Duchesne River Watershed Restoration Plan

This plan was created under the direction of Uinta Basin Watershed Council.

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INTRODUCTION

This watershed planning tool is intended to help local communities, watershed organizations, and agencies operating within the Duchesne River watershed to develop and implement plans to meet water quality standards and protect water resources. In addition, the Duchesne River Watershed Restoration Plan (DRWRP) 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 Duchesne 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. TMDL's for the Duchesne River watershed were approved in 2007 and mainly target high levels of Total Dissolved Solids (TDS) in the river system. TDS exceedences of the water quality standard led to impairments of the warm-water fishery and agriculture beneficial uses.

The need to decrease the pollutant loads in the Duchesne River watershed involves both point and non-point source load reductions. Point source pollution loads usually involve a relatively focused restoration area, whereas non-point sources usually require a broader restoration at the total 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 once implemented, will restore and maintain water quality in the watershed.

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.

DRWRP covers the entire Duchesne River watershed (14060003 HUC) from the confluence of the Green 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 implementation the DRWRP is an iterative process and is managed as such. In the initial phase of development, the plan only focused on a few sub-watersheds; however as other sub-watersheds become priorities, this plan will be updated to include them.

1.0 Watershed Management Plan Purpose

The mission of the Duchesne River Watershed Restoration Plan is to establish and implement socially, environmentally, and economically sustainable watershed management standards and practices that will protect and improve the water quality of the Duchesne 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 Duchesne River TMDLs. Implementation of these recommendations will help to foster activities that create a balance between the local community and its ecosystems.

Duchesne River Watershed Workgroup and Uintah Basin Watershed Council served as the oversight committee during the plan development. A presentation was given in January 2012 describing the process of assembling the 319 and Utah State NPS planning grant proposals and the tasks ahead in the watershed management planning process. The steering committee started in April 2012 to lead and plan implementation activities. Organizations represented include:

Central Utah Water Conservation District (CUWCD)

Duchesne County (DC)

Duchesne County Water Conservation District (DCWCD)

Natural Resource Conservation Service (NRCS)

Trout Unlimited (TU)

Uintah Basin Watershed Council (UBWC)

United States Forest Service (USFS) – Ashley 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)

Utah Farm Bureau Federation (UTFB) - Duchesne County Farm Bureau

Utah State University (USU) Extension

Ute Tribe

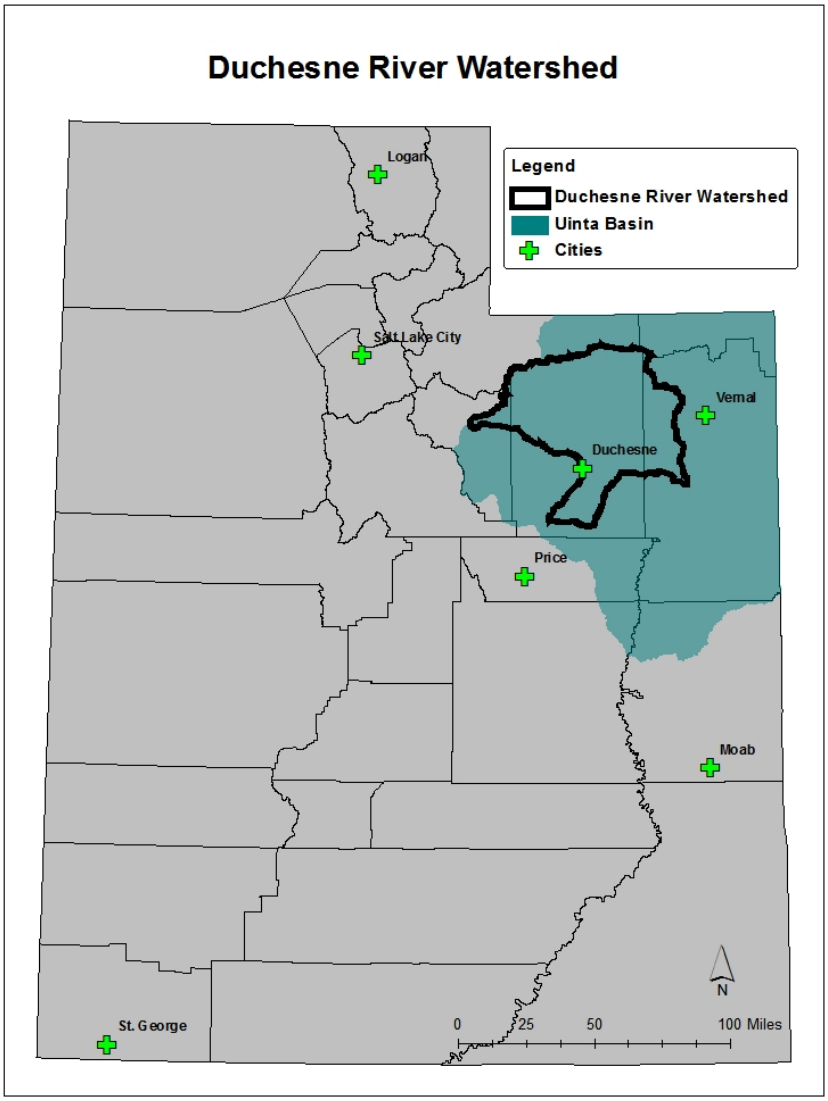
The development of the Duchesne River Restoration Plan is considered to be an iterative process by focusing implementation efforts in priority subwatersheds every five years. This plan will be updated every five years to incorporate such changes. The six priority subwatersheds consist of 4 along the mainstem of the Duchesne River, Lake Fork River-1, and Antelope Creek.

2.0 Watershed Description

2.1 Watershed Boundaries

The Duchesne River watershed drains approximately 2,679 square miles (1,714,553 acres) in northeastern Utah located in the Uintah Basin (Figure 1). The watershed is bounded by the Uintah Mountains to the north, Green River to the east, the Wasatch Mountains to the west, and the Tavaputs Plateau to the south. It occupies approximately 102 sq miles of Wasatch County, 2,103 sq miles of Duchesne County, and 474 sq miles of Uintah County. Although the Strawberry River is a tributary to the Duchesne River, that watershed is covered in its own plan.

Figure 1. Location of the Duchesne River Watershed Boundaries.



2.2 Hydrology

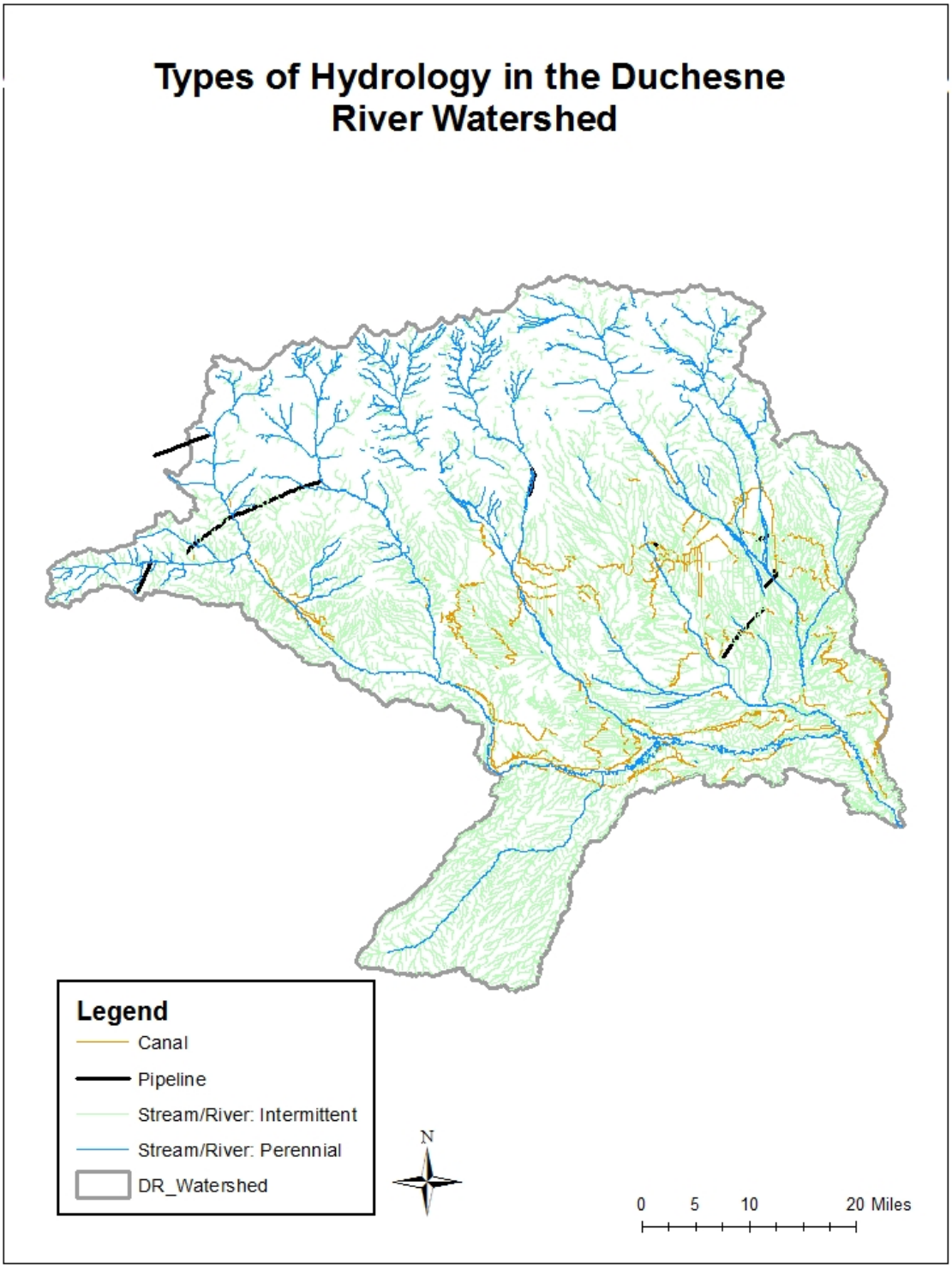
The hydrology of the Uintah Basin is dominated by spring runoff and from brief, intense storms that occur in late summer. Several large reservoirs in the basin have altered the natural hydrology of these major rivers by reducing spring peak and providing higher minimum flows during summer and winter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

The National Hydrography Dataset, created by the EPA and the USGS, indicate four different stream types in the Duchesne River watershed (Figure 2). Most of the streams were classified as intermittent streams (Table 1). Intermittent streams have flow only for short periods during the course of a year, and flow events are usually initiated by rainfall. Perennial stream flow was classified predominantly in the mainstems of rivers and streams. 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. For example, in dry years, groundwater flow is the primary source of flow in Indian Canyon Creek and Antelope Creek. Most of the canals, ditches, and pipelines are along perennial streams and rivers throughout the watershed to utilize snowmelt and precipitation for irrigated crop production.

Table 1. Summary of Stream Types in Duchesne River Watershed.

Stream Type	Stream Length (mi)	Percent (%)
Perennial Stream/River	1,229	19
Intermittent Stream/River	4,725	73
Pipeline	36	1
Canal	507	7
Total	6,497	100

Figure 2. Types of Hydrology in the Duchesne River Watershed.



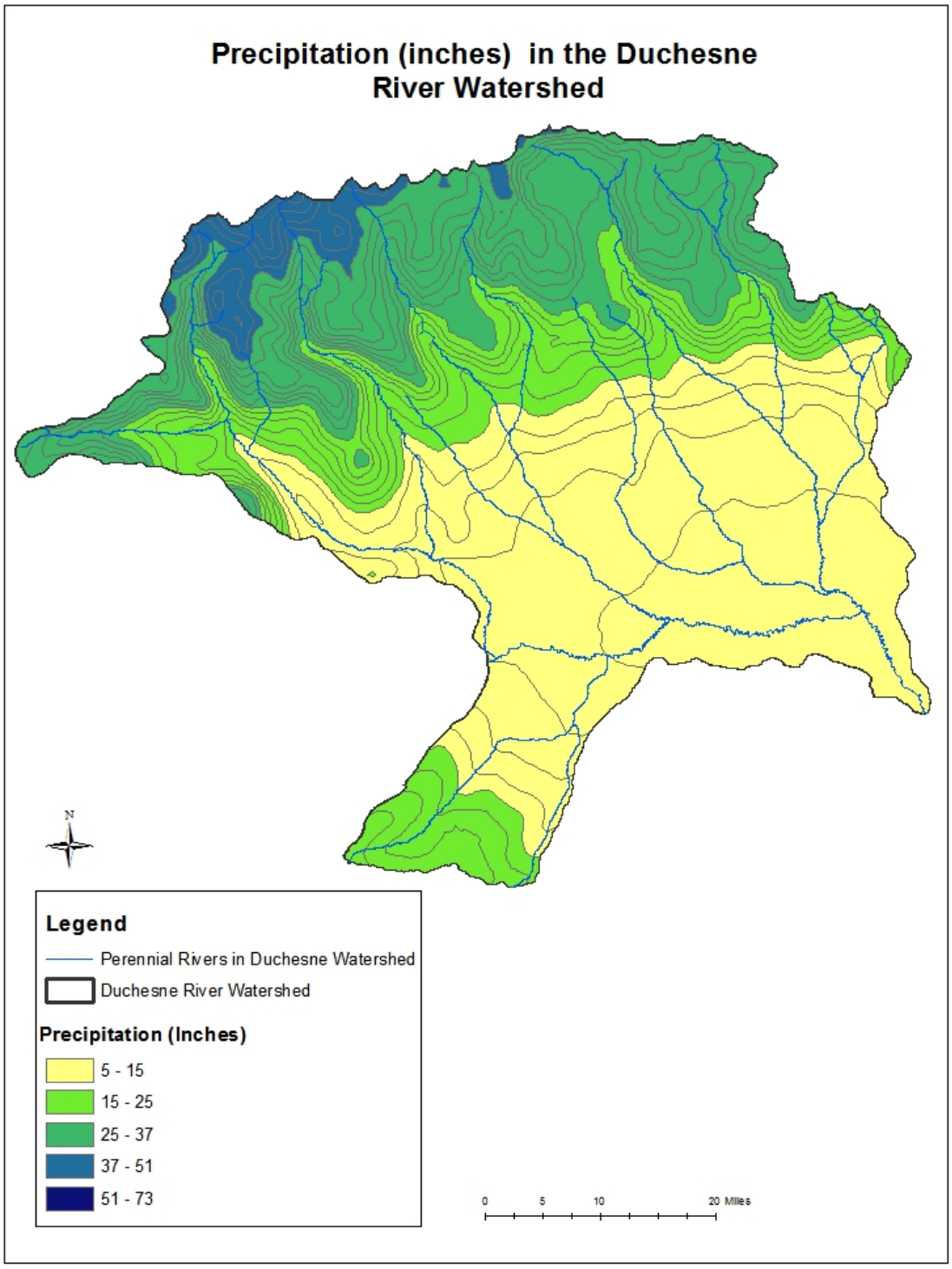
2.3 Climate / Precipitation

Climate within the Uintah Basin varies with changes in topography. Average annual precipitation throughout the Uintah 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 5 inches near Ouray at the Duchesne River–Green River confluence to about 70 inches in the adjacent Uinta Mountains. Snowfall characterizes winter precipitation, while thunderstorms dominate during the summer season when a northerly 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.

Daily temperature extremes can vary as much as 40 degrees. Annual extreme temperatures range from -30° to 105°F. The basin averages between 80 and 160 frost-free days a year while much of the UintaMountains have fewer than 40 days free of frost. The average frost-free period is 115 days at Duchesne and 125 days at Roosevelt.

A distribution of annual average precipitation in the Duchesne River watershed is available from the NRCS, Water and Climate Center (NRCS, 1998). The NRCS climate dataset is a continuous distribution of average annual precipitation interpolated from precipitation measurements made at local climate stations. This interpolation method, Parameter-elevation Regressions on Independent Slope (PRISM), uses precipitation measurements and Digital Elevation Models (DEMs) to generate a gridded estimate of precipitation that incorporates spatial scale and the effects of elevation on precipitation.

