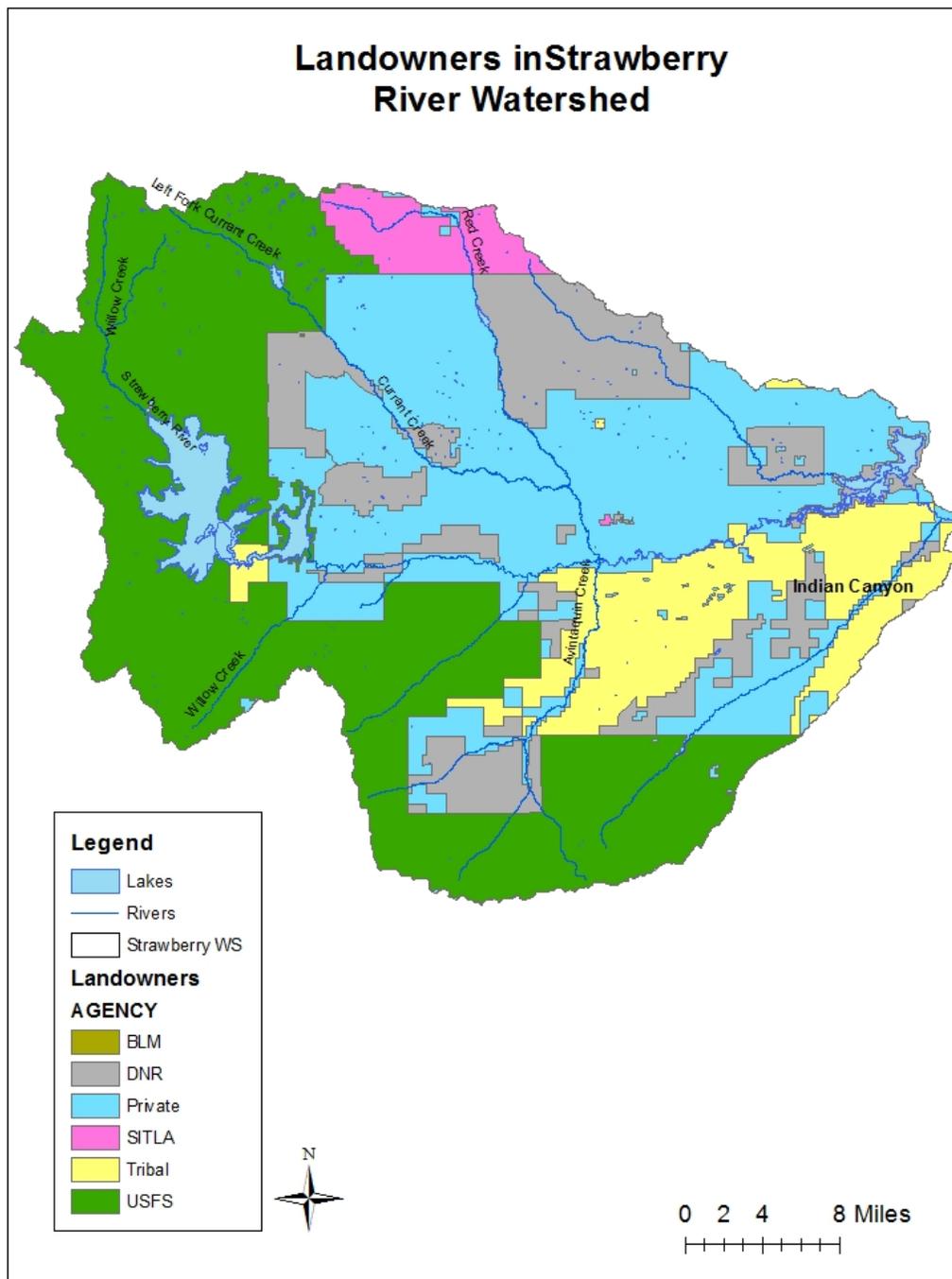
Land ownership information was digitized for the Utah GAP analysis and is available for the entire state of Utah. This dataset describes general land management units as well as enclaves of land ownership within each management unit. Various federal, state, private, and tribal agencies are responsible for managing land throughout the Strawberry River watershed (Figure 10 & Table 9). The Forest Service manages a majority of the land in this watershed at 41%. This land surrounds Strawberry Reservoir and is commonly the headwaters of many tributaries of Strawberry River. Private land owners manage 30% and the State (DNR) controls 15%. Not shown is a Mitigation Commission easement located on the Strawberry River near the Wasatch and Duchesne Counties' borders.

**Table 9. Landowners in the Strawberry River Watershed.**

<b>Landowner</b>	<b>Area (acre)</b>	<b>Area (mi<sup>2</sup>)</b>	<b>Percent (%)</b>
Private	222,719	348	30
Forest Service	308,566	482	41
Tribal	80,503	126	11
BLM	56	0	0
DNR	110,777	173	15
SITLA	22,091	35	3

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Figure 10. Landowners in the Strawberry River Watershed.



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## 3.0 WATERSHED WATER QUALITY CONDITIONS

### 3.1 Designated Uses

The central objective of the Clean Water Act (CWA) is to, “restore and maintain the chemical, physical, and biological integrity of the Nation's waters” (CWA §101 (a)). To meet this objective, the CWA and associated regulations develop the concept of “designated uses”. In essence, designated uses describe key aspects of waters that should be maintained to ensure that all surface waters provide important services to humans and aquatic life. The creation of use classes allows different waterbodies (i.e., river segments, lakes) to be classified into similar classes (groups), which can then be used to develop numeric criteria that describe pollutant concentrations that must not be exceeded to ensure protection of the use class. Under Federal Regulations each State is required to establish use classes, which can include as many classes as are needed to ensure protection; however, at a minimum the classes must ensure protection of aquatic life and recreation uses for all surface waters (40CFR 131.10(a)).

DWQ has designated uses to the rivers, streams, lakes and reservoirs of Utah. Utah’s designated uses include: domestic use sources, recreation uses, aquatic life uses, and agricultural uses (Table 10), and are defined for specific waterbodies throughout Utah in [UAC R317-2-6](#). As the narrative descriptions describe, each of the designated uses—and associated subclasses—protect numerous activities and organisms.

**Table 10. List of Designated Uses for Surface Waters.**

Designated Use Class	Use Description
1C	Protected for domestic purposes with prior treatment processes as required by Utah Division of Drinking Water
2A	Protected for frequent primary contact recreation such as swimming
2B	Protected for infrequent primary contact and secondary contact recreation such as boating or wading
3A	Protected for cold water species of game fish and other cold water aquatic life, including aquatic organisms in their food chain
3B	Protected for warm water species of game fish and other warm water aquatic life, including aquatic organisms in their food chain
3C	Protected for nongame fish and other aquatic life, including aquatic organisms in their food chain

# Strawberry River Watershed Restoration Plan

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3D	Protected for waterfowl, shore birds, and other water oriented wildlife not included in Classes 3A, 3B, or 3C, , including aquatic organisms in their food chain
3E	Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.
4	Protected for agricultural uses including irrigation of crops and stock watering.
5	Great Salt Lake specific.

## 3.2 Water Quality Standards

Water quality standards are criteria that express the condition of the water that is necessary to support the beneficial uses. Numeric criteria represent the concentration of a pollutant that can be in the water and still support the designated use of the waterbody. Narrative criteria are general water quality criteria that apply to all surface waters. These criteria state all waters must be free from sludge, floating debris, oil and scum. All water quality standards can be found in Utah's Administrative Code ([UAC R317-2](#)).

## 3.3 Assessment Units

DWQ segments waters into homogenous units called Assessment Units (AU's). The physical, chemical, or biological conditions of the waters within an AU are more similar to each other than to the conditions in adjacent AU's. Segments that have different beneficial uses than an adjacent segment are always classified as different AU's. A stream may be divided into several AU's even when beneficial uses are the same because of significant changes in natural features. Factors such as flow, channel morphology, substrate, riparian condition, adjoining land uses, confluence with other waterbodies, and potential sources of pollutant loading are considered when delineating AU's. AU's for streams and rivers are established for defined stream segments or watersheds, whereas lakes or reservoirs are typically considered to be a single and distinct AU. Within the Strawberry River Watershed, there are 15 AU's (subwatersheds).

## Strawberry River Watershed Restoration Plan

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**Table 11. List of Assessment Units (AUs) in the Strawberry River Watershed.**

<b>Name</b>	<b>AU</b>	<b>Description</b>
Avintaquin	UT14060004-005	Avintaquin Ck and tribs from confluence Strawberry R to headwaters
Indian Canyon Creek	UT14060004-002	Indian Canyon Ck and tribs from confluence Strawberry R to headwaters
Lower Currant Creek	UT14060004-009	Currant Creek and tribs from Red Creek confluence to Currant Creek Reservoir
Upper Currant Creek	UT14060004-015	Currant Creek Reservoir tribs
Lower Red Creek	UT14060004-006	Red Ck and tribs from confluence Strawberry R to Currant Ck confluence
Middle Red Creek	UT14060004-007	Red Ck and tribs from confluence Currant Ck to Red Creek Reservoir
Upper Red Creek	UT14060004-008	Red Creek Reservoir tribs
Starvation Tribs	UT14060004-003	Starvation Reservoir tribs except Strawberry R
Strawberry-1	UT14060004-001	Strawberry R from confluence Duchesne R to Starvation Dam
Strawberry-2	UT14060004-004	Strawberry R and tribs from Starvation Reservoir to Avintaquin Ck confluence
Strawberry-3	UT14060004-010	Strawberry River and tribs from Avintaquin Ck to confluence Strawberry Reservoir
Strawberry-4	UT14060004-013	Strawberry Reservoir tribs other than the Strawberry R
Upper Strawberry	UT14060004-014	Strawberry R and tribs from Strawberry Reservoir to headwaters
Timber Canyon Creek	UT14060004-011	Timber Canyon Ck and tribs from confluence Strawberry R to headwaters
Willow Creek	UT14060004-012	Willow Creek and tribs from confluence Strawberry River to headwaters

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## 3.4 Assessment of Surface Waters

Clean Water Act (CWA) regulations require UDWQ to report the condition—or health— of all surface waters to Congress every other year. Known as the *Integrated Report* (IR), this report contains two key pieces of information. First, the report identifies waterbodies that are not meeting their designated uses. These waters are listed as impaired on the 303(d) list, which subsequently requires that DWQ develop restoration plans (TMDLs) to improve the condition of these waters. Second, the report summarizes the overall condition of Utah’s surface waters, and estimates the relative importance of key water quality concerns such as pollutants, habitat impairment and sources of water quality problems.