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



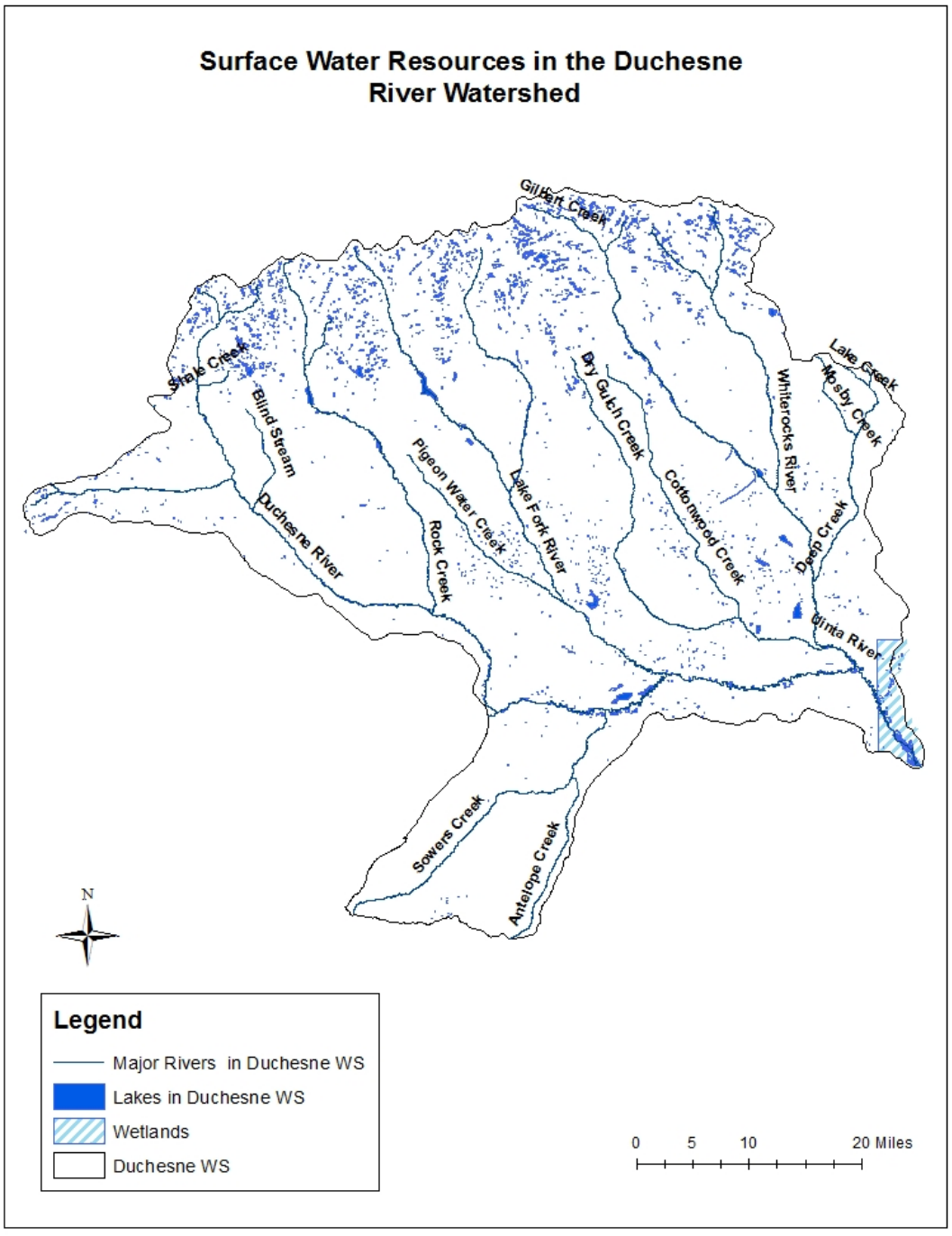
2.4 Surface Water Resources

Surface water resources in the Duchesne River Watershed include any rivers, wetlands, or lakes (ponds) located within the watershed. Table 1 shows that there are approximately 6,000 river miles, both perennial and intermittent. All the major rivers, Lake Fork, Deep Creek, Rock Creek, and Antelope Creek, flow into the Duchesne River, which begins from the south slopes of the Uinta Mountains and flows into the Green River near Ouray National Wildlife Refuge. The hundreds of lakes and reservoirs in the Duchesne River Watershed have over 12,000 surface area acres. The major ones include Big Sand Wash Reservoir, Upper Stillwater Reservoir, Pyramid Lake, and Moon Lake.

A list of the major lakes in the State of Utah has briefly summarized by UDWQ. These summations can be found at: http://www.waterquality.utah.gov/watersheds/lakes/.

The Lower Duchesne River Wetlands Mitigation Project (LDWP) is a federally mandated project to restore and enhance wetland, riparian and supporting upland along the Duchesne River in the Uinta Basin in Northeastern Utah. The underlying need for the Project is to make up for impacts to wetland and wildlife habitat caused by construction and operation of the Central Utah Project. It fulfills mitigation commitments the Federal Government made to the Ute Indian Tribe in 1965. It is managed by Utah Reclamation Mitigation and Conservation Commission. The Project area is approximately 4,800 acres in size and is composed of three management units. Of the 4,800 project acres, 1,592 are privately owned, 985 are Tribal allotted lands, and 2,230 are Tribal trust lands. For more information on the LDWP see: http://www.mitigationcommission.gov/index.html.

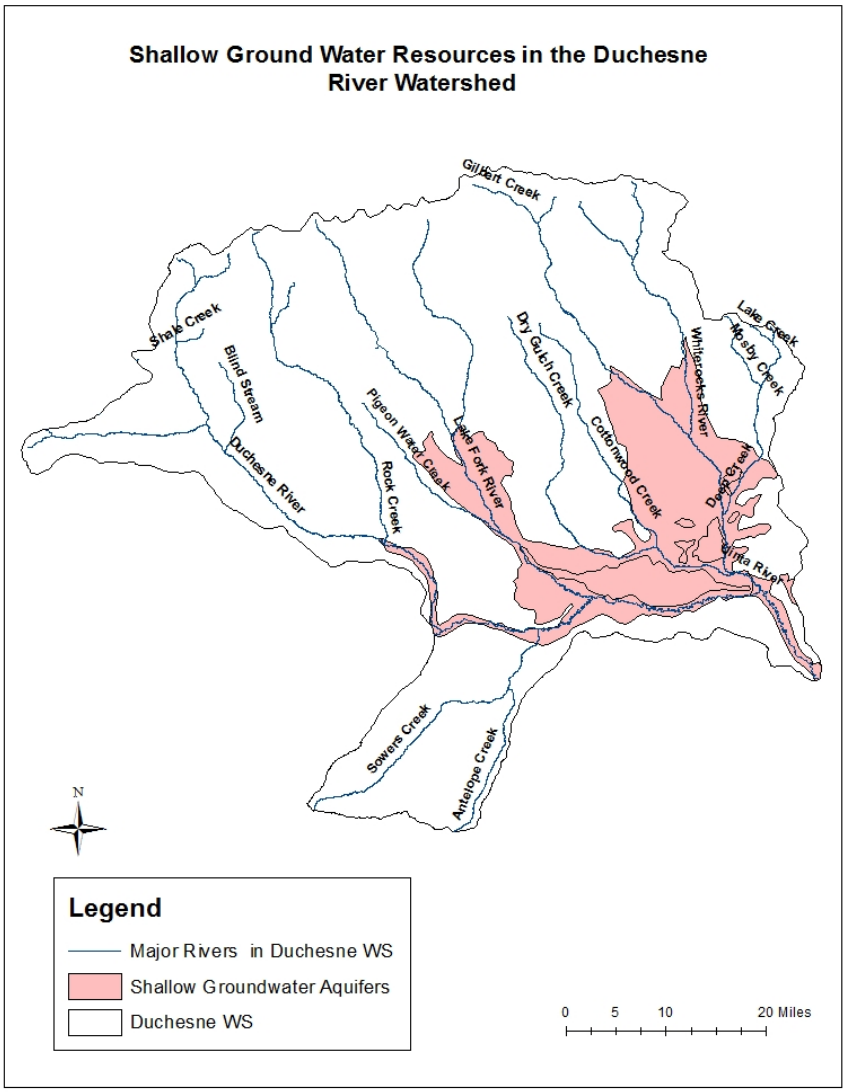
Figure 4. Surface Water Resources in the Duchesne River Watershed.



2.5 Groundwater Resources

Groundwater is water located beneath the ground surface in soil pore and in the fractures of rock formation. It is the primary source of drinking water in the Duchesne River Watershed. Groundwater levels can increase (recharged) directly from streams or from percolation through soil of rainwater. Shallow groundwater aquifers are generally the primary water source for springs, seeps, and wetlands, all of which provide habitat for plants and animals. Shallow groundwater occurs within 30 feet of the land surface. Deep groundwater is rainwater that has percolated deep into the underground during thousands of years. Figure 5 shows that there are 449 mi^2 of shallow groundwater aquifers in this watershed and lie near the major rivers of the Duchesne, Lake Fork, and Uinta Rivers.

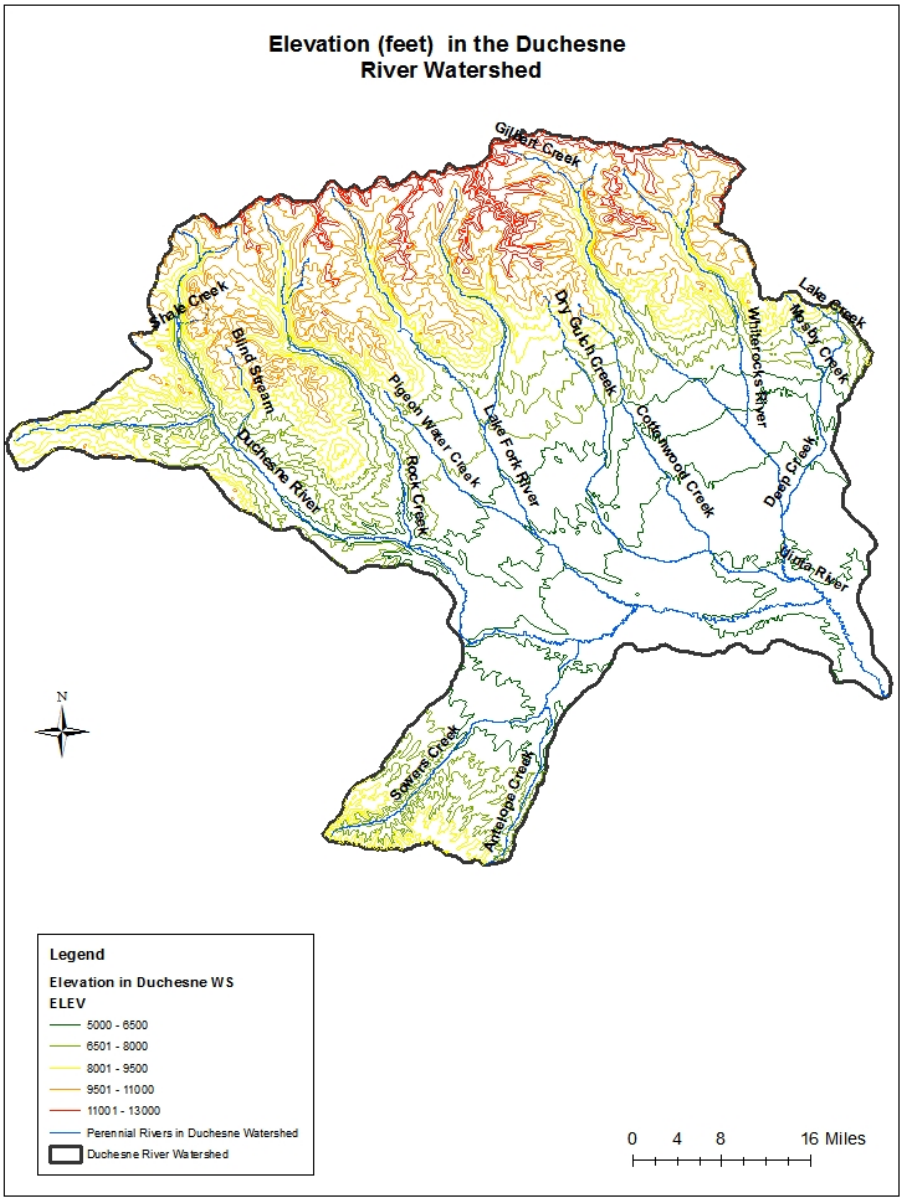
Figure 5. Shallow Groundwater Aquifers in the Duchesne River Watershed.



2.6 Topography / Elevation

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by elevation. Figure 6 displays the general topography in the Duchesne River watershed. Elevation ranges from 13,481 feet (4,109 meters) above sea level in the headwaters of Yellowstone River to 4,649 feet (1,417 meters) at the Duchesne River-Green River confluence.

Figure 6. . Elevation (feet) in the Duchesne River Watershed.



2.7 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 Duchesne Watershed are Duchesne, Uinta, Bridger, Crazy Hollow (T3), which compromises of 48% of the formations surveyed, surficial glacial deposits (Qg) at 34%, sedimentary and metasedimentary (PCs) at 17%, and surficial alluvium and colluviums (Qa) at 17%. See Table 2 for the breakdown of the entire survey. Figure 7 displays the geologic data visually.

Figure 7. Geologic Data in the Duchesne River Watershed.

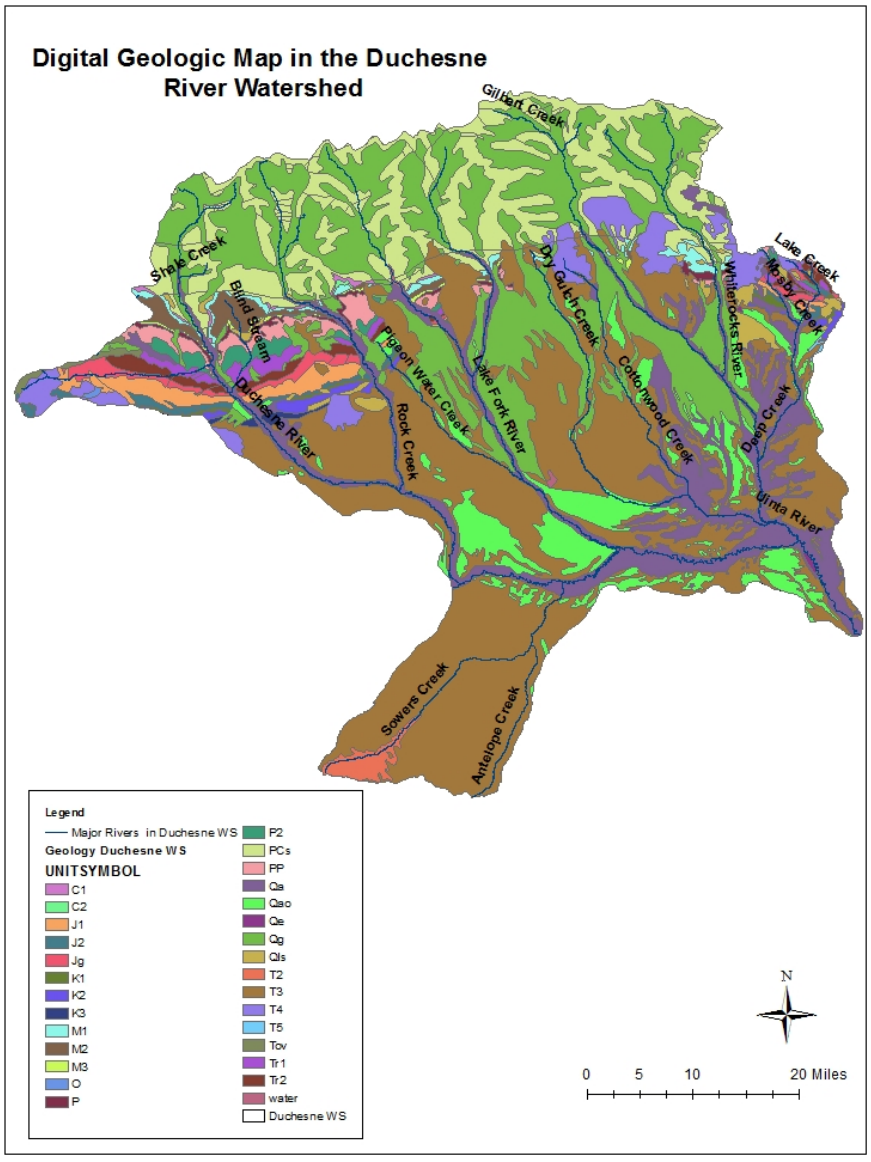


Table 2. Geologic Data Breakdown in the Duchesne River Watershed.

Unit Symbol	Unit Name	Area (mi^2)	%
T3	Duchesne River, Uinta, Bridger, Crazy Hollow and other Fms	869	48
Qg	Surficial glacial deposits	613	34
PCs	Sedimentary and metasedimentary Fms	306	17
Qa	Surficial alluvium and colluvium	299	17
Qao	Surficial older alluvium and colluvium	171	9
T4	Salt Lake Fm and other valley-filling alluvial, lacustrine, and volcanic units	86	5
J1	Summerville, Entrada, Carmel, Arapien, Twin Creek and other Fms	40	2
PP	Oquirrh Group, Wells, Weber, Ely, Callville and other Fms	33	2
Qls	Surficial landslide deposits	28	2
Jg	Glen Canyon Group (Navajo, Kayenta, Wingate, Moenave Fms) and Nugget Ss	27	2
M2	Great Blue, Humbug, Deseret and other Fms	25	1
Tr2	Chinle, Ankareh Fms	25	1
Tr1	Moenkopi, Dinwoody, Woodside, Thaynes and other Fms	22	1
P2	Kaibab, Toroweap, Park City and other Fms	22	1
M1	Redwall, Madison, Gardison, Ludgepole and other Fms	21	1
T2	Green River, Fowkes and other Fms	18	1
J2	Morrison Fm	16	1
K2	Indianola, Mancos, Frontier, Straight Cuffs, Iron Springs and other Fms	14	1
P	Morgan, Round Valley, Honaker Trail, Paradox, Ely and other Fms	11	1
K1	Dakota, Cedar Mountain, Kelvin and other Fms	7	0
ToV	Volcanic rocks	6	0
M3	Chainman, Manning Canyon, Doughnut and other Fms	6	0
K3	Mesaverde Group, Price River, Kaiparowits, Echo Cyn and other Fms	5	0
C1	Prospect Mountain, Tintic, Ignacio, Geertsen Canyon and other Fms	5	0
Water	Water	2	0
Qe	Surficial eolian deposits	1	0
T5	Sevier River, Browns Park, Castle Valley Fms	1	0
O	Fish Haven, Swan Peak, Garden City, Eureka and other Fms	1	0
C2	Middle Cambrian Fms	1	0
Total		2,679	100

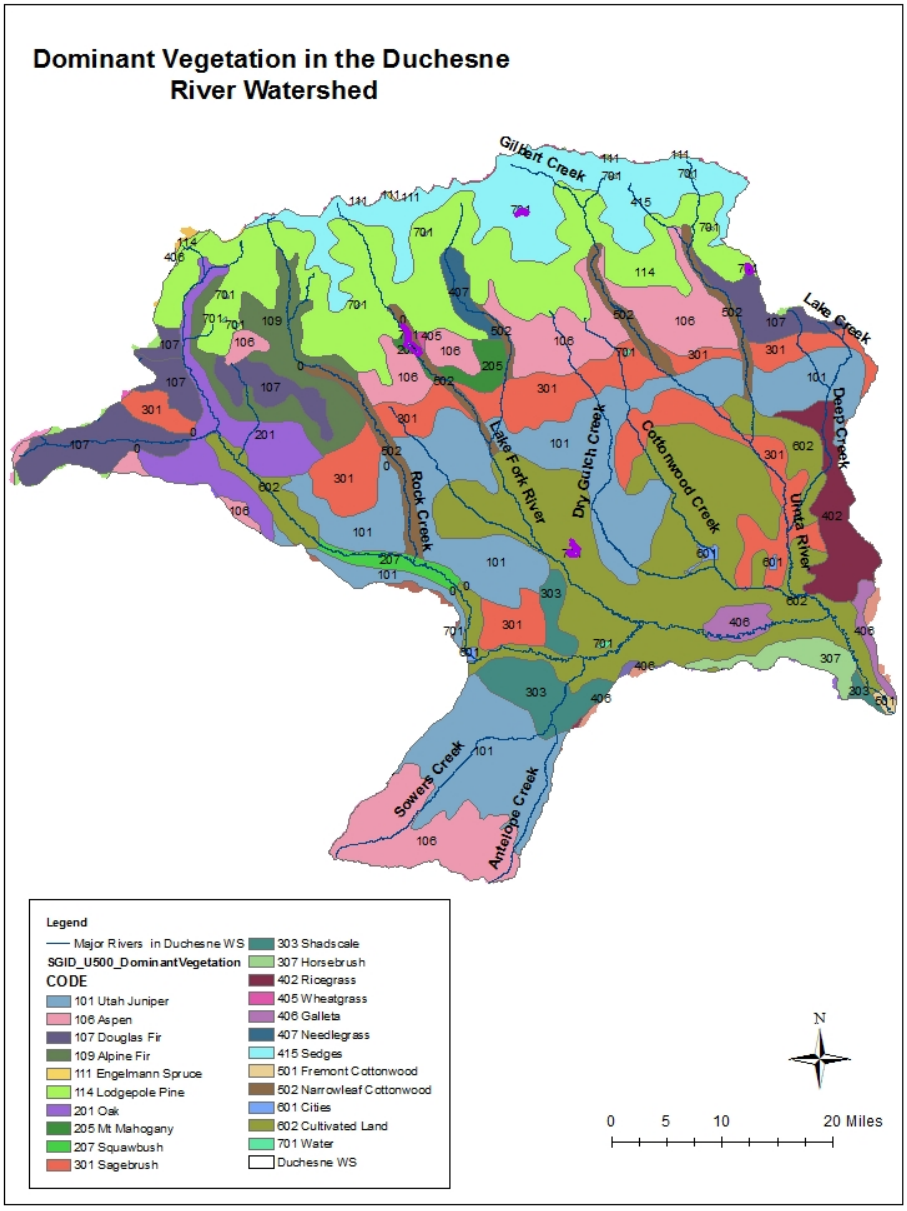
2.8 Vegetation

Vegetation data were gathered from the Gap Analysis Project (GAP) completed for the state of Utah. GAP classifications for the Duchesne River watershed are summarized in Table 3 and displayed in Figure 8. Cultivated land (602) accounted for 19% of total watershed land cover, Utah Juniper (101) 18%, Lodgepole Pine (114) 14%, Sagebrush (301) and Aspen (106) both at 10%.

Table 3. Dominant Vegetation in the Duchesne River Watershed.

Code	Vegetation Type	Area (mi2)	%
602	Cultivated Land	494	19.04%
101	Utah Juniper	467	17.99%
114	Lodgepole Pine	360	13.89%
301	Sagebrush	266	10.24%
106	Aspen	265	10.20%
415	Sedges	196	7.54%
107	Douglas Fir	138	5.31%
109	Alpine Fir	91	3.49%
502	Narrowleaf Cottonwood	71	2.72%
303	Shadscale	64	2.46%
402	Ricegrass	58	2.25%
307	Horsebrush	27	1.05%
406	Galleta	26	1.02%
207	Squawbush	18	0.71%
205	Mt Mahogany	18	0.70%
407	Needlegrass	16	0.62%
201	Oak	9	0.34%
601	Cities	4	0.16%
501	Fremont Cottonwood	3	0.11%
701	Water	2	0.10%
405	Wheatgrass	1	0.04%
111	Englemann Spruce	1	0.03%
Total		2596	100.0%

Figure 8. Dominant Vegetation in the Duchesne River Watershed.



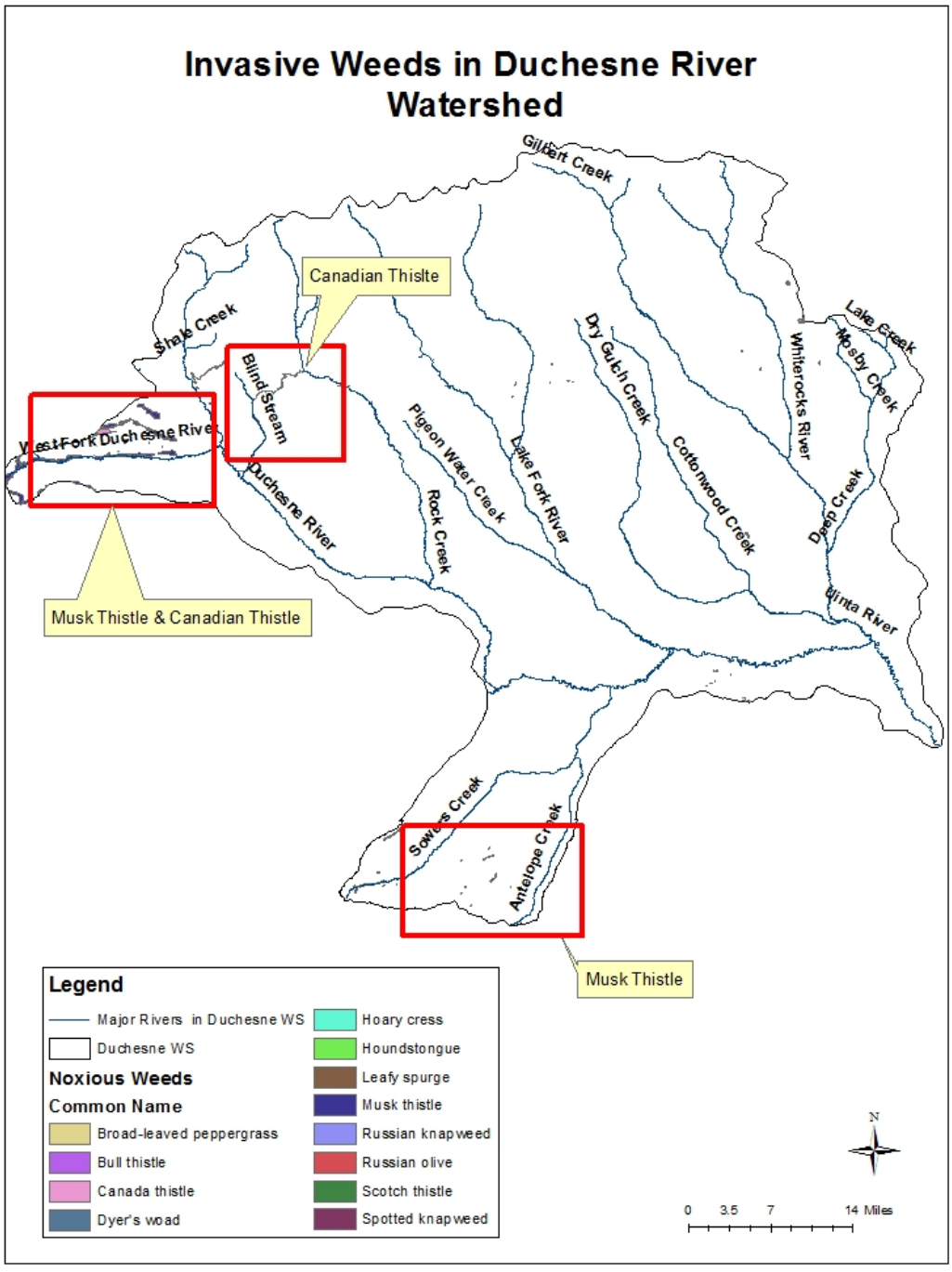
2.9 Exotic / Invasive Species

Presence of noxious weeds was recorded in several Utah Counties including Duchesne and Uintah. Data was collected from 2000 – 2005. Most commonly, Musk Thistle (7,856 acres) and Canadian Thistle (1,246 acres) were found in these counties. Musk Thistle and Canadian Thistle were primarily found along the West Fork of the Duchesne beside Highway 35. Musk Thistle was also discovered near the headwaters of Antelope Creek. Canadian Thistle was found alongside the road heading up Blind Stream, which is a tributary of the Duchesne River north of Hanna. Currently, BLM-Vernal is working on mapping the presence of Tamarisk and Russian Olive in the Uintah Basin. That data will be included in this plan once it becomes available.

Table 4. Noxious Weeds Found in the Duchesne Watershed.

Common Name	Acres	Common Name	Acres
Musk Thistle	7836	Dyer's Woad	13
Canadian Thistle	1546	Scotch Thistle	4
Broad-leaved Peppergrass	924	Bull Thistle	1
Russian Knapweed	575	Houndstongue	1
Russian Olive	104	Leafy Spurge	1
Hoary Cress	25	Spotted Knapweed	1

Figure 9. Noxious Weeds Found in the Duchesne Watershed from 2000 – 2005.



2.10 Wildlife

Amphibians

Relative to the eastern United States, Northeastern Utah can be considered depauperate in terms of species diversity of amphibians. Six amphibians are known to exist in the drainage, although the tiger salamander and boreal toad are only known from higher elevation locations within the drainage.

Northern leopard frog *Rana pipiens*

Boreal chorus frog *Pseudacris maculata*

Woodhouse toad *Bufo woodhousii*

Spadefoot toad *Spea intermontana*

Boreal toad *Bufo boreas boreas*

Tiger salamander *Ambystoma tigrinum*

Only one nonnative amphibian has been documented in the Duchesne River watershed and that is the American bullfrog *Rana catesbeiana*. This species was introduced into the golf course ponds in the town of Roosevelt around 2004 and has radiated out to backyard water features and stock ponds in the immediate area. It has not been found in the mainstem Duchesne River as of 2012, but has been observed in the Uinta River, a major tributary to the Duchesne River.

2.11 Protected Species

Animals

Of the native nongame species, the historical range of the Colorado pikeminnow and razorback sucker (both listed as federally endangered) have been drastically reduced (U.S. Fish and Wildlife Service 2002a and 2002b). In addition, the range of the bluehead sucker, flannelmouth sucker, and roundtail chub, collectively referred to as the "three species", has been drastically reduced (Bezzerides and Bestgen 2002), which has prompted their listing as a Tier I Sensitive Species in Utah (UDWR 2005) and a sensitive species in other states throughout their respective ranges (UDWR 2006a). To ensure the persistence of three species populations, both a state of Utah management plan (UDWR 2006a) and a multi-agency range-wide conservation and management agreement (UDWR 2006b) between Arizona, Colorado, Nevada, New Mexico, Utah, Wyoming, federal, tribal, and NGO agencies was implemented with the goal of preventing listing through conservation of populations and habitat.

The Colorado River cutthroat trout has also experienced drastic declines leading to a petition for listing as threatened or endangered filed in 2000 and as threatened in 2006. The U.S. Fish and Wildlife Service responded with a Not Warranted designation; however, the species remains a Utah Tier I Sensitive Species (UDWR 2005). A State Conservation Team meets annually to discuss past and future projects; this group operates from a range-wide Conservation Agreement and Strategy, a state conservation plan. And finally, in addition to conservation agreement

species, speckled dace are currently listed as Tier III species, which means that they are linked to an at risk habitat, have suffered declines, or there is little information regarding their ecology or status (UDWR 2005).

Northern leopard frog and boreal toad are both Tier III sensitive species in the state of Utah. Northern leopard frog was recently petitioned for listing to the U.S. Fish and Wildlife Service. The petition for listing was for the western-most portion of the frog's range and included 19 states. The 12-month finding resulted in a "Not Warranted" conclusion; therefore, although the species has experienced declines range-wide, these declines and the continued threats to this species are not severe enough to warrant federal protection (U.S. Fish and Wildlife Service 2011).