For more information on the 303(d) list, visit <http://www.waterquality.utah.gov/WQAssess/currentIR.htm>. A restoration plan or Total Maximum Daily Load (TMDL) is then developed for the impaired waterbody for each pollutant causing the impairment. A complete list of EPA approved TMDLs can be found online: <http://www.waterquality.utah.gov/TMDL/index.htm#approved>. Table 12 shows which AUs (subwatersheds) are impaired or have an approved TMDL. Figure 11 displays these watersheds as well.

## Strawberry River Watershed Restoration Plan

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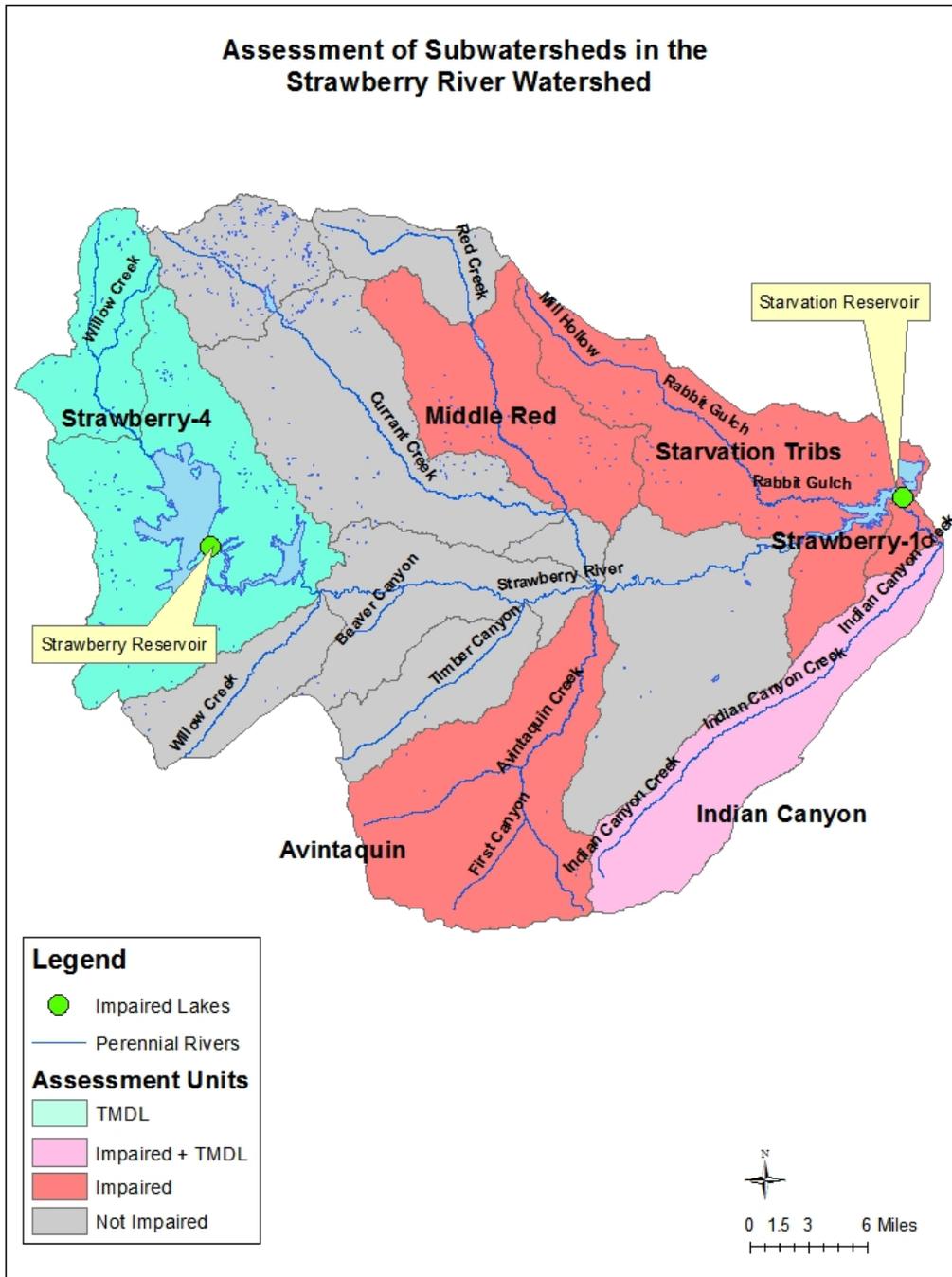
**Table 12. Impaired or TMDL Approved Assessment Units in the Strawberry River Watershed.**

<b>Subwatershed</b>	<b>Waterbody</b>	<b>Use</b>	<b>Year Listed</b>	<b>Parameter</b>	<b>Year TMDL Approved</b>
Avintaquin	Avintaquin Creek	Drinking Water	2008	Arsenic	
Indian Canyon	Indian Canyon Creek	Drinking Water Agriculture	2008 2008	Arsenic Boron	
Indian Canyon	Indian Canyon Creek	Agriculture		Total Dissolved Solids	2007 SSC*
Middle Red Creek	Red Creek	Cold Water Fishery	2008	Benthic Macros	
Starvation Tribs	Starvation Reservoir	Cold Water Fishery	2008 2010	Dissolved Oxygen Temperature	
Strawberry-1	Strawberry River	Agriculture	2008	Boron	
Strawberry-4	Strawberry Reservoir	Cold Water Fishery		Total Phosphorus/ Dissolved Oxygen	2007

\*SSC = Site Specific Criteria

# Strawberry River Watershed Restoration Plan

Figure 11. Impaired or TMDL Approved Assessment Units in the Strawberry River Watershed.



# Strawberry River Watershed Restoration Plan

## 3.5 Benthic Macroinvertebrates

UDWQ has developed a method called RIVPACS (River Invertebrate Prediction and Classification System) to assess attainment of biological beneficial uses by quantifying the health of aquatic insects or macroinvertebrates. The model compares the list of species that are observed (O) at a site to the list of species expected (E) in the absence of human-caused stress. An O/E score of 0.7 means that 7 out of 10 taxa were discovered at the site or 30% of the taxa have become locally extinct as a result of human-caused alterations to the stream.

The assessment methodology of biological beneficial use support can be found online and a list all impaired

AUs: [http://www.waterquality.utah.gov/WQAssess/documents/IR2010/Part1/2010\\_Part-1-IR-Final\\_10Nov2010.pdf](http://www.waterquality.utah.gov/WQAssess/documents/IR2010/Part1/2010_Part-1-IR-Final_10Nov2010.pdf)

**Table 13. Beneficial Use Support Determination for O/E Values Obtained From Different Sample Sizes.**

Sample Size	O/E Threshold	Use Determination
≥ 3 collected over 3 years	≥ 0.83	Fully Supporting
≥ 3 collected over 3 years	< 0.83	Not Supporting
< 3 samples	≥ 0.78 – 0.83	Insufficient data
< 3 samples	< 0.78	Not Supporting

Six subwatersheds have been assessed for benthic macroinvertebrate communities since 2002. Middle Red Creek had low O/E scores in both 2005 and 2008 thus received a “poor” status and was listed on the 303(d) List of Impaired Waterbodies. Lower Currant Creek and Strawberry River-4 received a “fair” status. Lower Red Creek, Strawberry River-3, and Upper Strawberry River received “fair-good” or “good” status. Note that the 2010 sample collection in Upper Strawberry River and Strawberry River-4 was taken during the summer while being compared to a model containing fall data. More data is needed to properly assess these subwatersheds.