Plants

The following is a list of Threatened or endangered species found in the watershed;

- Barnaby Ridge-Cress *(Lepiduium Barnebyanum)*
- Clay Reed-Mustard *(Schoenocrambe Argillacea)*
- Graham's Beardtounge *(Penstemon Grahamii)*
- Pariette Cactus *(Sclerocactus Brevispinus)*
- Shrubby Reed-Mustard *(Glaucocarpum Suffrutescens)*
- Uintah Basin Hookless Cactus *(Sclerocactus Wetlandicus)*
- Ute Ladies'-Tresses *(Spiranthes Diluvialis)*
- White River Beardtongue *(Penstemon Scariosus Albifluvis)*

2.12 Land Use and Land Cover

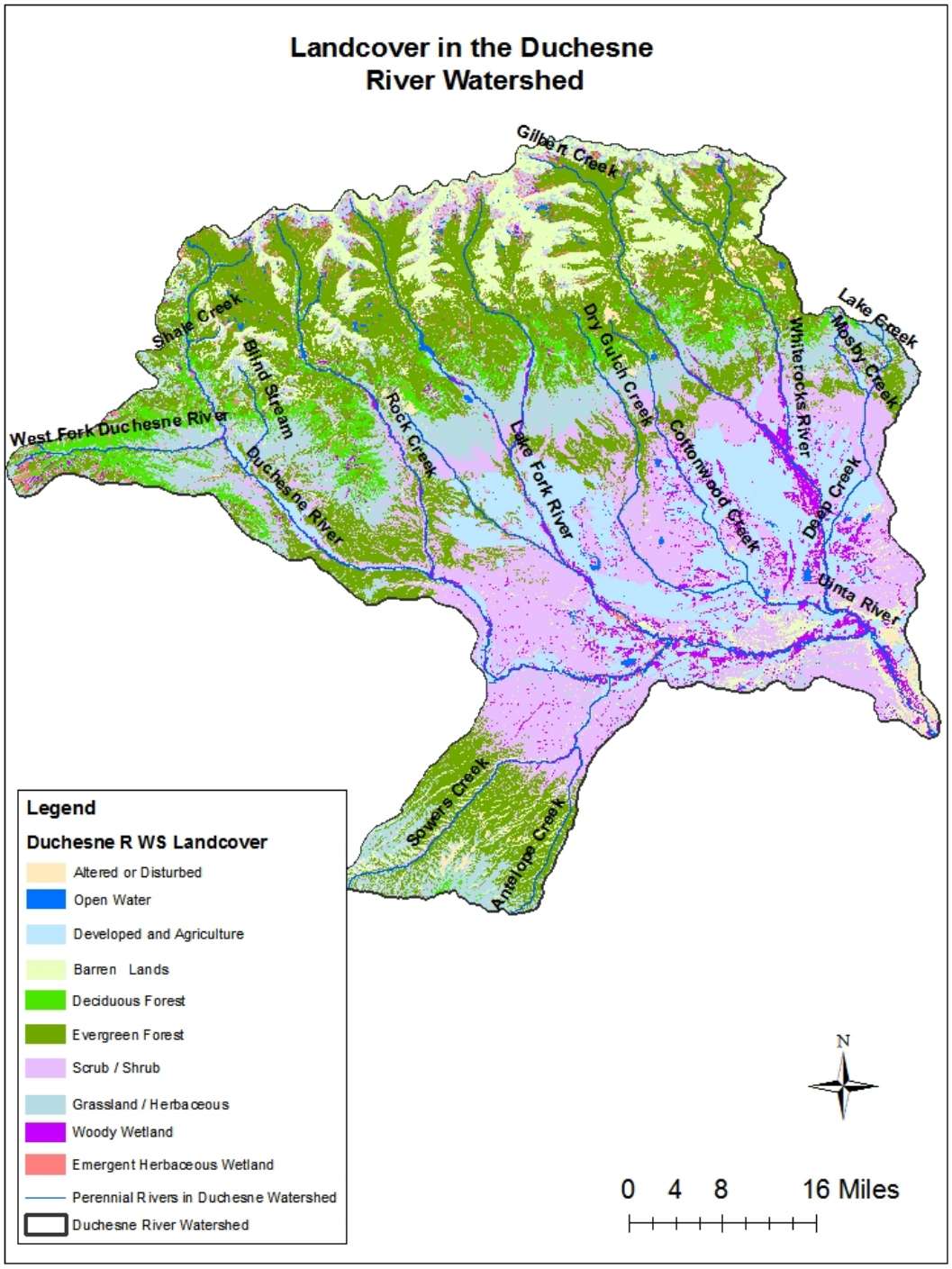
General land use and land cover data for the Duchesne River watershed from the Multi-Resolution Land Characteristics Consortium's National Land Cover Dataset (NLCD) database are shown in Table 5 and Figure 10. Table 5 summarizes land cover in the Duchesne River watershed and shows that evergreen forest is the dominant land cover, comprising approximately 29% of the total area. Scrub/shrub comprises of 21%, grassland and developed/agriculture are both 13%.

Table 5. Land Cover in the Duchesne River Watershed.

Land Cover	Area (mi2)	%	Land Cover Type	Area (mi2)
Altered or Disturbed	38	1%	Recently Burned	4
			Invasive SW Riparian Woodland and Shrubland	6
			Invasive Annual Grassland	12
			Recently Logged Areas	11
			Recently Chained Pinyon-Junifer Areas	4
			Disturbed, oil well	1
Other Cover Types	20	1%	Open Water	20
Developed and Agriculture	340	13%	Developed, Open Space - Low Intensity	11
			Developed, Medium- High Intensity	6

			Agriculture	323
Barren Lands	267	10%	North American Alpine Ice Field	2
			Rocky Mountain Alpine Bedrock and Scree	145
			Rocky Mountain Alpine Fell-Field	45
			Rocky Mountain Cliff and Canyon	36
			Colorado Plateau Mixed Bedrock Canyon and Tableland	25
			Inter-Mountain Basins Shale Badland	15
Deciduous Forest	133	5%	Rocky Mountain Aspen Forest and Woodland	133
Evergreen Forest	788	29%	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	255
			Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	50
			Rocky Mountain Lodgepole Pine Forest	161
			Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	8
			Rocky Mountain Montane Mesix Mixed Conifer Forest and Woodland	10
			Rocky Mountain Ponderosa Pine Woodland	35
			Colorado Plateau Pinyon-Juniper Woodland	249
			Inter-Mountain West Aspen-Mixed Conifer Forest and Woodland Complex	21
Shrub/ Schrub	575	21%	Rocky Mountain Alpine Dwarf-Shrubland	23
			Inter-Mountain Basins Mat Saltbrush Shrubland	9
			Rocky Mountain Gambel Oak-Mixed Montane Shrubland	17
			Rocky Mountain Lower Montane-Foothill Shrubland	16
			Colorado Plateau Pinyon-Juniper Shrubland	167
			Inter-Mountain Basins Big Sagebrush Shrubland	220
			Colorado Plateau Mixed Low Sagebrush Shrubland	56
			Inter-Mountain Basins Mixed Salt Desert Scrub	68
Grassland/ Herbaceous	349	13%	Inter-Mountain Basins Montane Sagebrush Steppe	271
			Inter-Mountain Basins Semi-Desert Shrub Steppe	9
			Rocky Mountain Dry Tundra	24
			Rocky Mountain Sulalpine Mesic Meadow	33
			Southern Rocky Mountain Montane-Subalpine Grassland	8
			Inter-Mountain Basins Semi-Desert Grassland	4
Woody Wetland	119	4%	Rocky Mountain Subalpine-Montane Riparian Shrubland	15
			Rocky Mountain Lower Montane Riparian Woodland and Shrubland	44
			Inter-Mountain Basins Greasewood Flat	59
Emergent Herbaceous Wetland	50	2%	Rocky Mountain Alpine-Montane Wet Meadow	50
Total	2679			2679

Figure 10. Land Cover in the Duchesne River Watershed.



2.13 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 Duchesne River Watershed in 2006. The data show that a total of 253,071 acres, or approximately 15% of the watershed area, were devoted to water related land uses in the Duchesne River watershed. Distinct water related land use types for the watershed and their associated areas are given in Table 6. Figure 11 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 60% and 17%, respectively, of total water related land uses in the watershed. Pasture (52%) and alfalfa (34%) require the most water in the watershed under the irrigation category.

Figure 11. Water Related Land Use in the Duchesne River Watershed.

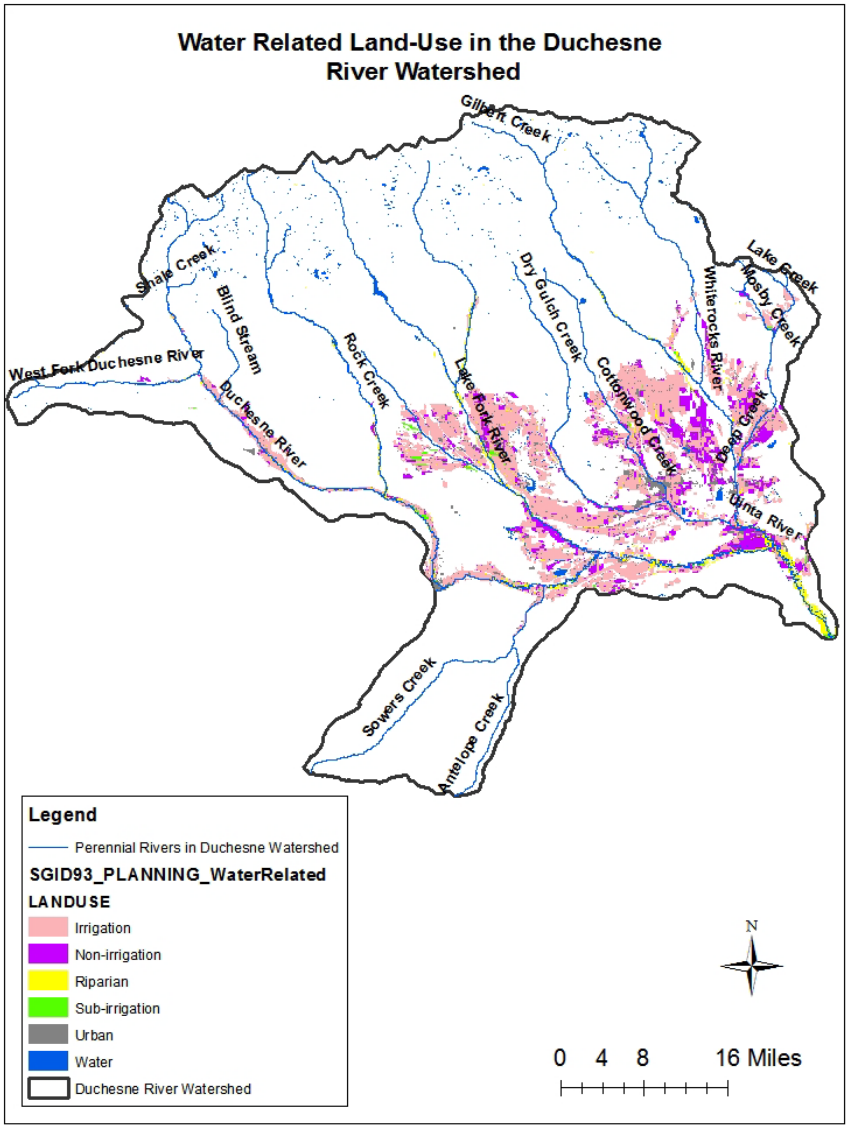


Table 6. Water Related Land Use in the Duchesne River Watershed.

Land Use	Type	Acres	Percent
Irrigation 150,763 ac 60%	Pasture	78745	52%
	Alfalfa	51171	34%
	Hay	11368	8%
	Grain	5203	3%
	Corn	4157	3%
	Turf Farms	35	0%
	Orchard + Vegetables	12	0%
Non-irrigation 44,101 ac 17%	Range Pasture	19817	45%
	Idle - Irrigated Land	19346	44%
	Dry Pasture	4437	10%
	Fallow - Irrigated Lands	262	1%
	Dry Idle	239	1%
Riparian 20,159 ac 8%	Riparian	20159	100%
Urban 17,558 ac 7%	Urban	16944	97%
	Urban Grass / Parks	614	3%
Water 16,569 ac 7%	Lakes & Ponds	6810	41%
	Reservoir	4798	29%
	Streams	4765	29%
	Sewage Lagoon	165	1%
	Evaporation Pond	31	0%
Sub-irrigation 3,922 ac 2%	Pasture - subirrigated	3778	96%
	Hay - subirrigated	144	4%
	Potatoes	70	2%

2.14 Fisheries

Owing to the large drainage area covering high and mid-elevations, the Duchesne River and its tributaries cover many different habitat types and sustain a diverse aquatic species assemblage from the headwaters to the confluence with the Green River. Fish species within the drainage can be categorized as native nongame, native game, nonnative game, and nonnative nongame species. Species are listed below by these categories. Occurrence information is included by reaches in subsequent sections.

Table 7. Fish Species Found in the Duchesne River Watershed.

Category	Common Name	Scientific Name
Native Nongame Fish	Colorado pikeminnow	*Ptychocheilus lucius*
	Razorback sucker	*Xyrauchen texanus*
	Bluehead sucker	*Catostomus discobolus*
	Bonytail	*Gila elegans*
	Flannelmouth sucker	*Catostomus latipinnis*
	Mottled sculpin	*Cottus bairdii*
	Mountain sucker	*Catostomus platyrhynchus*
	Roundtail chub	*Gila robusta*
	Speckled dace	*Rhinichthys osculus*
Native Game Fish	Mountain whitefish	*Prosopium williamsoni*
	Colorado River cutthroat trout	*Oncorynchus clarki*
Nonnative Game Fish	Brown trout	*Salmo trutta*
	Rainbow trout	*Oncorhyncus mykiss*
	Brook trout	*Salvelinus fontinalis*
	Smallmouth bass	*Micropterus dolomieu*
	Channel catfish	*Ictalurus punctatus*
	Green sunfish	*Lepomis cyanellus*

Nonnative Nongame Fish	Utah chub	*Gila atraria*
	White sucker	*Catostomus commersonii*
	Walleye	*Sander vitreus*
	Common carp	*Cyprinus carpio*

Historical fisheries records (pre-2000) on the upper Duchesne River (above Myton Diversion) and its tributaries are taken from the Interagency Aquatic Biological Assessment Team (IABAT) sampling effort of the 1980's and 1990's and pre-IABAT data (1960's and 1970's) that was collected at some of the same locations. IABAT sampling included sites on the West Fork Duchesne River, mainstem Duchesne River, Rock Creek, Currant Creek, and Strawberry River. Barge/canoe electrofishing (typically 400 m stream reaches) occurred in 1965, 1969, 1972, 1973, 1976, 1981, 1984, 1985, 1987, 1988, 1989, 1991, 1992, 1993, 1995, 1996, 1997, and 1999. However, not all sites were sampled each year.

Historical records from all other locations are summarized from unpublished UDWR sampling records.

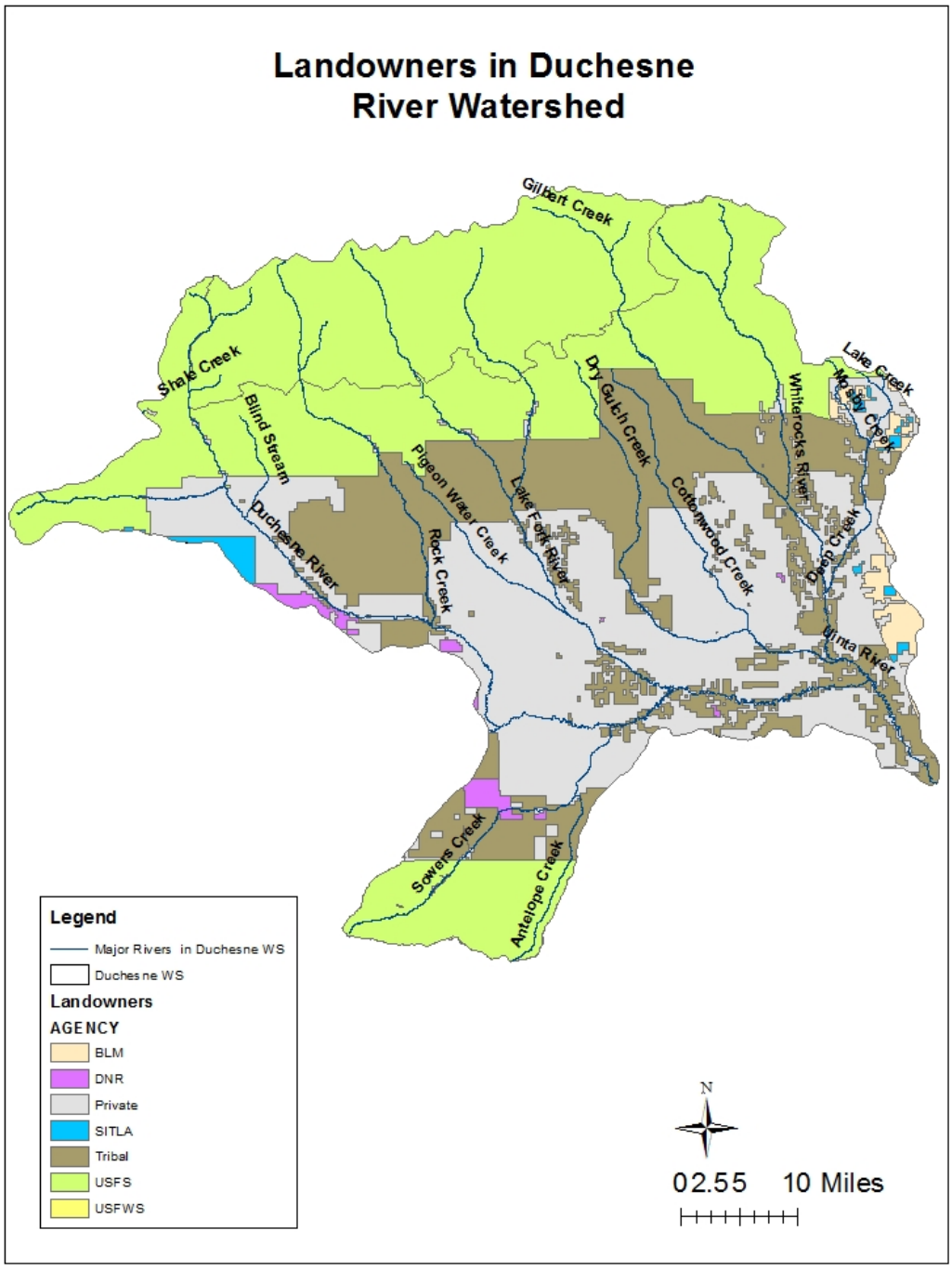
2.15 Landowners

Land ownership information was digitized for the U.S. Fish and Wildlife 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 Duchesne River watershed (Figure 12; Table 7). U.S. Forest Service manages 1,115 mi^2 (43%), while private landowners are responsible for managing 819 mi^2 (31%). Tribal lands comprise 24% of the watershed. Other land managers include the State of Utah, BLM, and USFWS.

Table 8. Landowners in the Duchesne River Watershed.

Landowner	Area (acre)	Area (mi^2)	Percent (%)
Forest Service	739,072	1,115	43
Private	524,268	819	31
Tribal	405,861	634	24
BLM	20,170	32	1
DNR	13,948	22	1
SITLA	11,211	18	1
USFWS	9	0	0

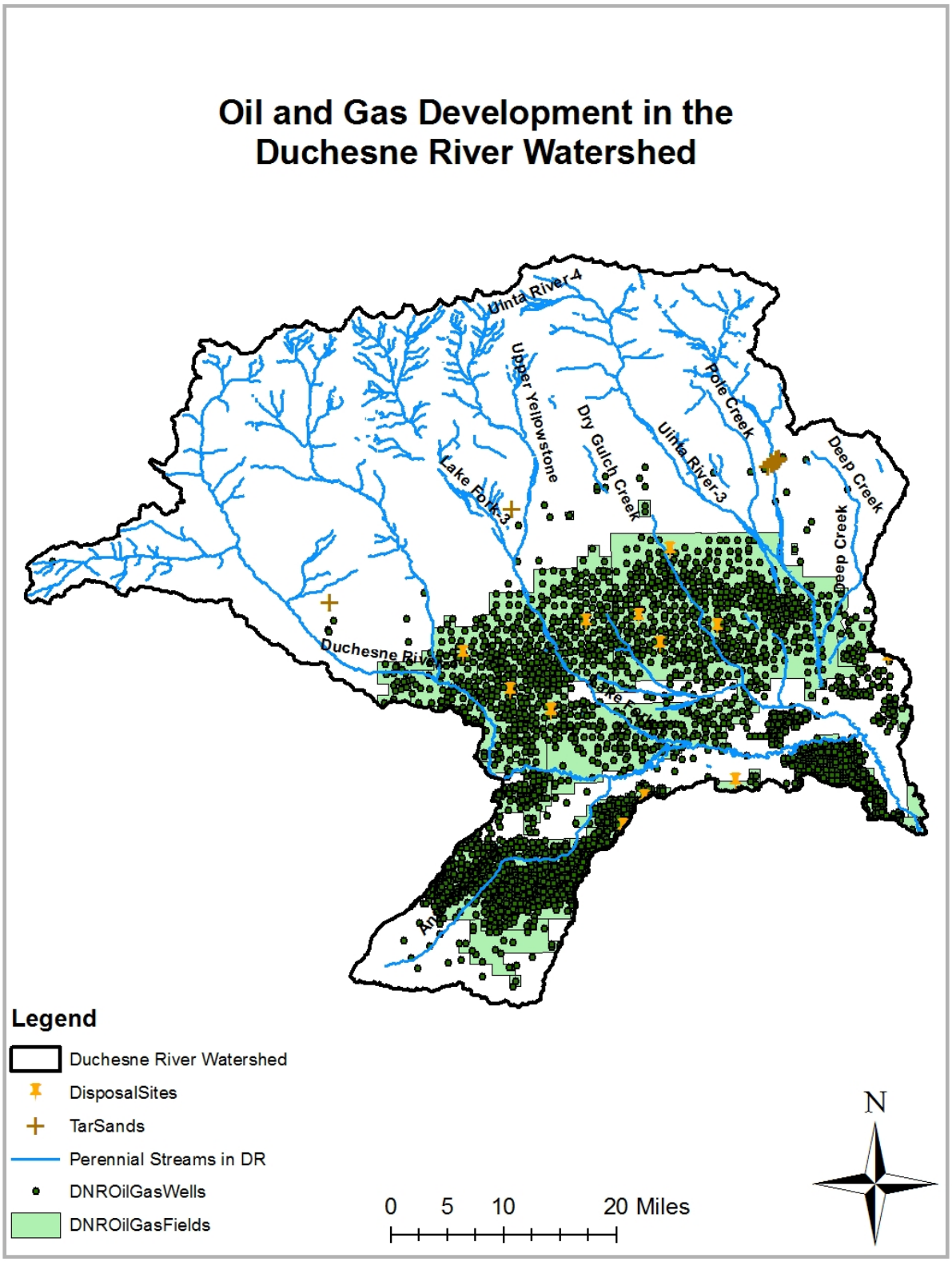
Figure 12. Landowners in the Duchesne River Watershed.



2.16 Energy Development

Oil and gas developments must adhere to the BLM's best management practices (BMPs) standards and specifications to prevent runoff from the pads into surface waters and must obtain a permit from Utah Division of Oil Gas and Mining (UDOGM). The industry is required to collect and transport produced wastewater to approved disposal facilities. There are 12 disposal facilities in the watershed. There is some evidence of illicit discharges of produced water occurring in the past throughout the Uintah Basin because regulatory fines have been levied. Though oil and gas well pads are prevalent in the watershed, they are not considered a major source based on observations of BMPSs employed during site visits in the field. Figure 13 shows the oil and gas development located in the Duchesne River Watershed. There are approximately 4,000 oil and gas wells located in this watershed or 11% of the total number of oil/gas wells in Utah. There are also 15 tar sands facilities. There are approximately 480 mi^2 of oil fields within the watershed. Most oil and gas development exist in Antelope Creek subwatershed. This industry has increased in the past few years and there are many more leases that are planned to be developed.

Figure 13. Energy Development in the Duchesne River Watershed.



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 other organisms. 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 4-1), and are defined for specific waterbodies throughout Utah in UAC R317-2-6. As the narrative descriptions elucidate, each of the designated uses—and associated subclasses—actually protects numerous activities (i.e., recreation, agricultural) or organisms (i.e., aquatic life, Great Salt Lake).

Table 9. 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
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 the 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 UAC R317-2.

3.3 Assessment Units

DWQ segments waters into relatively homogenous units called Assessment Units (AUs). The physical, chemical, or biological conditions of the waters within an AU are more similar to each other than to the conditions in adjacent AUs. Segments that have any different beneficial uses than an adjacent segment are always classified as different AUs. A stream may be divided into several AUs even when beneficial uses are the same because of for instance, different total dissolved solids concentrations when the stream crosses the Mancos Shale. 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 AUs. AUs 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 Duchesne River Watershed, there are 24 AUs (subwatersheds).

Table 10. List of Assessment Units (AU) in the Duchesne River Watershed.

Name	Assessment Unit	Description
West Fork Duchesne	UT14060003-018	West Fork Duchesne R and tribs from confluence Duchesne R to headwaters.
North Fork Duchesne	UT14060003-019	North Fork Duchesne R and tribs from confluence Duchesne R to headwaters
Duchesne River-4	UT14060003-017	Duchesne R from Strawberry R confluence to West Fk Duchesne Confluence
Duchesne River-3	UT14060003-006	Duchesne R from Myton to Strawberry R confluence
Duchesne River-2	UT14060003-002	Duchesne R from Randlett to Myton
Duchesne River-1	UT14060003-001	Duchesne R from confluence Green R to Uinta R confluence
Antelope Creek	UT14060003-005	Antelope Ck and tribs from confluence Duchesne R to headwaters
Upper Rock Creek	UT14060003-020	Rock Ck and tribs from USFS bndy to headwaters
Lower Rock Creek	UT14060003-016	Rock Ck and tribs from confluence Duchesne R to USFS bndy
Zimmerman Wash	UT14060003-007	Zimmerman Wash from confluence Lake Fork River to headwaters
Moon Lake Tribs	UT14060003-021	Moon Lake Tribs
Lake Fork-3	UT14060003-022	Lake Fork River and tribs from Yellowstone confluence to Moon Lake
Lake Fork-2	UT14060003-015	Lake Fork River and tribs from Pigeon Ck to Yellowstone R confluence (includes Yellowstone and Pigeon Ck to USFS bndy)
Lake Fork-1	UT14060003-008	Lake Fork River and tribs from confluence Duchesne R to Pigeon Water Ck confluence
Upper Yellowstone	UT14060003-023	Yellowstone R and tribs from USFS bndy to headwaters
Dry Gulch Ck	UT14060003-009	Dry Gulch Ck and tribs from confluence Duchesne R to headwaters
Uinta River-4	UT14060003-024	Uinta R and tribs from USFS bndy to headwaters
Uinta River-3	UT14060003-010	Uinta R and tribs from HWY 40 to USFS bndy (excluding Whiterocks R)

Uinta River-2	UT14060003-004	Uinta R from Dry Gulch confluence to US HWY 40
Uinta River-1	UT14060003-003	Uinta R and tribs from confluence Duchesne R to Dry Gulch confluence
Pole Creek	UT14060003-014	Pole Ck
Deep Creek	UT14060003-012	Deep Ck and tribs from confluence Uinta R to headwaters
Upper Whiterocks	UT14060003-013	Whiterocks R and tribs from Tridell WTP to headwaters
Lower Whiterocks	UT14060003-011	Whiterocks R from confluence Uinta R to Tridell WTP

3.4 Assessment of Surface Waters

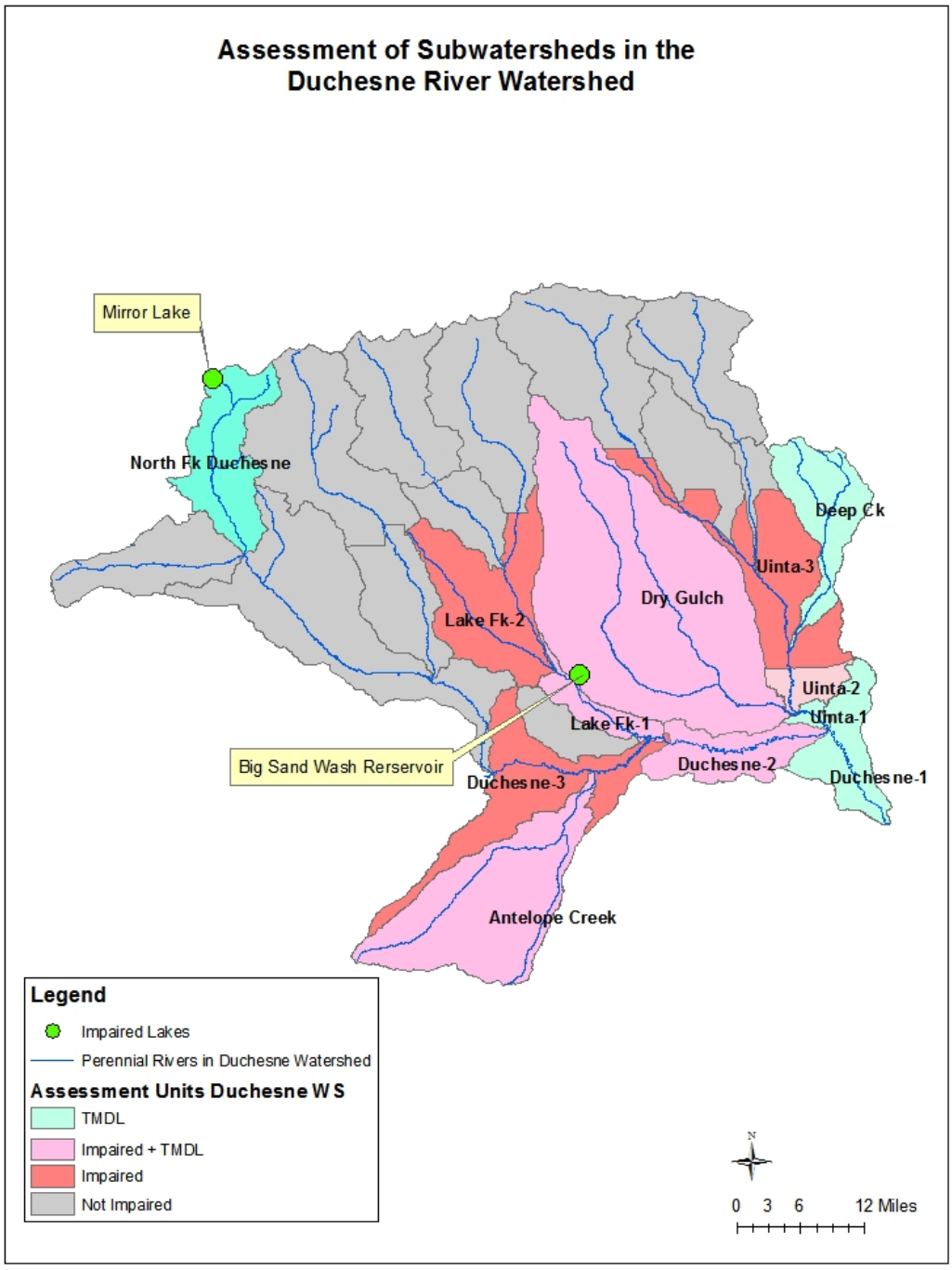
Clean Water Act (CWA) federal rules and regulations require UDWQ to report the condition— or health— of all surface waters to Congress every other year. Known as the *Integrated Report* (IR), this report contains two key pieces of information. First, the report identifies waterbodies that are not meeting their designated uses. These waters are listed as impaired on the 303(d) list of this report, which subsequently requires that DWQ develops 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 (i.e., pollutants, habitat destruction) and sources of water quality problems.

Each AU is assessed every two years by UDWQ. Each segment of river and lake / reservoir that exceeds its designated water quality standard is listed on Utah's 303(d) List of Impaired Waterbodies. 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 on online: http://www.waterquality.utah.gov/TMDL/index.htm#approved. Table 11 shows which AUs (subwatersheds) are impaired or have an approved TMDL. Figure 14 displays these watersheds as well.

Table 11. Impaired or TMDL Approved Assessment Units in the Duchesne River Watershed .