## Strawberry River Watershed Restoration Plan

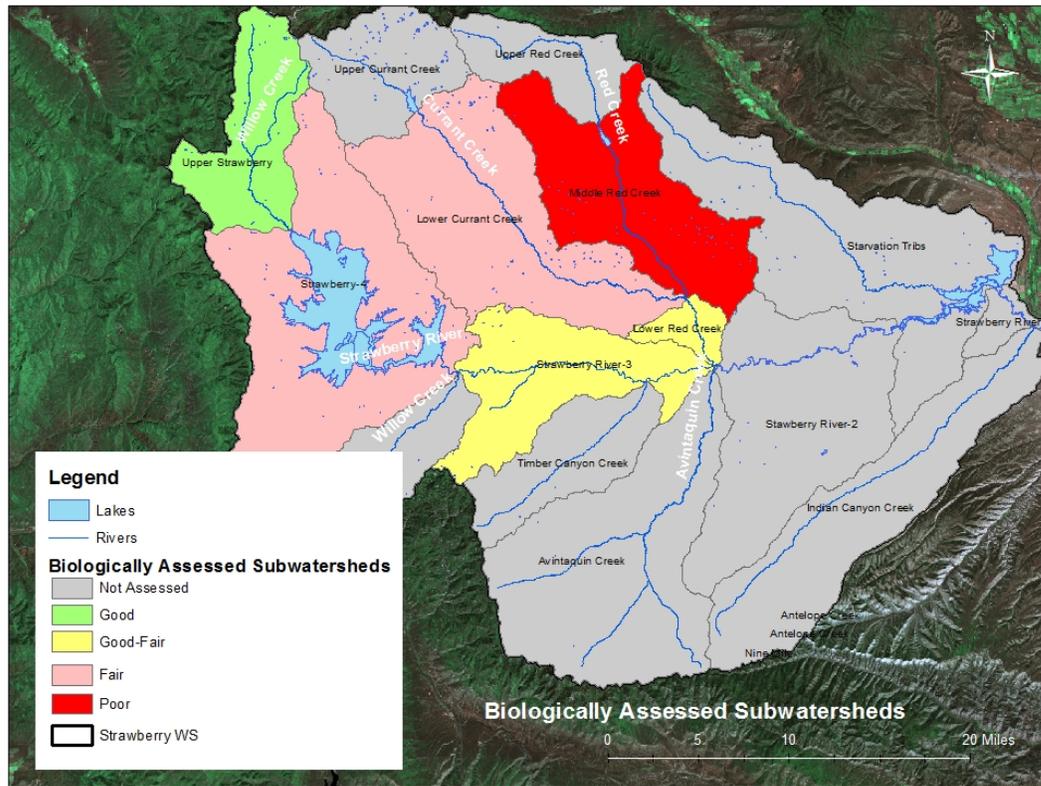
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**Table 14. Impaired Assessment Units in the Strawberry River Watershed for Benthic Macroinvertebrates.**

<b>AU</b>	<b>AU Name</b>	<b>Year</b>	<b>O/E Score</b>	<b>Status</b>
UT14060004-006	Lower Red Creek	2005	0.57108	Fair
		2008	1.0065	Good
UT14060004-009	Lower Currant Creek	2005	0.6763	Fair
UT14060004-007	Middle Red Creek	2005	0.48896	Poor
		2008	0.691033	Poor
UT14060004-010	Strawberry River-3	2002	0.7745	Good
		2002	0.7743	Good
		2002	0.6777	Fair
		2007	0.7808	Fair
		2010	0.5695	Poor
UT14060004-014	Upper Strawberry River	2008	1.1753	Good
		2010	0.7389	Poor*
		2010	0.7464	Poor*
UT14060004-013	Strawberry River-4	2010	0.7332	Poor*

# Strawberry River Watershed Restoration Plan

**Figure 12. Biologically Assessed Subwatersheds in the Strawberry River Watershed.**



## 3.6 Fisheries Data

### Upper Strawberry River (above Soldier Creek Dam)

Strawberry Reservoir is one of Utah’s premier cold water fisheries, and sustains as much as 1.5 million angler hours in a year, more than any other fishery in Utah. The reservoir and its associated tributaries have been chemically treated on two occasions in the past to remove unwanted (largely nonnative) nongame fish populations. The most recent treatment in 1990 was the largest rotenone treatment ever attempted. The management plan following the 1990 treatment called for new strategies to keep the non-game fish under control, primarily through the use of Bear Lake cutthroat trout as a top predator in the system. These cutthroat trout have been very effective at keeping these non-game fish (such as Utah chub) under control in Strawberry Reservoir.

# Strawberry River Watershed Restoration Plan

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In addition to the Bear Lake cutthroat, the Strawberry Reservoir fishery is currently managed to provide a fishery for rainbow trout (sterile) and kokanee salmon. Angler catch rates in recent years have exceeded 0.60 fish per hour, with an average size of harvested rainbows of around 16", and even larger cutthroat being caught. Current regulations protect all cutthroat trout between 15" and 22". These regulations have provided the needed numbers and larger sized cutthroat predators to keep Utah chub populations under control. These regulations have also provided numerous large cutthroats for anglers to catch, with as many as 20% of the cutthroat in the reservoir being over 20" in length. Kokanee salmon contribute much less to the fishery than cutthroat and rainbows do, but they do provide a unique fishing opportunity that many anglers have come to enjoy.

## 4.0 STRAWBERRY RESERVOIR TP TMDL

### 4.1 Overview of Water Quality Data

High total phosphorus (TP) and low dissolved oxygen (DO) in Strawberry Reservoir has resulted in its being listed as impaired for its cold-water aquatic life beneficial use. It was listed on Utah's 2004 303(d) List of Impaired Waters. The Strawberry Reservoir TMDL was approved by EPA on July 9, 2007 and can be found at: [http://www.waterquality.utah.gov/TMDL/Strawberry\\_Reservoir\\_TMDL.pdf](http://www.waterquality.utah.gov/TMDL/Strawberry_Reservoir_TMDL.pdf)

There are 32 water quality monitoring stations in the Upper Strawberry River watershed

The 32 stations are comprised of 16 lake sites, 14 river sites, and 2 spring sites.

#### **Strawberry Reservoir**

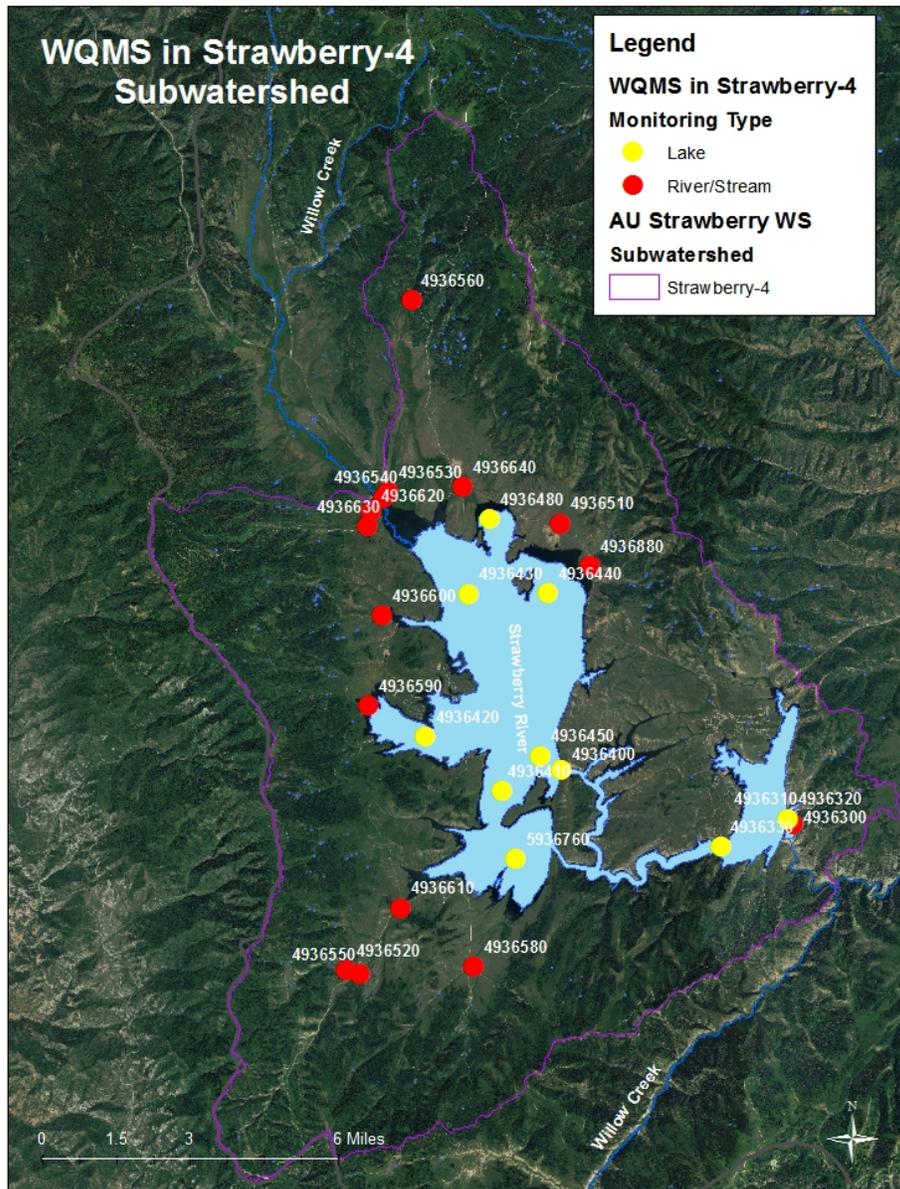
Of the 16 lake monitoring sites, Strawberry Reservoir above Soldier Creek Dam (4936320) was assessed as impaired for low DO and high TP. At this monitoring site, 76% of the water column has DO levels less than 4 mg/L during September. East Portal Bay and Soldier Creek Bay is considered borderline nutrient enriched (eutrophic) while the rest of the main body of the reservoir is nutrient stable (mesotrophic).

Other locations in the reservoir show more favorable conditions. The TMDL data evaluation concluded that there is no apparent correlation between water quality exceedances and fishery population trends and thus the cold water fishery is no longer threatened due to water quality exceedances. UDWR has summarized the current fishery trends at Strawberry Reservoir. Overall game fish numbers and associated angler catch rates have remained relatively high, though composition has changed in recent years. In gillnet surveys, adult cutthroat numbers have decreased slightly since about 2009, while rainbow numbers have increased over the same period. Angler catches in the 2011 creel survey also verified these trends in species composition shift. Rainbow catch and harvest was as high as we have documented since the 1990 treatment,

# Strawberry River Watershed Restoration Plan

while cutthroat catches were about half of what they were in 2006. Chub catches in the gillnets have remained low since 2003, with only minor fluctuations overall. However, since about 2010, we have started to see a slight increase in young (age I and age II) chubs, likely related to the decreases we have noticed in adult cutthroat over the same period.

**Figure 13. Water Quality Monitoring Stations in the Upper Strawberry-4 Subwatershed.**



# Strawberry River Watershed Restoration Plan

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## 4.2 Causes and Sources of Pollution

There are currently no point sources of pollution within the Strawberry watershed. All TP loading into Strawberry Reservoir is derived from non-point sources such as soil erosion and land use. Examples of land use sources of pollution include recreation, hydrologic modifications, grazing, roads, and energy development.

In the watershed, excess soil erosion is a major concern. Excess sediment in streams can cover gravels needed for fish spawning and smother eggs. The 2003 Uinta National Forest Plan aims to have at least minimal protective ground cover, soil organic matter, and large woody material to protect the soil and preserve its ability to filter and regulate nutrient cycling for water quality. Soils from the gray shale of Strawberry River and Co-op Creek subwatersheds contain high concentrations of phosphorus. Runoff from this area contains phosphorus rich sediment and contributes loading to the rivers.

### Recreation

Over 2 million people visit Strawberry Valley each year. Developed recreational facilities and dispersed recreational activities uses have been heavy in the past and are rapidly expanding. Generally, if visitation increases there could be a corresponding increase in NPS pollution. Recreation Management Standards and Guidelines identified in the 2003 Forest Service plan should be fully implemented to control impacts to the watershed from increased recreational activities. The USFS has taken many steps to minimize the negative impacts of recreation such as limiting motorized recreation use to designated roads and trails and dispersed campsites have been established and signed to concentrate use. Very little ATV use is permitted off road on public lands; however, heavy ATV use on dirt roads is a source of pollution in the watershed.

### Degradation

The Restoration Report (USFS 2004) reviewed the history of management of the Strawberry Reservoir watershed and determined that historical water diversions, elimination of riparian species through herbicide spraying, trapping of beaver, and removal of beaver dams have all caused detrimental impacts to the hydrology of Strawberry Valley's rivers and streams. The system is recovering through the implementation of extensive management programs since the early 1980's. However, much work remains in maintaining and expanding effective restoration measures throughout the watershed. Implementation of the Standards and Guidelines for Riparian Habitat Conservation Areas (RHCAs) continues to improve watershed conditions within the Uinta National Forest. Additional improvement is expected through implementation of the programs outlined in the 2004 Strawberry Watershed Restoration Report.

### Grazing

Livestock, deer, and elk grazing occur within the Strawberry Reservoir watershed. The land is managed by the USFS, which leases out the land for domestic livestock grazing. It is expected

# Strawberry River Watershed Restoration Plan

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that animal waste makes up a part of the phosphorus loading to the reservoir, although the portion of phosphorus loading attributable to grazing activities could not be determined from the available data. Livestock and wildlife generally have direct access to the tributaries of the reservoir for watering although riparian fencing and off-site water developments are becoming more prevalent. The USFS requires all grazing permittees to follow specific grazing instructions for their particular allotment yearly. Overall, improved awareness of water quality concerns relative to grazing management practices are having a positive effect on the watershed.

## Irrigation

There are approximately 4,455 acres of irrigated land in the watershed. The vast majority of irrigated acres are below Strawberry Reservoir. Of those 4,455 acres, less than 30% are flood irrigated. The remainder have been upgraded to sprinkler irrigation systems, which are more efficient and do not contribute much to pollution.

## Roadways

U.S. Highway 40 passes through the watershed and is used by visitors as the primary access to Strawberry Reservoir. The watershed is accessible by 207 miles of classified roads.

Approximately 40 miles of inventoried trails are also used to access the Forest. The Roads Analysis for the Uinta National Forest provides information for all roads within the Strawberry Reservoir watershed. Results of the analysis show that 35 miles of road analyzed for the Strawberry watershed are rated as high risk for contributing sediment. These roads include:

- Squaw Creek road
- Trout Creek road
- Devils Notch road
- Mill B road
- Clyde Creek road
- Chipman road

These roads correlate with higher levels of stream sedimentation as determined by the USFS sedimentation analysis. To minimize soil erosion, it will be imperative to implement USFS standards and guidelines that will help eliminate increased pollutant loads from future construction and maintenance of the roadways.

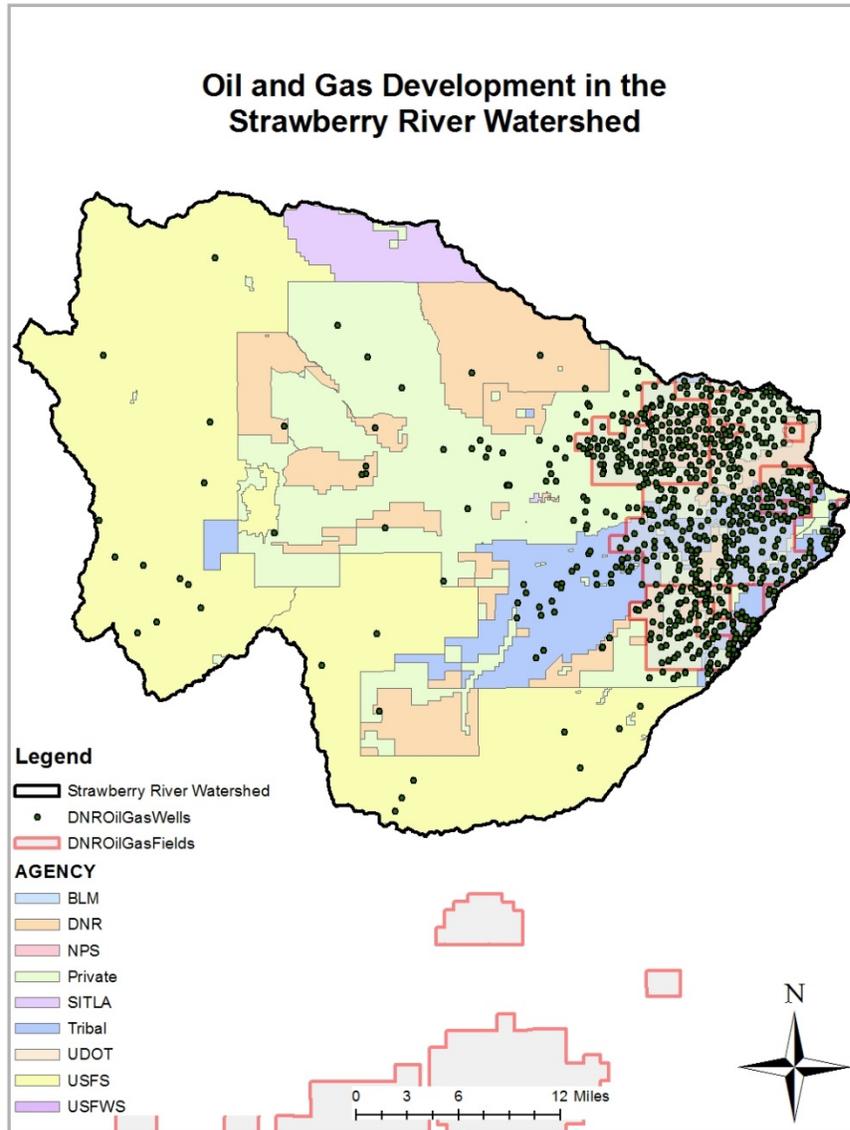
## Energy Development

Within the watershed there are over 1000 oil and gas wells. The majority of these wells sit on the 160 mi<sup>2</sup> of designated oil and gas fields on the East side of the watershed (see Figure 14). These fields are on a mixture of mostly private and Tribal land. There are a few other wells scattered throughout the watershed on private, USFS, Tribal and UDNR land. Strawberry Reservoir is

# Strawberry River Watershed Restoration Plan

classified as High Quality Waters – Category 1 in which new point source discharges of wastewater, treated or otherwise, are prohibited in such segments after the effective date of designation. In addition, due to the vital importance of Strawberry Reservoir as a premier fishery as well as one of the primary sources of municipal water for the Wasatch Front we recommend that all oil and gas developments and other permitted activities associated with it be required to obtain individual permits to ensure that water quality is protected.

**Figure 14. Oil and Gas Development in the Strawberry Watershed**



# Strawberry River Watershed Restoration Plan

## 4.3 Load Allocation and Reduction

The TMDL load allocation assigns loads to all sources including point, non-point, and background sources. In addition, a margin of safety (MOS) is included to account for the uncertainty inherent in the data and its analysis. The current watershed loading is 15,100 lbs/year of TP. The MOS was included implicitly through conservative assumptions and explicitly by allocating 5% of the loading capacity or 755 lbs/year to the MOS. Load reductions are allocated to the entire watershed to support the watershed-scale improvement projects that are planned in the near future. A reduction of 1,015 lbs/year of TP loading is required to protect Strawberry Reservoir’s cold water fishery. There are no point sources in the watershed thus all reduction in loading will be from non-point sources of pollution.

Figure 16 shows that TP loading into Strawberry Reservoir originates from the Strawberry River (22%), The Ladders (29%), Co-op Creek (6%), Sheet flow (16%), and all other inputs combined (27%). Loading in winter (October – March) is minimal, accounting for 10% of the April to September loads. Flow in the Ladders originates from a trans-basin diversion and thus is not affected by the Strawberry Reservoir watershed. The Ladders represent 45% of total surface water inflow into the reservoir with TP concentrations less than 0.02 mg/L.

The majority of the needed load reduction will come from the movement of total phosphorus from bottom sediments out of the reservoir where concentrations aren’t as great. Recent data show a net export of total phosphorus of approximately 4,000 lbs/year, well above the needed 900 lbs/year. Remaining load reductions were allocated proportionally among the tributary streams that have exceeded the 0.05 mg/L indicator value for total phosphorus, including Co-op Creek, Clyde Creek, Trail Hollow (tributary to Chipman Creek), and Strawberry River.