Subwatershed	Waterbody	Use	Year Listed	Parameter	Year TDML Approved
North Fork Duchesne River	Mirror Lake	Cold Water Fishery	2000	DO	Delisted 2004
Duchesne River-3	Duchesne River	Cold Water Fishery	2008	Benthic Invertebrate	
Duchesne River-2	Duchesne River	Cold Water Fishery	2008	Temp	
Duchesne River-2	Duchesne River	Agriculture		TDS	2007
Duchesne River-1	Duchesne River	Agriculture		TDS	2007
Antelope Creek	Antelope Creek	Agriculture	2008	Boron	
Antelope Creek	Antelope Creek	Agriculture		TDS	2007 SSC
Lake Fork-2	Lake Fork	Cold Water Fishery	2002	Habitat Alteration	
Lake Fork-1	Lake Fork	Cold Water Fishery	2008	Temp	
Lake Fork-1	Lake Fork	Agriculture		TDS	2007
Dry Gulch	Big Sand Wash Reservoir	Cold Water Fishery	2010	DO Temp	
Dry Gulch	Dry Gulch	Agriculture		TDS	2002
Uinta River-3	Uinta River	Cold Water Fishery	2002	Habitat & Flow Alteration	
Uinta River-2	Uinta River	Cold Water Fishery	2002	Habitat Alteration	
Uinta River-2	Uinta River	Agriculture		TDS	2002
Uinta River-1	Uinta River	Agriculture		TDS	2002
Deep Creek	Deep Creek	Agriculture		TDS	2002

Figure 14. Impaired or TMDL Assessment Units in the Duchesne River Watershed.



3.5 Benthic Macroinvertebrates

Biological and habitat data can be useful sources of information when interpreting aquatic life beneficial use support. UDWQ has developed an empirical model that directly assesses attainment of biological beneficial uses by quantifying the health of macroinvertebrate assemblages. Biological assessments are often conducted by comparing the biological assemblage observed at a site with the expected biological assemblage in the absence of human-caused disturbance. UDWQ employs the RIVPACS (River Invertebrate Prediction and Classification System) model approach to quantify biological integrity. To quantify the biological condition of a certain river, the model compares the list of taxa that are observed (O) at a site to the list of taxa expected (E) in the absence of human-caused stress. O/E quantified the loss of diversity. 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.

Assessment methodology of biological beneficial use support and a list all impaired AUs can be found online at: http://www.waterquality.utah.gov/WQAssess/documents/IR2010/Part1/2010_Part-1-IR-Final_10Nov2010.pdf

Table 12. 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

3.6 Fisheries Data

Duchesne River-1 and Duchesne River-2 Subwatersheds

The UDWR classified this reach as a sportfish class 4X, meaning that it is not important as a sportfishery, but does hold value for threatened and endangered fish, such as the Colorado pikeminnow. It is considered a wild fish fishery and no fish, sportfish or otherwise, are stocked in this reach. Wild fish fisheries have catch rate goals for sportfish in the reach; however, the UDWR attempts to meet those goals via means other than stocking (e.g., increasing or maintaining habitat to encourage natural reproduction). The UDWR gives this reach of river a health class rating of 1-B/D meaning that no prohibited pathogen has been detected here (e.g., Whirling Disease), that sensitive species are present in the area, and that fish in this reach are naturally reproducing including both native and nonnative species.

Cataraft electrofishing surveys were conducted below the Myton Diversion by the Ute Tribe and UDWR in the mainstem Duchesne River during peak flows in June of 2009. Flannelmouth sucker, roundtail chub, and speckled dace as well as endangered bonytail, Colorado pikeminnow, and razorback sucker were present below the Myton Diversion (Breen and Groves, unpublished data). Bluehead suckers were not present in the lower Duchesne River in 2009 based on this sampling, but they have been observed in past years (Crosby and Bartlett 2005). Crosby and Bartlett (2005) also describe records of razorback suckers and Colorado pikeminnow in the lower Duchesne drainage (mainstem Duchesne River and Uinta River), but they regard their usage of the drainage as poorly understood.

Game fish surveys are not completed in the lower Duchesne due to differing fisheries goals; however, the Upper Colorado River Recovery Program in conjunction with the Ute Tribe does complete nonnative removal in the lower Duchesne River in some years. The main targeted species is smallmouth bass during these efforts. Below the Myton Diversion, the species assemblage resembles that of the Green River with abundant smallmouth bass, green sunfish, and channel catfish.

Nonnative, nongame species within the Duchesne drainage have not always been recorded in species sampling; however, Utah chub are sporadically detected in the lower Duchesne and are relatively common in Starvation Reservoir. Carp can be ubiquitous in locations where habitat is adequate in the drainage in both lower elevation reservoirs and stream segments. Finally, white sucker are common in the mainstem Duchesne River below the Myton Diversion, but are not common above this diversion.

Surveys for amphibians have not been as extensive as for fish. However, the northern leopard frog has been observed in many areas of the lower Duchesne drainage up to the Knight Diversion and is considered abundant at least below the town of Myton.

Duchesne River-3 Subwatersheds

The UDWR classified the fishery in this reach as a sportfish class 4X, meaning that it is not important as a sportfishery, but does hold value for threatened and endangered fish, such as the Colorado pikeminnow. It is considered a wild fish fishery and no fish, sportfish or otherwise, are stocked in this reach. Wild fish fisheries have catch rate goals for sportfish in the reach; however, the UDWR attempts to meet those goals via means other than stocking (e.g., increasing or maintaining habitat to encourage natural reproduction). The UDWR gives this reach of river a health class rating of 1-B/D meaning that no prohibited pathogen has been detected here (e.g., Whirling Disease), that sensitive species are present in the area, and that fish in this reach are naturally reproducing including both native and nonnative species.

The Duchesne River between the Myton Diversion and Knight Diversion was last sampled by UDWR personnel in 2004 and 2009 when flannelmouth sucker, mottled sculpin, mountain sucker, and speckled dace were present below the Knight Diversion (Brunson, unpublished data; Breen and Hedrick 2010). Bluehead and flannelmouth sucker were not recorded above the Knight Diversion, but were both found at the Knight Diversion and below in Bridgeland in 1990's surveys (IABAT 1994a); however, more recent surveys have detected flannelmouth sucker and *mountain* sucker (which are often misidentified as bluehead sucker) at Knight Diversion and in Bridgeland (Breen and Hedrick 2009). Bluehead suckers were no longer present below Knight Diversion based on these surveys. Additionally, observations of roundtail chub in the Duchesne River between Myton and the town of Duchesne have been made historically (Crosby 1982), but have not been verified in recent sampling.

Brown trout are also found in the Duchesne at Bridgeland, below the confluence of the Strawberry River where a higher baseflow ensures adequate habitat for trout, even through the summer. Few other game fish are found between the Knight Diversion and the Strawberry River confluence or below the diversions in Bridgeland and the Myton Diversion; however, mountain whitefish have been sampled in higher reach in the most recent surveys (2004 and 2009).

Duchesne River-4 Subwatershed

Fish –Non-Game

Mottled sculpin and mountain sucker were found in the West Fork Duchesne River (IABAT 2000); however, these were the only native, nongame species recorded in the upper reaches. Mottled sculpin were recorded from all middle Duchesne sites (Stockmore, Hanna, and Tabiona) (IABAT 2000), while speckled dace were recorded at Stockmore and Tabiona, but not Hanna (IABAT 1994a; IABAT 1996a). According to unpublished data from pre-IABAT surveys, flannelmouth sucker were observed above the Knight Diversion near the Utahn bridge (Unpublished data, 1969) near Tabiona (Unpublished data, 1969). Mountain sucker were recorded only at Tabiona on the mainstem Duchesne River (IABAT 1988; IABAT 1994a; IABAT 1996a; IABAT 2000). Mountain sucker and speckled dace were recorded in Rock Creek (Harper et al. 1982; IABAT 1989a; IABAT 1990; IABAT 1994b; IABAT 1996b). Bluehead sucker, flannelmouth sucker, and mountain sucker were recorded in Currant Creek (IABAT 1987; IABAT 1995a).

In the upper Duchesne River, 2009 surveys (Birchell and Breen, unpublished data) showed that bluehead sucker, flannelmouth sucker, and roundtail chub are absent above the Knight

Diversion. However, mottled sculpins were present at all survey sites, mountain suckers were present at 8 of 14 sites, and speckled dace were present at 5 of 14 sites. Mottled sculpins were the most abundant native nongame species, averaging 3,491 individuals per mile (based on 3 collection sites; noted as abundant when not collected). Where present, speckled dace averaged 160 individuals per mile and mountain suckers averaged 109 individuals per mile.

Fish – Game

According to IABAT surveys (1987, 1988, 1989a, 1989b, 1990, 1994a, 1994b, 1995a, 1995b, 1998, 2000), brown trout are abundant in much of the upper Duchesne River above the Knight Diversion up to about 7,300 ft elevation where the dominant species tends to switch to brook or cutthroat trout. In addition, Colorado River cutthroat trout are found in the West Fork Duchesne River above the Vat Diversion and brook trout are found throughout much of the upper mainstem tributaries and the high Uintas.

Species surveys in the upper Duchesne mainstem were completed in 2009 between the Knight Diversion up to the upper West Fork (UDWR unpublished data). Surveys between the Knight Diversion and Rock Creek (n=1) resulted in estimates of 408 mountain whitefish per km and 39 brown trout per km between Knight Diversion and Rock Creek. Moving upstream, surveys between Rock Creek and the town of Hanna (n=7), estimated brown trout at 163 fish per km and 57 mountain whitefish per km (n=7). Rainbow trout were captured in both of these areas, but not in great enough numbers to estimate abundance. Finally, on the mainstem Duchesne, surveys between the North/West fork confluence and Hanna (n=4) estimated brown trout at 205 fish per km, mountain whitefish at nine fish per km, and rainbow trout at 35 fish per km. In this area, brook and cutthroat trout were captured, but could not be estimated for abundance due to low numbers.

The West Fork Duchesne River was also divided into three distinct sections, each with three separate sampling locations. Cutthroat trout were prevalent in all three sections, but co-occurred with brown trout and rainbow trout in the site nearest to the confluence. Within the second reach, upstream from the first, cutthroat were only found overlapping with mottled sculpin, and in the third (most upstream) reach above the Little West Fork confluence, cutthroat were the only species sampled.

Amphibians

The only known population of boreal toad in the drainage is found only in the West Fork of the Duchesne River drainage above the Vat Diversion. Surveys for tiger salamander and boreal chorus frog have not been extensive, but in searching for boreal toad, we have observed chorus frog to be abundant in the Grandaddy Lakes Wilderness Area and tiger salamander to be present, but rare, in this same basin. Spadefoot toads have been documented in the Tabby Mountain Wildlife Management Area, but nowhere else in the drainage. It is likely that they are more common than has been documented. This is likely true for Woodhouse toads as well. They are likely quite common in the drainage, but have not been documented due to lack of surveys.

Lake Fork River-1 Subwatershed

This reach of the Lake Fork River has limited sportfish value and is currently given a rating of 4. It is a wild fish fishery and both native and game fish populations are naturally reproducing in the area. Wild fish fisheries have catch rate goals for sportfish in the reach; however, the UDWR attempts to meet those goals via means other than stocking (e.g., increasing or maintaining habitat to encourage natural reproduction). It has health class rating is 1-D, meaning that no prohibited pathogens have been detected in the area (e.g., Whirling Disease).

Very little sampling information exists on this reach of river due to its use for irrigation and its limited value as a sportfishery. However, barge electrofishing by the UDWR and Ute Tribe in 2005 did show some sportfish and also a few native fish in addition to nonnative, nongame fish as found in the mainstem Duchesne River. In a one-quarter-mile sampling station, biologists captured two small brown trout, three fathead minnow, two red shiner, three redside shiner, and two white sucker. There were, however, also one flannelmouth sucker and one speckled dace, suggesting that the river still holds some potential as a native fish fishery.

Antelope Creek Subwatershed

The UDWR does not have fishery goals for this location and as such have no sampling information for either the fishery or amphibians in this drainage. While there are no known prohibited pathogens (e.g., Whirling Disease) in this reach (health class rating 1-F), there is also no known reproduction of fish in this reach either.

4.0 Duchesne River Watershed TDS TMDLs

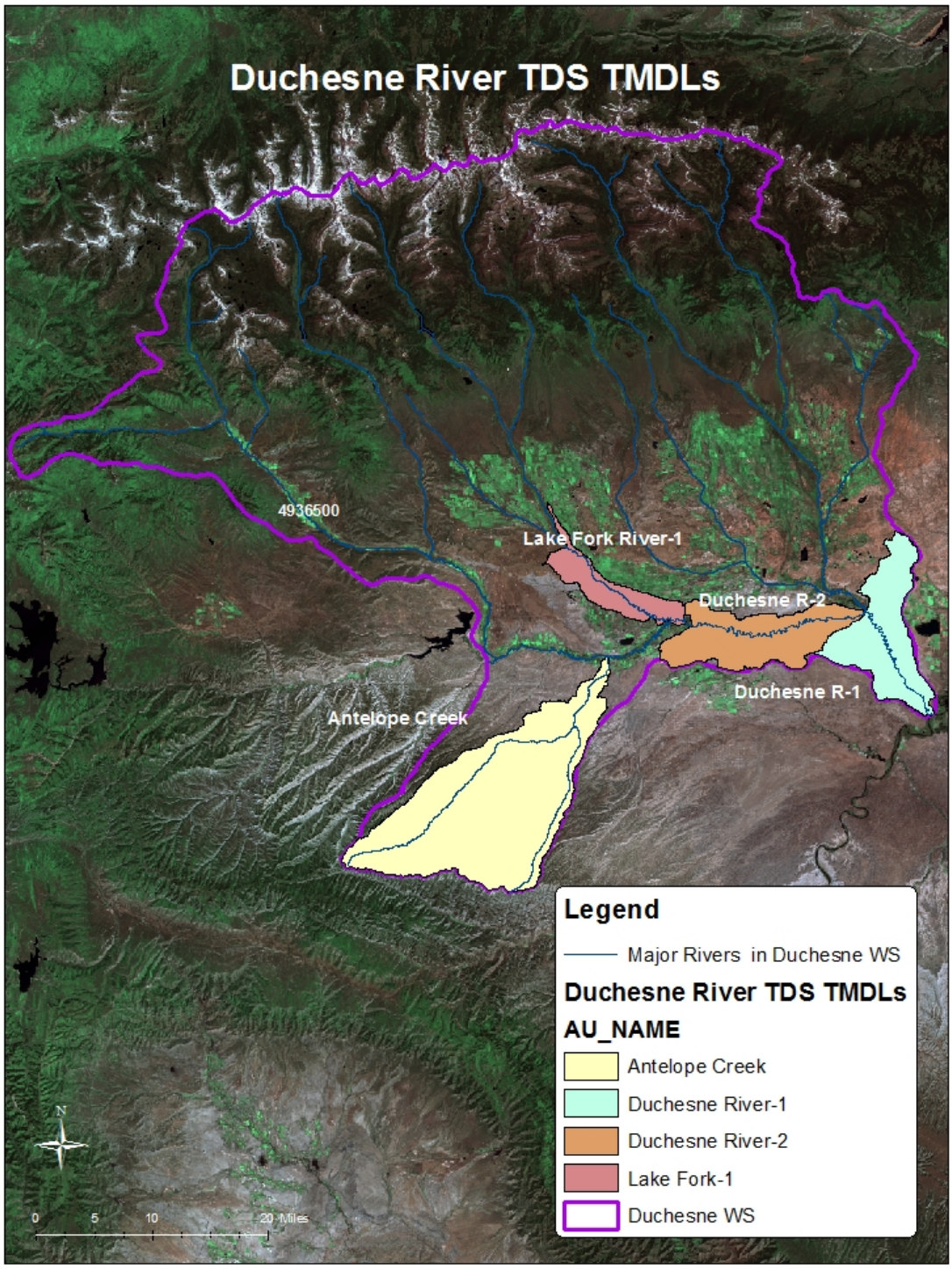
4.1 Overview of Water Quality Data

High total dissolved solids (TDS) in Duchesne River and some tributaries have exceeded water quality standards for its agricultural beneficial use designation. It was listed on Utah's 2004 303(d) List of Impaired Waters. Duchesne River Watershed TMDLs was approved by EPA on July 9, 2007. This report includes TDS TMDLs for two sections of the Duchesne River and Lake Fork River as well as TDS site specific criteria recommendations for Antelope Creek and Indian Canyon Creek. Indian Canyon Creek subwatershed is not located in the Duchesne River system and is not included in this restoration plan. The TMDL can be found at http://www.waterquality.utah.gov/TMDL/Duchesne_River_Watershed_TMDL.pdf.