Even though water quality conditions currently exceed the State’s indicator values for total phosphorus and dissolved oxygen, the reservoir is currently believed to be supporting its Cold Water Fishery beneficial use (3A). It is expected that current and proposed management and operational practices will continue to improve conditions within the reservoir.

**Table 15. Strawberry Reservoir TP TMDL.**

Current Load	15,100 lbs/year
Loading Capacity (TMDL)	15,100
MOS	755
Wasteload Allocation*	0
Load Allocation	14,345

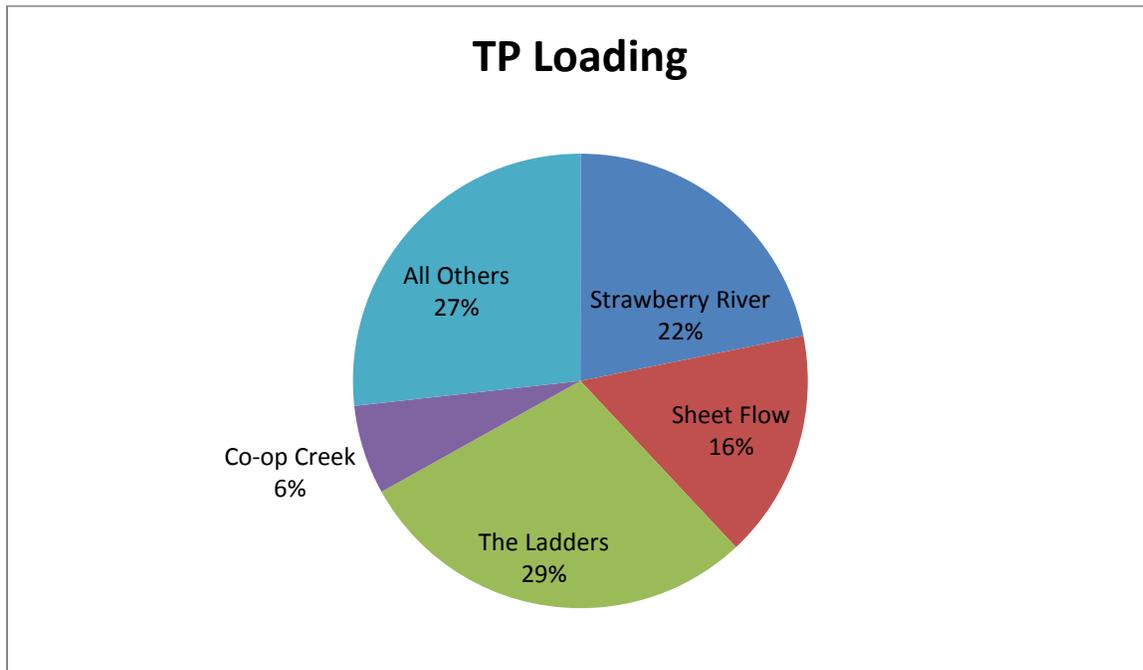
\*No point sources

## Strawberry River Watershed Restoration Plan

**Table 16. Total Phosphorus TMDL Load Allocations (lbs/year).**

Source	Current Load	Allocation	Reduction
Strawberry River	3,100	3,025	75
Indian Creek	400	400	0
Co-op Creek	900	880	20
Clyde Creek	300	295	5
Trout Creek	100	100	0
Chipman Creek	800	785	15
Mud Creek	300	300	0
Broad Hollow	200	200	0
Other Stream Inflows	1,700	1,700	0
Sheet Flow	2,300	2,300	0
The Ladders	4,100	4,100	0
Bottom Sediments	900	0	900
Future Sources		260	
MOS		755	
Total	15,100	15,100	1,015

**Figure 15. Major Tributary Sources of TP Loading to Strawberry Reservoir.**



# Strawberry River Watershed Restoration Plan

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## 5.0 WATERSHED IMPLEMENTATION STRATEGY

### 5.1 Goals and Objectives

The TMDL has

indicated that Strawberry Reservoir's water quality conditions are currently adequate to support the fishery. The stable mesotrophic status indicates a healthy reservoir. The TMDL implementation plans suggests that current and planned management efforts should be maintained and continued to improve water quality and sustainability of the fisheries. The goals of this watershed plan are congruent with several other management plans completed. These other management plans include:

- Revised Forest Plan Wasatch-Cache National Forest 2003 [https://fs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb5347083.pdf](https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5347083.pdf)
- 2004 USFS Strawberry River Restoration Report <http://www.riversimulator.org/Resources/farcountry/USFS/StrawberryWatershedRestorationReport2004.pdf>
- 1997 Mitigation Commission and USFS Strawberry Valley Assessment <http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1056&context=govdocs>
- 1987 UDWR Fishery Management Plan for Strawberry Reservoir

The goals and objectives of this watershed plan are:

- Ensure a high quality, diverse fishery and associated habitats
- Improve/maintain overall recreational experience at Strawberry
- Improve natural reproduction of cutthroat trout and Kokanee salmon populations
- Identify ecological measures to improve riparian, wetlands, and fish habitat in streams
- Prioritize needs and measures according to resources allocation for satisfying the needs of constituent users and for meeting the multiple use and sustainable yield mandates
- Create project and management recommendations for site-specific projects ready for NEPA analysis to begin the implementation process
- Develop site-specific restoration recommendations for addressing non-properly function aspects of the watershed by building on the 1997 Strawberry Valley Assessment and utilizing all past, current, and collected data/information and assessments

# Strawberry River Watershed Restoration Plan

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## 5.2 Current Implementation Projects

There have been several studies, programs, and planning efforts highlighting this area as a high priority watershed.

- The headwater portion of the Strawberry River has been identified as “high quality category 1” water. The proposed Best Management Practices (BMPs) will contribute to the maintenance of high water quality for aquatic life and recreational uses of both the stream and downstream reservoir.
- A portion of the East Daniels Grazing Allotment was identified as a priority project area in the 2004 Strawberry Watershed Restoration Report, prepared by the Heber District, Uinta National Forest and their partners.
- Strawberry Reservoir is designated by Utah Division of Wildlife Resources as a “Blue Ribbon Fishery”. Priorities of this plan include the improvement of streambank stability by re-vegetation of riparian areas, improved grazing management, cattle access restrictions to streambanks and waterways, establishment of vegetative buffer strips, and encouragement of watershed groundcover to improve watershed health and water quality.

Protection of these sensitive headwater areas is a priority for the US Forest Service, Utah Division of Water Quality, Utah Division of Wildlife Resources, and the Friends of Strawberry Valley and their partners. Although Strawberry Reservoir is currently supporting a high quality cold water fishery, it is expected that both current and proposed management and operational practices will continue to improve conditions within tributaries and the reservoir itself. Given the anticipated increase in recreational use due to population growth, popularity of the fishery, possible oil and gas development, continued grazing pressure, and development for summer residences, projects implemented over the next few years will go a long way to maintain high water quality into the future.

### **Upper Strawberry River East Daniels Grazing Allotment Project**

Both the Strawberry Watershed Restoration Report (2004) as well as the TMDL for Strawberry Reservoir recommend grazing management as one of the BMPs to be implemented. Grazing management includes fencing cattle from erosive hillslopes and riparian zones to access the stream. This exclusion will promote sufficient vegetative cover and buffer strips to increase riparian habitat and reduce hillslope erosion. By reducing bank trampling, sediment and nutrient loading will also be reduced improving the overall buffering capacity of the riparian zone.

The Upper Strawberry River East Daniels Grazing Allotment Project is located in the headwater area of the Strawberry River upstream of the reservoir. It is anticipated that this fencing project will significantly contribute to the reduction of the downstream loading of Strawberry River.

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Projected loading reductions in the riparian project area are 10 lbs/year nitrogen (N) reduction and 2 lbs/year TP, with additional reduction of 350 lbs/year N, and 14 lbs/year TP resulting from improvements in upland vegetation and filtration capacity of the riparian area.

The main stem of the Strawberry River is the eastern boundary of the Strawberry Allotment, which is now included in the East Daniels Allotment. At present this area is difficult to access and is not heavily used by the public for recreation, although there is limited dispersed camping. The only Forest Service identified recreational site located in close proximity to the project is a trailhead at the southern boundary of the fence. The primary land uses for this area are cattle and wildlife grazing. There are currently no readily available digital soils data for this project area.

This fencing project is anticipated to achieve load reductions by constructing approximately 4 miles of fence over five years along a steep-sloped portion of the Strawberry River and its smaller headwater tributaries. This project has essentially three areas which will be affected by the proposed fence. Figure 3 shows the western Strawberry Pasture (2000 acres), northeastern section named Special Use pasture (820 acres), and the lower section (1280 acres). The proposed fence will be installed on the ridge between the western Strawberry pasture (Daniels Canyon) and the two eastern pastures along the Strawberry River. After the completion of the fence, the western pasture will be included into a rest-rotational grazing system that the East Daniels Grazing Association currently uses. The lower 1280 acre section will be completely closed to grazing, which is congruent with the Forest Service's plan for the downstream part of the watershed.