Table 13. Assessment Units Covered in the Duchesne River TDS TMDLs .

Assessment Unit	Description	TMDL/SSC
Duchesne R-1	Duchesne River and tributaries from confluence of Green River to confluence Uinta River	TDS TMDL
Duchesne R-2	Duchesne River and tributaries from Randlett to Myton	TDS TMDL
Lake Fork River-1	Lake Fork River and tributaries from confluence of Duchesne River to confluence of Pigeon Water Creek	TDS TMDL
Antelope Creek	Antelope Creek and tributaries from confluence Duchesne River to headwaters	TDS SSC

Figure 15. Duchesne River TDS TMDLs.



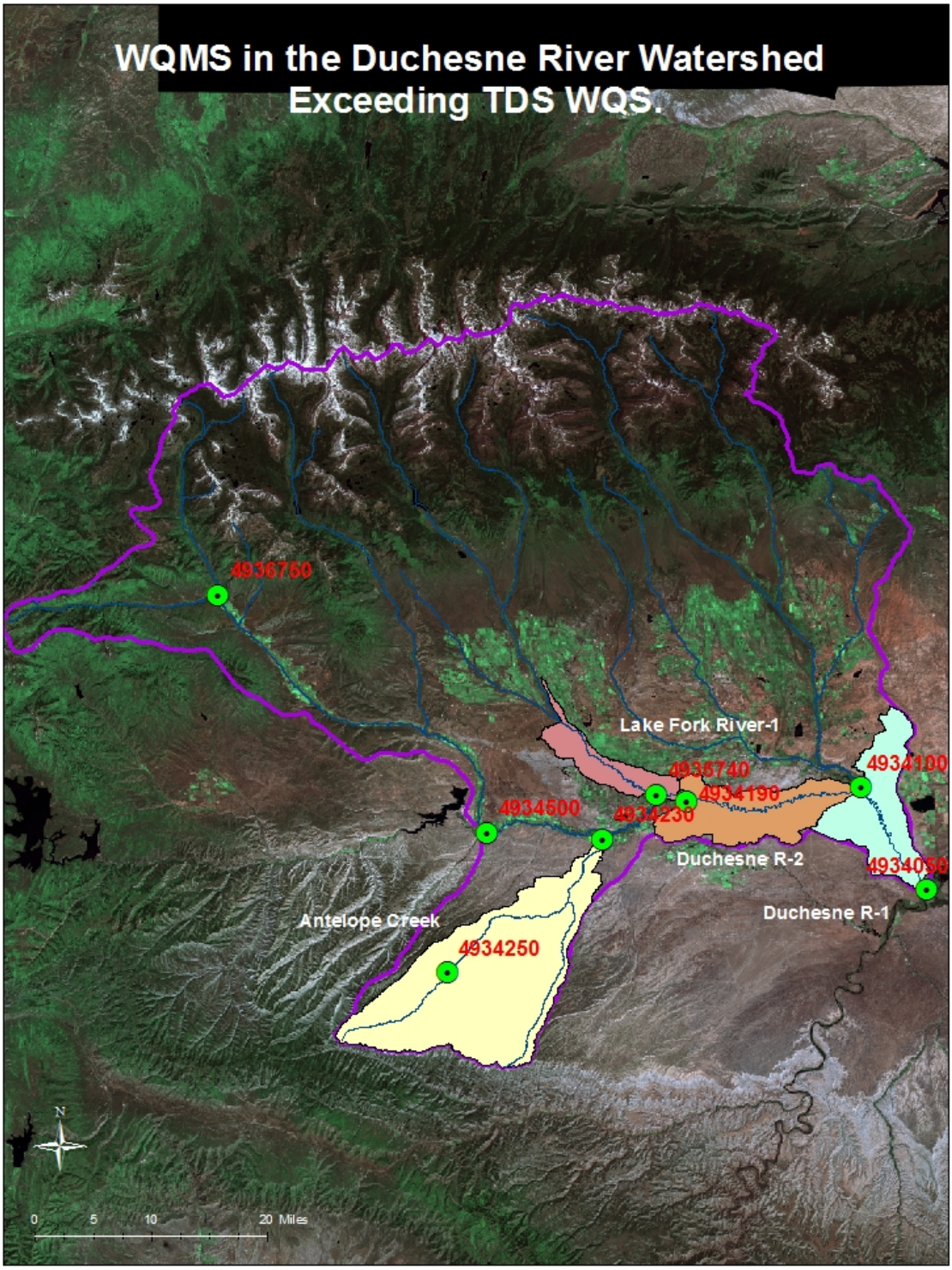
UDWQ collected TDS data at 79 stations in the Duchesne River watershed. Over 232,000 samples were collected between 1975 to 2004. Eight stations exceeded the water quality standard of 1,200 mg/L; however only 2 stations had averages higher than the WQS. These 2 sites include Antelope and Indian Canyon Creeks. Site Specific Criteria (SSC) for TDS for both subwatersheds are being developed. See Table 14 for the summary statistics on these stations.

Average flow patterns are similar at all sites with flows remaining consistent throughout the fall, winter, and peaking in May or June as a result of snowmelt. Stations with higher flows have a tendency to have more variable monthly TDS averages. Correlation between flow and TDS in the Duchesne River watershed are not very strong. TDS tends to decrease with increasing flows with the highest TDS concentrations typically occurring during low flows.

Table 14. Summary of TDS Data at WQ Stations Exceeding TDS WQS.

Station ID	Description	# Samples	Avg (mg/l)	Min (mg/l)	Max (mg/l)	Date Range	% Exceedance
4934050	Duchesne R above confluence Green R	34	892	228	1,638	1979 - 2001	29%
4931400	Duchesne R near Randlett	230	962	184	2,316	1976 - 2001	30%
4934190	Duchesne R at Myton HWY 40	132	666	186	2,222	1979 - 2001	5%
4934230	Antelope Ck at HWY 40	23	2,013	334	2,764	1980 - 1996	96%
4934250	Sowers Ck nr USFS Bndy	29	998	720	1,364	1987 - 2004	17%
4934500	Duchesne R above confluence Strawberry R	83	338	104	1,800	1979 - 2001	1%
4935740	Lake Fork R above confluence Duchesne R	45	941	106	3,390	1979 - 2001	20%
4936750	Duchesne R above Tabiona	78	231	94	2,052	1977 - 2004	1%

Figure 16. Monitoring Stations within Duchesne River Watershed Exceeding TDS WQS.



4.2 Causes and Sources of Pollution

Significant natural and anthropogenic sources of TDS exist in the watershed. Geologic features are dominated by the slightly to moderately saline Uinta and Duchesne River formations and the highly saline Mancos Shale formation. Background contributions of TDS loading contributes to elevated levels in surface waters. However, due to the modified hydrology of the Duchesne River from canals and diversions, it's practically impossible to identify the true natural condition of the watershed.

Surface and subsurface irrigation return flows that dissolve and transport TDS to receiving streams have been identified as a significant source of TDS in the watershed. Irrigation water and natural precipitation that is not taken up by vegetation, evaporated into the atmosphere, or held in the soil, percolates through the soil and enters the shallow alluvial aquifer (i.e. groundwater), eventually returning to watershed streams as baseflow. High deposition of salts on the ground surface essentially seals the soil, preventing percolation of precipitation. This action greatly enhances the effects of runoff, increasing the velocity of runoff, developing sheet flows, and increasing TDS loading.

Irrigation return flows in the watershed are a potential source of salinity because they dissolve and transport salts from fields and return them to surface waters through surface and subsurface flows. Flood irrigation is a potentially major source of salinity because of the large amounts of water used with the method and the need to leach salts from agricultural fields. During the field assessment, it was noted that almost all of the pasture, crop and hay fields in the Duchesne River watershed were irrigated by some method. Some fields were irrigated with flood irrigation through the use of canals. Seepage of water from unlined canals is a known contributor to TDS loading of streams in the Duchesne River watershed. BOR and NRCS (1993) estimates that canal seepage increases the TDS load by 67 tons per mile of canal. Return flows are mostly through subsurface flows, and several of these returns were observed to be entering active stream channels. Other types of irrigation in the watershed include more efficient center pivot, wheel line, and hand line sprinkler systems.

Subsurface bedrock formations, particularly Mancos Shale, dissolve easily and contribute TDS to the groundwater passing through them. Water quality is degraded by irrigation return flows high in salinity entering the creeks and rivers. As water flows through the watershed and is used and reused for irrigation and other purposes, it accumulates increasing amounts of salt. Salt can also accumulate on the land surface in areas of saline soils or areas of poor drainage where groundwater rises to the surface and evaporates, leaving the soluble salts on the surface. When salts accumulate on the surface, they are available for transport to watershed streams.

Livestock grazing can result in surface disturbance and soil compaction, which can decrease infiltration, vegetative cover, and streambank stability, thereby potentially increasing TDS loading. Streambank erosion caused by watering animals in readily accessible streamside areas can also result in increased sediment production, and accompanying TDS loadings.

Data retrieved from EPA's Permit Compliance System showed one permitted facility with a TDS

discharge in the Duchesne River watershed. Duchesne City Wastewater Treatment Facility (UPDES Permit #UT0020095) is a minor municipal discharger that consists of four discharging lagoons. The facility serves the City of Duchesne with a current population of 1,700 people. The facility is approximately one mile east of Duchesne and discharges very intermittently to the Duchesne River. The facility has operated as a total containment lagoon since October 1988. All discharge monitoring reports submitted by the permittee to the state indicate no discharges, and the state has indicated very intermittent discharges from this facility. In 2004, there was only one discharge, and, in 2005, the facility discharged in March and September. According to the 2002 Statement of Basis, the state's monitoring data are minimal from this facility, and results show compliance with the permit limits, although one exceedance was recorded by the state in 2004. Overall, the analysis of point source data revealed the current impact of point source TDS contributions to the Duchesne River is insignificant.

Sources of TDS loading in the Duchesne River Watershed include areas of surface disturbance, irrigation activities, natural sources (geology), streambank erosion/destabilization, grazing, roadways, and energy development. Table 18 summarizes the potential sources and severity for each cause of impairment.

Antelope Creek flows are not continuous. The creek is dry-dammed 1.5 miles upstream of the confluence of the Duchesne River. Irrigation diversions reduce flows by 90%. In dry years, groundwater is the main source of flow in the creek. Approximately 430 acres of the irrigated land in this subwatershed exit and 55% (230 acres) have been treated with salinity control measures. Irrigation return flows are a low to moderate source of TDS in the creek. Sowers Canyon, main tributary to Antelope Creek, is rich with energy exploration and development. Energy construction and development also increases TDS loading to surface waters. The geologic nature (high saline content) of the upper part of the watershed also contributes to the sediment loading.

Lake Fork River-1 is inundated with irrigated lands, pastures, and cattle activities which might be a moderate source of TDS loading. Mancos Shale formations also contribute to sediment loading into the river.

Duchesne River-2 (Randlett to Myton) contains some irrigation and grazing activities. There are several agricultural drains and irrigation return flows feeding this section of the river. Previous high-flow events have eroded banks. The overall riparian corridor is healthy.

Duchesne River-1 (Green River to Randlett) subwatershed is contains mainly agricultural or undeveloped lands. Mancos Shale dominates the landscape. Ouray School Canal diverts approximately 60% of the flow. Irrigation return flows also contribute to TDS loading in this reach of the river. Energy development is minimal.

Irrigation practices are moderate in these impaired sections and are considered sources of anthropogenic TDS loading although a majority of irrigated lands have been converted from surface to pressurized irrigation systems, reducing irrigation return flows, and deep percolation. Energy development, surface disturbances, roads, and grazing activities are also key sources to reducing TDS loading in the Duchesne River watershed.

The hydrology of the watershed is extensively manipulated and altered for agricultural use. Without a reference condition, it is not possible to determine what effect that the alternation has had on the water quality.

Table 15. Expected TDS Sources in the Duchesne River by Subwatersheds.

Subwatershed	Sources	Severity
Antelope Creek	Oil and Gas activities	Moderate to high
	Geology	Moderate to high
	Streambank destabilization	Moderate to high
	Irrigation practices	Low to moderate
Lake Fork River-1	Geology	Moderate
	Irrigation practices	Moderate
	Pasture lands	Moderate
	Livestock practices	Moderate
	Oil and Gas activities	Moderate
Duchesne River-1	Flood irrigation	High
	Open drainage canals	High
	Geology	Moderate to high
Duchesne River-2	Open drainage canals	High
	Irrigation practices	Moderate to high
	Geology	Moderate
	Livestock practices	Moderate
	Flow diversions	Moderate
	Streambank destabilization	Low to moderate

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. A statistical load duration curve was used to develop the loading capacities and existing loadings within the watershed. For the load duration curves for the 3 impaired subwatersheds, please check the TMDL.

Through careful interpretation the load duration approach can help identify the major issues contributing to the impairment and differentiate between various types of sources. Loads that need reduction in the low flow conditions (1-15%) are likely indicative of constant discharge sources. Those needing reduction between 30-90 flow regimes are likely to be reflection of precipitation driven sources. Reductions needed in the 1 percent or greater than 90 percent flow ranges reflect hydrologic conditions of extreme drought or flood, respectively.

Table 15 summarizes the TDS load reductions identified to meet the TMDL allocations for each flow range for the impaired segments in the Duchesne River and Lake Fork River. For Duchesne River-1 reach, the greatest load reduction of 15% is needed for the 20-30 percentile flow range. For Duchesne River-2 reach, there is one permitted point source, Duchesne City Wastewater

Treatment Plant. Its Wasteload Allocation (WLA) is 1 ton / day. The largest load reduction (30%) is needed during low flows (0-10 percentile flow regime). For Lake Fork River, TDS data was not available for all flow regimes. The only flow range requiring a load reduction (4%) is the 90-100. Critical conditions occur during spring and fall when streamflows are decreased and TDS concentrations are high.

If the load reductions identified in this TMDL are attained from recent or future salinity control projects and water quality standards are still violated, this TMDL will be reviewed or site-specific water quality standards will be developed based on additional data collected. Regardless of the short-term effect on instream flows and concentrations, the available and recommended control efforts should improve irrigation efficiencies and water quality will ultimately benefit.

Table 16. Summary of Necessary TDS Load Reductions (%) for Duchesne River and Lake Fork River.

Flow Percentile Ranges	Duchesne R-1	Duchesne R-2	Lake Fork River-1
0-10	12	30	0
10-20	8	17	0
20-30	15	13	0
30-40	0	0	0
40-50	0	0	0
50-60	0	0	0
60-70	0	0	0
70-80	0	0	0
80-90	0	0	0
90-100	0	0	4

Table 17. TDS TMDLs for the Duchesne River Subwatersheds.

	Duchesne R-1	Duchesne R-2	Lake Fork River-1
Flow Regime	20-30	0-10	90-100
Loading Capacity (kg/d)	264,230	102,756	254,542
Observed Loading (kg/d)	309,335	145,650	265,612
Estimated Reduction (%)	14.6%	29.4%	4.2%

4.4 Antelope Creek Site Specific Standard for TDS

Development of site-specific criteria for TDS was recommended for the 303d-listed reach of Antelope Creek. TDS limits may be adjusted if the adjustment does not impair the designated beneficial use. A new TDS standard should be set where it can be shown that natural or unalterable conditions prevent its attainment of the current TDS WQS. Waters where the local geology may result in naturally elevated TDS concentrations are those most often proposed as waters needing ambient-based criteria.

TDS data for Antelope Creek is not available during natural conditions. It is assumed that conditions might slightly improve however it is unlikely that the current TDS WQS of 1,200 mg/l can be met due to a combination of naturally saline soils and irreversible modifications from irrigation practices. Less than 1% of the drainage is irrigated and a majority of the irrigated acres have already been treated with salinity control projects.

The proposed site-specific TDS criteria for Antelope Creek are based on the 90th percentile concentration of available ambient TDS data. This approach is consistent across Utah. The proposed TDS SSC of 2,655 mg/l will support the beneficial uses of irrigation and stock watering. Adverse effects will be minimized by this change. Considering the high levels of salinity in the soil, the salinity in the water will have little additional effect on the crops. The primary crop being alfalfa will have had to adapt to the high salinity in the soils. Table 19, taken from the Utah Lake TMDL, shows the yield potentials of several crops at specific TDS levels. This adjusted criterion requires approval by EPA.