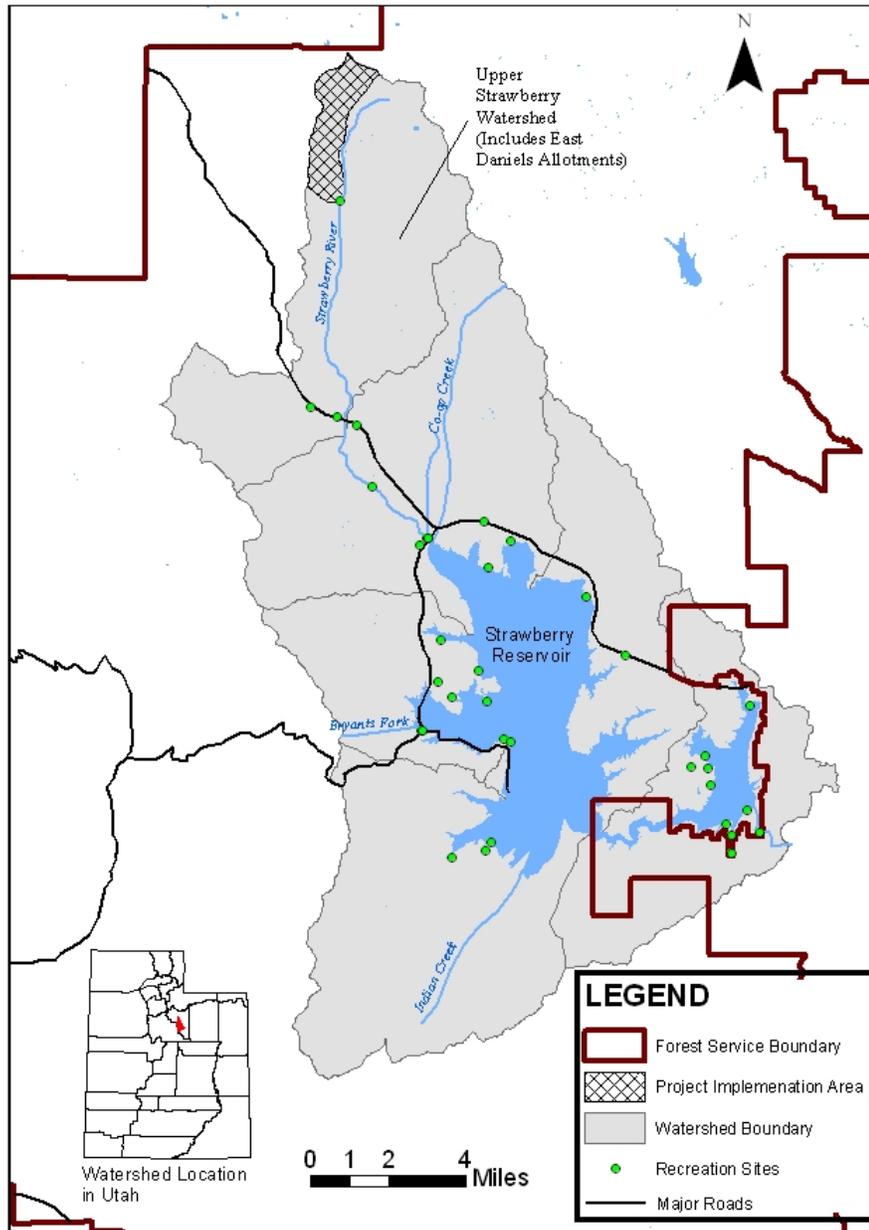
This project will not build the fence to enclose the Special Use pasture however the Forest Service plans to seek funding to enclose this 820 acre pasture via wire fence after this proposed fence has been installed. It will then be incorporated into the grazing system with increased management parameters.

It is important to note that the Special Management pasture and the west side pasture area will not result in increased cattle numbers, but will provide additional feed and forage for the current number of 935 cows with calves that graze the entire East Daniels Allotment. This will lessen grazing impacts over more than 18,000 acres in the Upper Strawberry watershed area. The Special Use and the lower 1280 acre pastures will provide opportunities for vegetative understory development and improve buffering and filtration. These components will also minimize streambank degradation and direct nutrient contributions of livestock to the river.

# Strawberry River Watershed Restoration Plan

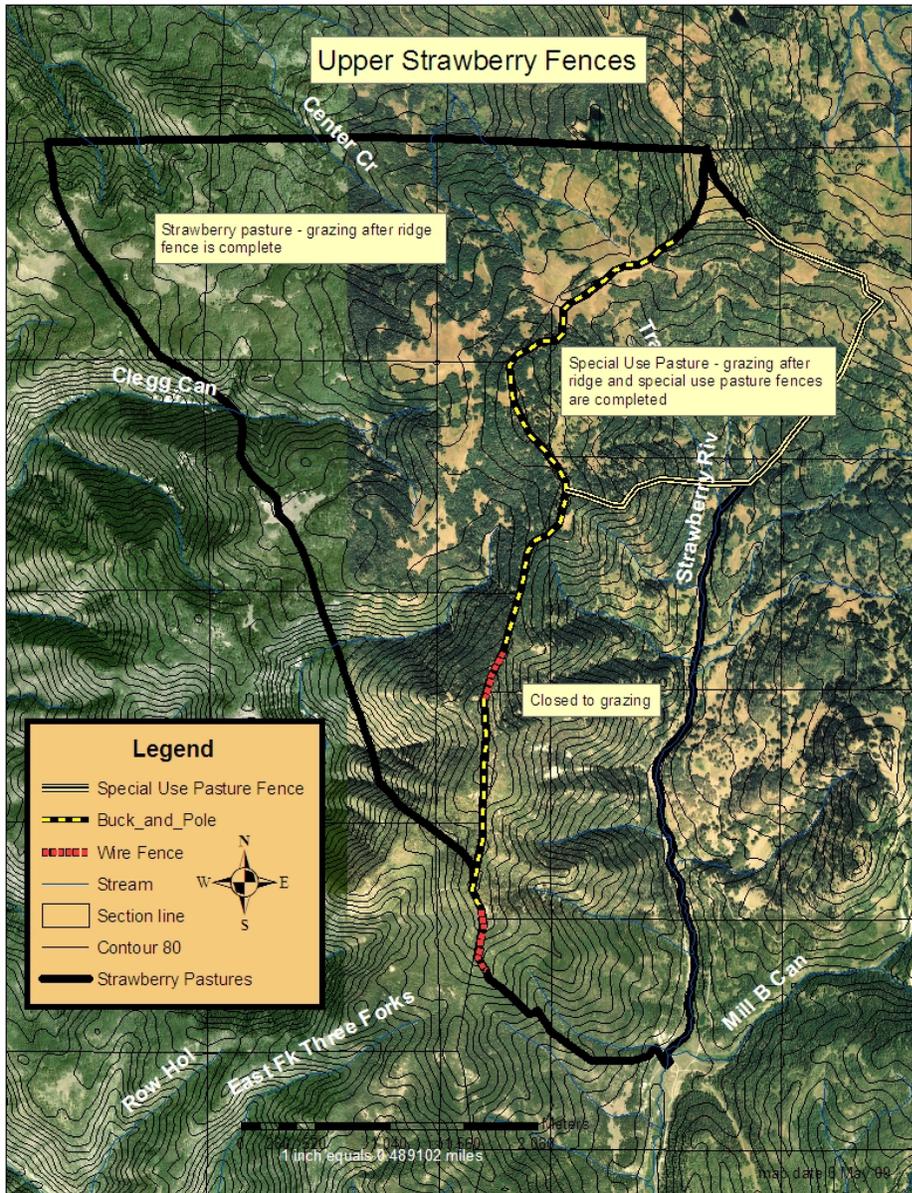
Figure 16. East Daniels Grazing Allotment Project Area on the Upper Strawberry River.

Figure 1: Location of Project in Upper Strawberry Watershed



# Strawberry River Watershed Restoration Plan

Figure 17. East Daniels Grazing Allotment with Proposed Fencing Installations.



# Strawberry River Watershed Restoration Plan

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## Project Goals

1. Reduce nutrient contributions to the upper Strawberry River (headwaters) and downstream Strawberry Reservoir. This reduction will be accomplished by constructing approximately 4 miles of fence over five years to restrict cattle grazing to the western Strawberry pasture and eliminating grazing from the 1280 acre downstream pasture.
2. Improve grazing management practices by including the west side pasture in the current grazing management system, leading to less grazing impacts over the entire East Daniels Allotment. This will increase the current grazing system from a 7 pasture rest-rotation grazing system to 8 pastures. Work with the East Daniels Grazing Association and US Forest Service, Heber District to alter grazing management on the project area. Assist with creation of a formal Grazing Management Plan.
3. Establish a monitoring program including initial inventory of existing conditions by which to later evaluate effectiveness of fencing to achieve Project Goal 1. (See section 5.1 for detailed monitoring plan).

**Figure 18. Livestock Crossing on the Upper Strawberry River.**



# Strawberry River Watershed Restoration Plan

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## **Strawberry River Restoration Phase IV**

The primary goals of implementation projects in the Strawberry River Watershed are to reduce phosphorus loading into Strawberry Reservoir and create more favorable habitat conditions for cutthroat trout and kokanee salmon by reducing streambank erosion, narrowing channel width, increasing habitat complexity and lowering of water temperature. These goals will be accomplished through re-vegetation, streambank protection, and channel realignment.

In an effort to improve water quality and fish habitat in the Strawberry River and Strawberry Reservoir, UDWR and USFS plan to restore and stabilize riparian and instream habitats within the watershed. Restoration efforts will be undertaken according to best management practices. Restoration activities will take place between May 2013 and September 2015.

### **Project Goals**

The project's main objectives will be to: 1) reduce erosion, and nutrient loading from stream banks to achieve designated beneficial uses; 2) stabilize/re-vegetate critical riparian habitats to improve water quality in Strawberry Reservoir and achieve beneficial uses; 3) Improve fisheries habitat by making a complex riverine environment with maximum shading. By implementing these practices we hope to encourage adoption and implementation of similar activities to address water quality problems within the entire watershed. The project will accomplish the main objectives through the following major goals:

1. Stabilize stream banks to minimize erosion rates along the Strawberry River. Re-vegetation of the riparian corridor to help stabilize banks.
2. Reduce sediment and nutrients entering Strawberry Reservoir from unstable stream banks and impaired riparian corridors. Calculations estimate that stream bank stabilization on this reach of the Strawberry River could potentially reduce sediment by 320 lb/year. This project, combined with prior restoration efforts on the Strawberry River, is estimated to produce a reduction of 990 lb/year, nearly all of the 1,015 lb/year reduction identified in the Strawberry Reservoir TMDL, a load reduction identified basin wide not just in the Strawberry River itself.
3. Benefit aquatic species by creating a more natural and healthy river channel with functioning vegetative communities and off-channel habitat.
4. Inform and educate local stakeholders and the government agencies concerning non-point source pollution and the importance of maintaining and improving water quality within the watershed.

# Strawberry River Watershed Restoration Plan

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**Figure 19. Eroding streambank along the Strawberry River.**



## **5.3 Future Implementation Projects (5-10 year Plan)**

### **Mud Creek**

To reduce phosphorus loading into the Strawberry Reservoir the Mud Creek tributary has been identified as a priority area. Efforts will focus first on reducing runoff and dust from roads and campsites and then reducing the impacts of grazing.

### **Project Goals**

1. Harden dispersed campsites to reduce dust and runoff. (2016-2017)
2. Improve Road runoff management.(2017-2018)
3. Reduce road spurs. (2015-2016)
4. Improve Grazing Management (2015-2017)

# Strawberry River Watershed Restoration Plan

Figure 20. Mud Creak Area Map

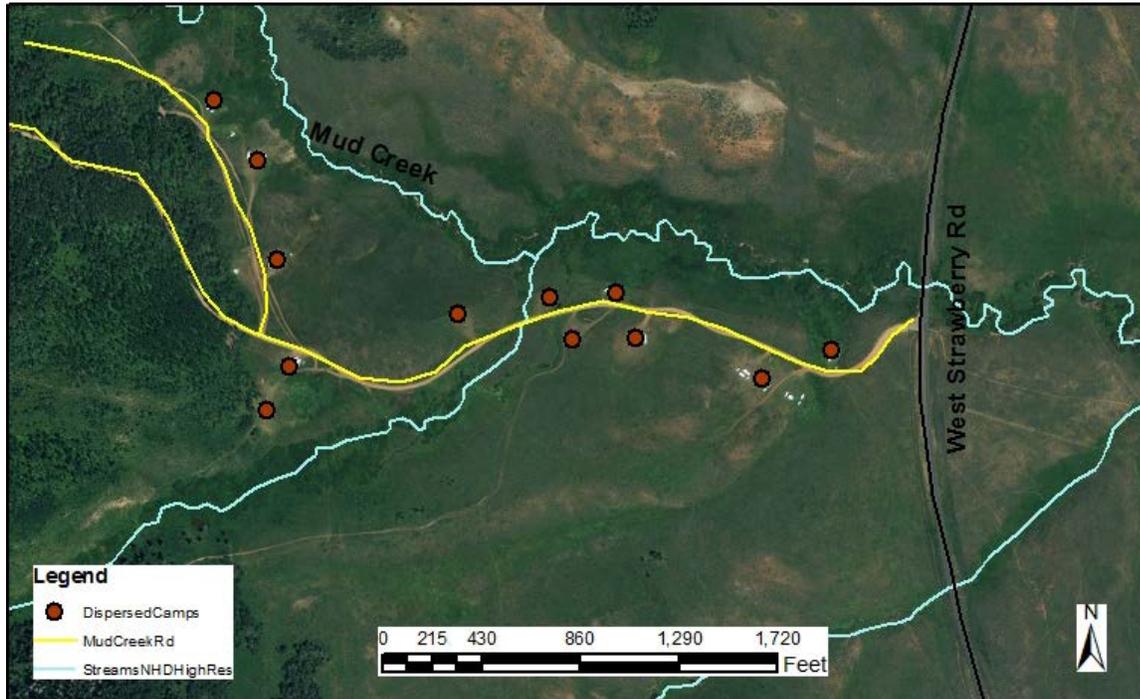
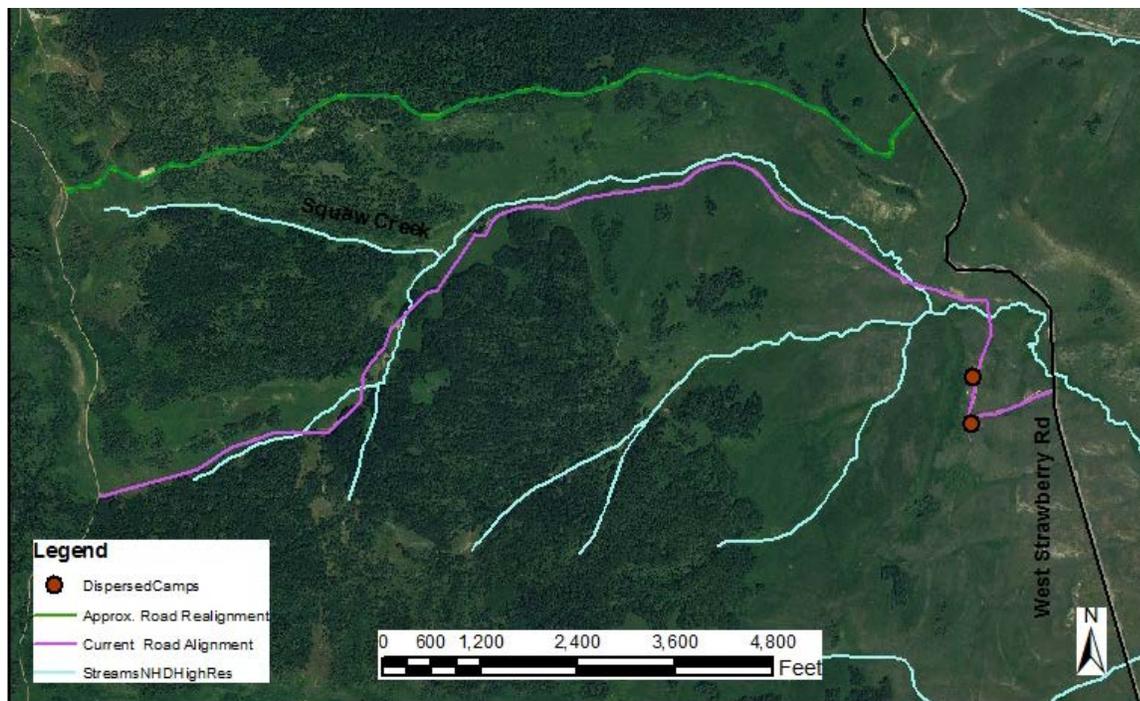


Figure 21. Squaw Creek Area Map



# Strawberry River Watershed Restoration Plan

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## Squaw Creek

The Squaw Creek tributary has been identified as another priority area. Efforts will focus on getting traffic away from the riparian corridor and managing runoff from roads and dispersed camp sites. Because of the expense of realigning the road, this will take a longer time frame.

### Project Goals

1. Harden dispersed campsites to reduce dust and runoff. (2016-2017)
2. Reduce road spurs.(2015-2016)
3. Reduce the number of creek crossings. (2015-2020)
4. Realign the Squaw Creek Road out of the riparian corridor. (2015-2020)

**Figure 22. Squaw Creek Road Crossing**



## 5.3 Funding Needs

These projects identified in Table 17 describe current projects employing EPA 319 funds and associated match. All projects have been identified and approved by FOSV, UDWR, UDWQ, and USFS. More projects will be added when target areas are identified and prioritized.

## Strawberry River Watershed Restoration Plan

**Table 17. Funding Table for Implementation of the Strawberry River Watershed Plan.**

Category	Description	Budget	Sources of Funding
Upland (rangeland) improvement	Implement grazing management plan	\$240,000	Habitat Council, Grazing Association, Duchesne County Conservation District, UDWQ, USFS Volunteers, EPA 319
Stream Channel Restoration and Rehabilitation Work	Based on surveys and prioritization, implement stream channel restoration work to reduce phosphorus loads from erosion	\$475,000	Habitat Council, Blue Ribbon Advisory Council, Watershed Restoration Initiative, Utah NPS, EPA 319, Duchesne County Conservation District, UDWR
Squaw Creek Road Realignment	Realign roads out of the riparian corridor to reduce phosphorus loads caused by transportation dust.	\$716,400	Utah NPS, EPA 319, USFS, WRI, UDWR
Campsite Hardening along Squaw and Mud Creeks	Level and harden dispersed campsites using rock to reduce erosion, dust and runoff.	\$50,000	Utah NPS, EPA 319, USFS, WRI, UDWR
Reduce Road Spurs along Mud Creek	Block detrimental road spurs using rock boulders and reseed.	\$15,000	Utah NPS, EPA 319, USFS, WRI, UDWR
Ongoing Monitoring	Implement an ongoing water quality monitoring program to assess if implementation activities are achieving TMDL goals	\$64,000	UDWR, UDWQ, Utah NPS, EPA 319
Information and Education	Implement an ongoing I&E program targeted to minimize contributions of nutrients from residential sources	\$4,500	UDWR, UDWQ, Utah NPS, EPA 319
Total Estimated Funding Needed		\$1,564,900.00	

# Strawberry River Watershed Restoration Plan

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## 5.4 Technical Assistance Needs

Strawberry River Rehab Project Planning –UDWR will provide technical support for detailed project plans for stream rehabilitation work on the Strawberry River above Strawberry Reservoir. UDWR Staff will design and implement restoration work. USFS will provide any appropriate NEPA evaluation.

Monitoring – USFS, UDWR, and UDWQ staff will be consulted to properly measure project effectiveness.

Education/Outreach – UDWR will conduct watershed tours primarily focusing on the restoration work. UDWQ will produce fact sheets on the benefits of nonpoint source work on the Strawberry River.

## 5.5 Schedule for Implementation

**Table 18. Schedule of Implementation for Strawberry River Watershed.**

Implementation Item	Responsible Party(s)	Target Date
Upland (rangeland) improvement	USFS	August 2013
Stream Channel Restoration and Rehabilitation Work	UDWR	August 2016
Ongoing Monitoring	USFS, UDWR, UDWQ, Uintah Basin Watershed Coordinator	Ongoing
Information and Education	UDWR, UDWQ, Uintah Basin Watershed Coordinator	Ongoing

# Strawberry River Watershed Restoration Plan

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## 6.0 INFORMATION AND EDUCATION

One of the goals of the plan is to inform and educate local stakeholders and government agencies concerning non-point source pollution and the importance of maintaining and improving water quality within the watershed which are addressed by the following objectives:

Objective 1: Conduct outreach tours focusing on: 1) Informing local stakeholders on needs and accomplishments of stream bank stabilization and riparian restoration. 2) Importance of functioning riparian areas, stable streambanks, and properly managed uplands/pasture lands.

Output - 3-10 tours. Past tours have included all levels of interested parties from: Congressional Delegations, State legislative representatives, state and federal land managers, local user groups, Conservation groups, county government, local schools and Boy Scout Troops. DWR will plan these tours, when requested by interested groups, which they will conduct before, during or after project completion, as requested.

Objective 2: Share general and technical information with government entities on successful methodology and implementation for stream restoration projects to other practitioners;

Output - Fact sheets, newspaper articles, and educational workshops, DWR, DWQ and USFS will collaborate on the content. DWR and DWQ will jointly plan, produce and disseminate them. Give three to six PowerPoint or other presentations to government agencies discussing success, progress, and future expectations of restoration efforts. It is anticipated that presentations will be given to Utah Water Board, DWR Habitat Council, Blue Ribbon Advisory Council, Utah Watershed Initiative, Uintah Basin Watershed Council, Wasatch County and others.

## 7.0 MONITORING

### 7.1 Interim Milestones

An analysis of water quality data will be prepared using DWQ monitoring data and any other credible data sources from January 1, 2010 through December 31, 2017. This will include two intensive monitoring cycles and provide an opportunity to determine if the data shows any quantitative changes in water quality for Strawberry River and Strawberry Reservoir. This will include examination of diurnal oxygen monitoring, TP loading, benthic invertebrate and phytoplankton/periphyton data, and cold water fishery data.

# Strawberry River Watershed Restoration Plan

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The Interim Water Quality Data Analysis report will be prepared by June 30, 2016 by UDWR and UDWQ.

## 7.2 Criteria for Success

The criteria for success of this watershed plan are as follows:

### Strawberry River

1. Non-Point Source Criteria - Total Phosphorus concentrations in Strawberry River above Strawberry Reservoir at the Westside Road will have a 30 day mean equal to or less than 0.04 mg/l during the critical summer months of July through September. This will be a measure of the effectiveness of non-point source controls in the upper watershed.
2. Dissolved Oxygen Criteria – The dissolved oxygen values in Strawberry River will meet UDWQ water quality standards of a 30 day average of not less than 5.0 mg/l during the critical summer season of July through September.

### Strawberry Reservoir

1. Annual Phosphorus Load – The average annual load of phosphorus entering Strawberry Reservoir will be reduced to 1,015 pounds per year.
2. In-Lake Phosphorus Concentration – The average “in-lake” total phosphorus concentration will be equal to or less than 0.025 mg/l.
3. Trophic State Index – The seasonal trophic state index for the reservoir will be between 40 and 50.
4. Algal Dominance – The algal dominance in the reservoir will not be composed of blue green species (cyanobacteria).

## 7.3 Long Term Water Quality Monitoring Program

The monitoring goals of this project are to: 1) document progress in achieving improved water quality conditions as non-point source control programs are implemented and 2) document and review effectiveness of BMPs. Studies that present water quality and stream health on a point-in-time basis, before and after project implementation, can be conducted quickly and relatively inexpensively. Statistically rigorous studies that can defensibly predict overall watershed health and trend are beyond the scope of this project’s monitoring plan and should be coordinated closely with the Division of Water Quality (DWQ) at the state level.

Tasks associated with these goals include the following:

# Strawberry River Watershed Restoration Plan

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1. Identify the closest STORET monitoring sites to the projects.
2. Monitor long-term sites (established and maintained by Utah Division of Water Quality) for water quality and temperature to demonstrate sustained and overall improvements in water quality. DWR staff will gather samples when DWQ UCASE Monitoring Staff are unavailable.
3. Qualitatively monitor fisheries for overall improvement in habitat and population responses. DWR professionals will conduct this.
4. Visually demonstrate, with photo documentation, areas for overall improvement of vegetation, and riparian structure and function, DWR staff will conduct.
5. Maintain a common database pertaining to the Strawberry River and Reservoir improvement projects. This will be maintained by DWR staff and hosted on a Google internet site. URL located at: <https://sites.google.com/site/strawberryriverdatabase/>
6. Review data and include data summaries in accomplishment reports.

## General Design and Parameters

Sampling is designed to quantify the pollutant load reductions and to identify long-term trends through continued input to long-term monitoring. Monitoring will consist of; chemical analysis to document declines in phosphorus loading, (qualitative assessments) to detect changes in channel morphology, vegetative cover and establishment, and disturbance reduction needs and (something) to assess the fishery response.

## Sampling design

The DWR and DWQ will monitor water characteristics at three sites on the Strawberry River as part of its long-term water quality monitoring efforts. This will be a continuation of monitoring protocols established in 2008, which are still ongoing.

## Sampling and sampling site locations

Water quality data before and after the project is implemented will be compared and evaluated at a number of monitoring sites. The closest upstream and downstream monitoring sites have been identified. These sites must be established jointly with a DWQ TMDL Coordinator and a Sampling and Analysis Plan. Sites will be monitored by DWQ or by the DWR, after appropriate training. Samples will be analyzed through DWQ at the State Health Laboratory. Water quality monitoring at the Division of Water Quality sites, fishery monitoring, and stream channel monitoring will all be done according to protocols established by the Division of Water Quality.

The DWQ will monitor water quality at established long-term and intensive survey sites according to their statewide monitoring schedule. The DWR team will monitor the additional sites.

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**Table 19. Strawberry River Monitoring Sites.**

Name	Storet #
Strawberry River Below East Daniels Grazing Allotment	4936685
Strawberry River at Highway 40	4936710
Strawberry River at Bull Springs Rd	4936655
Strawberry River at West Side Road	4936650
Strawberry River Below Soldier Creek Dam	4936300

Concentration, velocity, and discharge

Samples will be collected at upstream and downstream sites to be analyzed at an EPA and State of Utah certified laboratory for the following chemical parameters: total organic nitrogen, nitrate + nitrite, ammonia, dissolved total phosphorus, total phosphorus, total coliforms, fecal coliforms and total suspended solids. In addition, the following field parameters will be measured, using calibrated field probes: dissolved oxygen, temperature, pH, turbidity and conductivity. Discharge will be measured at each sampling site on each sampling date.

Sampling frequency or pattern

The State of Utah sampling frequency for chemical water quality sites is typically every six weeks throughout the year. These three sites on the Strawberry River will be monitored before and after the contract period to determine effectiveness of the restoration.

Macro invertebrate and fishery monitoring will be conducted by DWR, and then repeated after project implementation and completion.

Other monitoring methods (e.g. fish, photo points, acres under treatment)

Utah Division of Wildlife Resources will monitor stream fisheries at selected sites using electro-fishing to determine species diversity, numbers and production in pounds for each species. Fish habitat will also be evaluated qualitatively.

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Photo points will be established for each project site, and for each of the stream channel monitoring sites. Additional monitoring will include parameters appropriate for the specific project. Such parameters may include acreage (of plantings, seeding, or weed control), linear feet of streambank stabilization, or estimated volume of manure converted from inappropriate disposal to appropriate utilization measures.

Prior to restoration work, a full physical profile of the entire reach will be conducted. This survey will consist of a longitudinal stream profile, photo points, cross sections, bed and bar particle sizing, bank analysis (for erosion rates), in-stream habitat, discharge, and vegetation classification. After restoration efforts are completed these parameters/survey will be revisited in 5 years and then again in another 5-10 years. Analysis will be conducted to see changes through time from the current degraded state to a more stable natural state. The desired result will be a more stable channel morphology (indicating less stream bank erosion), more channel complexity, increased fish habitat for spawning and rearing, lower temperatures, and more riparian vegetation. These efforts mirror current efforts being conducted on the 5.7 miles of stream above the proposed reach (SRR Phase III). Pre-restoration data was gathered and the first post-restoration revisit survey is scheduled for 2014 (5 years post work).

### Data Management, Storage, and Reporting

The data from this project will be maintained in an accessible common database. In addition, water quality and other relevant data will be transferred electronically to the Utah Division of Water Quality database when requested. Data will be compiled, analyzed and used in completing progress reports to the State NPS coordinator, NPS Task Force, DEQ, EPA and others when requested. All water quality monitoring data will be transferred electronically to the Utah Division of Water Quality, which regularly enters data into EPA's national non-point source data tracking system. These data will be available to all interested parties and organizations. Quality Assurance and Quality Control will be conducted according to the guidelines established in the Utah Water Quality Manual. Only those data that meet QA/QC standards will be entered into the project database. Data will also be publically available on a web site already created for restoration efforts in the Strawberry Valley. Its location is:

<https://sites.google.com/site/strawberryriverdatabase/home>