Table 18. Recommended Site-specific TDS Criteria for Antelope Creek.

Creek	Proposed Site-Specific TDS Criterion (mg/l)	Station Used in Calculation	Station Location
Antelope Creek	2,655	4934230	Antelope Creek at HWY 40

Table 19: Individual Crop Tolerances to TDS Levels (mg/L)

Irrigation Water Application		% Yield Potential at Specific TDS Levels			
	Threshold*	90	75	50	0**
Alfalfa	838	1,386	2,240	3,642	6,141
Pasture	1,508	2,057	2,971	4,495	7,421
Grain	2,179	2,727	3,581	5,044	7,909
Corn	716	1,081	1,569	2,423	4,129
Grass Hay	1,508	2,057	2,971	4,495	7,421
Grass/Turf	1,264				
Other Vegetables	899	1,264	1,813	2,727	4,617
Orchard	655	838	1,203	1,752	2,788
Sorghum	2,788	3,093	3,459	4,129	5,349
Onions	533	777	1,142	1,813	3,093
Tomatoes	1,081	1,447	2,118	3,093	5,166

* Yield potential begins to be affected

** Theoretical value at which crop growth ceases

5.0 WATERSHED IMPLEMENTATION STRATEGY

5.1 Goals and Objectives

TDS impairments in the Duchesne River occur during low flow conditions when TDS tend to be concentrated and transport times are decreased and also during storm-driven flood events. Implementation strategies for this watershed are designed to reduce loadings from storm events and minimize their impacts during critical low flow season. All load reductions are associated with nonpoint sources and the implementation of these BMPs is purely voluntary. See Tables 19-22 for recommended BMPs for each impaired subwatershed.

The goals of this watershed plan are:

- Improve water quality in the watershed by decreasing the TDS and Sediment load
- Improve wildlife habitat
- Educate the public about water quality issues in the watershed as well as BMP's to protect and improve the water quality

Table 20. Recommended BMPs for Antelope Creek Subwatershed.

Nonpoint Source	Recommended BMPs	Specific Practices
Streambank Erosion	Develop off-stream livestock water stations and fencing Stabilize eroding streambanks via structures Revegetate eroding streambanks with woody vegetation	Fencing Pole/post plantings Erosion control fabric Seeding Biologs Grade stabilization structures Vertical bundle
Energy Development	Education and enforcement on illicit disposal of production water Adhere to stormwater permit	Silt fencing Straw bale barriers Workshops
Irrigated pastures	Establish and maintain vegetation buffers Improve irrigation water management via conservation plans Increase irrigation efficiency Reduce canal seepage by lining or piping canals	Filter strips Silt fence Irrigation sprinklers Irrigation pipeline Canal lining/piping

Table 21. Recommended BMPs for Lake Fork Creek-1 Subwatershed.

Nonpoint Source	Recommended BMPs	Specific Practices
Irrigated pastures	Establish and maintain vegetation buffers Improve irrigation water management via conservation plans Increase irrigation efficiency Reduce canal seepage by lining or piping canals	Filter strips Silt fence Irrigation sprinklers Irrigation pipeline Canal lining/piping
Pastureland	Implement rest-rotation grazing systems Revegetate streambanks with woody vegetation and allow for re-establishment	Grazing management Seeding Exotic Removal Practice Constructed wetland Watering facility
Energy Development	Education and enforcement on illicit disposal of production water Adhere to stormwater permit	Silt fencing Straw bale barriers Workshops

Table 22. Recommended BMPs for Duchesne River-1 Subwatershed.

Nonpoint Source	Recommended BMPs	Specific Practices
Irrigated pastures	Establish and maintain vegetation buffers Improve irrigation water management via conservation plans Increase irrigation efficiency Reduce canal seepage by lining or piping canals	Filter strips Silt fence Irrigation sprinklers Irrigation pipeline Canal lining/piping

Table 23. Recommended BMPs for Duchesne River-2 Subwatershed.

Nonpoint Source	Recommended BMPs	Specific Practices
Irrigated pastures	Establish and maintain vegetation buffers Improve irrigation water management via conservation plans Increase irrigation efficiency Reduce canal seepage by lining or piping canals	Filter strips Silt fence Irrigation sprinklers Irrigation pipeline Canal lining/piping
Pastureland	Implement rest-rotation grazing systems Revegetate streambanks with woody vegetation and allow for re-establishment	Grazing management Seeding Exotic Removal Practice Constructed wetland Watering facility
Open drainage canals	For canal seepages, line canals with concrete to limit infiltration losses	Irrigation pipeline
Streambank Erosion	Develop off-stream livestock water stations and fencing Stabilize eroding streambanks via structures Revegetate eroding streambanks with woody vegetation	Fencing Pole/post plantings Erosion control fabric Seeding Biologs Grade stabilization structures Vertical bundle

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 Duchesne 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.
- Duchesne River from the town of Hanna to the North Fork 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.

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.

Duchesne River Restoration Plan

The Duchesne River Restoration projects focus mainly on the reduction of sediment and TDS loading to the river resulting from inefficient irrigation practices, unstable streambanks and impaired riparian corridors by implementing the appropriate BMPs. Current project work include assisting with irrigation system improvements, restoring streambanks located on private property in the Bridgeland and Duchesne area and using the digital images from Aggie Air to identify additional high priority sites between the confluence of North Fork and West Fork stems down to the confluence of Wright Draw.
Duchesne County Conservation District will work with Dry Gulch Irrigation Company to complete their conversion from an open canal to a piped canal. The canal piping was funded by BOR, however, a diversion screen was overlooked making the system inoperable. The piping of the canal is allowing the land owners who use the canal to improve their irrigation practices by converting from flood irrigation to sprinkler irrigation with NRCS assistance.

In the Duchesne River-4 reach, project work includes mapping 30 river miles using Aggie Air and identifying erosion sources by evaluating the orthorectified digital imagery. DWR will work with landowners in this reach to identify and repair high priority sites. Orthorectified imagery will provide valuable information for continual restoration work in the Duchesne River watershed beyond the contract period.

Duchesne County Conservation District will work with landowners and the NRCS to develop conservation plans that will focus on repairing eroding streambanks in the Duchesne River 3 and 4

reaches. This will improve riparian and instream habitats within the drainage and specifically this project area. Restoration efforts will consist of various BMPs such as bank sloping, installation of rock structures, and planning of vegetation to help stabilize the soil present in the stream corridor.

Main Objectives:

1 Reduce sediment and TDS loading to the Duchesne River from inefficient irrigation practices.
2 Reduce sediment and TDS loading to the Duchesne River from unstable streambanks and impaired riparian corridors and reduce impacts from adjacent land activities by implementing the appropriate BMPs
3 Improve fish habitat (develop and ensure maintenance of pool, riffle, run complexes)
4 Inform and educate local landowners and the community concerning non-point source pollution and the importance of maintaining and improving water quality within the watershed
5 Monitor Duchesne River to determine project effectiveness

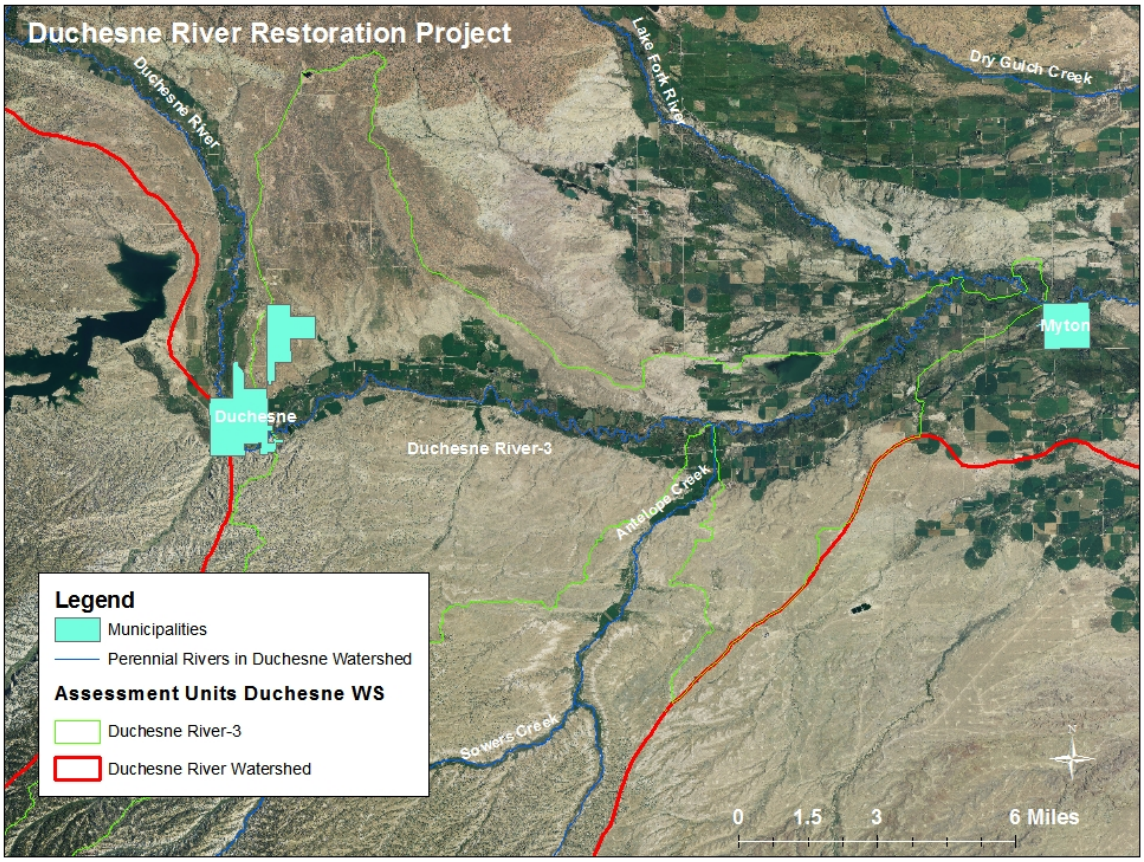
Irrigation Improvement Tasks:

- Contract with Dry Gulch Irrigation Company to complete the piping of one canal by constructing a screen
- Contract with Dry Gulch Irrigation Company to upgrade a deteriorated diversion
- Encourage on farm irrigation system improvements

Streambank Restoration Tasks:

- Contract with landowners to develop Conservation Plans for restoring Duchesne River streambanks
- Survey for T&E Species per USFWS requirements
- Restore 4,800 ft of river bank by resloping vertical cutbanks
- Remove Russian olive and Tamarisk in the riparian area
- Plant with native riparian plants
- Install barbs in the river channel to direct flow energy away from eroding banks
- Construct 1.25 mi fence along river to protect riparian work and limit direct cattle access
- Create and armor water gaps for cattle access
- Construct 700 ft berm to prevent manure from entering into river at 1 AFO

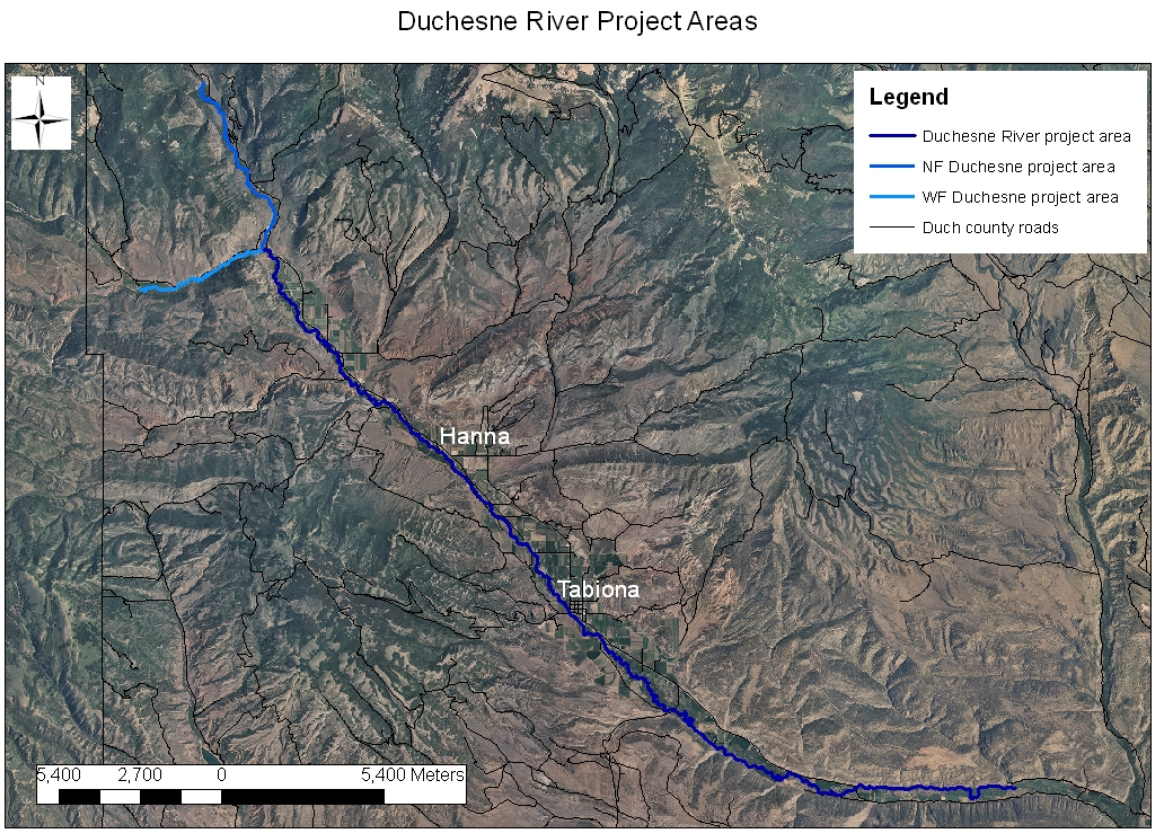
Figure 17. Restoration Project Locales along the Duchesne River



Aerial Mapping Tasks:

- Contract with Utah State University Aggie Air to fly 30 miles of upper Duchesne River taking photos of the river corridor and riparian zones
- Interpret photos to identify areas needing restoration work
- Amend streambank restoration plan to include upper river reaches (up to 2 miles)

Figure 18. Aerial Photography Mapping in Duchesne River-4 Subwatershed.



Fish Habitat Tasks:

- Use mapped photos to identify and prioritize areas where improved fish habitat work is needed
- Design and implement fish habitat plan to include pools, riffles, and run complexes

5.3 Funding Needs

Funding Sources	Total Cost
EPA Section 319 Funds	$149,481
EQIP	$1,150,000
BOR	$960,000
State/Local Match	$5,200 Utah NPS $118,756 Landowners $34,100 UDWR $40,000 WRI/Blue Ribbon $22,000 UDWQ $57,000 Dry Gulch Irr. Co.
TOTAL	$2,417,781

Work Element	Total Costs	319 Funds	Match	Source of Match
Irrigation Improvements	$2,237,000	$70,000	$2,167,000	Dry Gulch, EQIP, BOR
Aerial Photography	$56,600	$35,000	$21,600	UDWR
T&E Survey	$30,000	$30,000	$0	UDWR
Improve fish habitat	$40,000	$0	$40,000	WRI, Blue Ribbon
Outreach & Education	$9,217	$4,017	$5,200	Utah NPS
Monitoring	$34,500	$0	$34,500	UDWR, UDWQ
Administration Services	$10,464	$10,464	$0	n/a
Total	**$2,417,781.00**	**$149,481.00**	**$2,268,300.00**	

5.4 Technical Assistance Needs

Duchesne River Rehab Project Planning – Both NRCS and UDWR will provide technical support for detailed project plans and permits for stream rehabilitation work on the Duchesne River

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

5.5 Schedule for Implementation

Goals/ Objectives	Output	Implementation Date
Decrease TDS inputs in Duchesne River-3 by improving irrigation efficiency.	Work with Dry Gulch Irrigation Co. to improve the diversion of their State Road Canal.	April 2014 – August 2016
Survey for T&E species per USFWS requirements	Survey potential river bank restoration project sites for Ute Ladies Tresses.	July 2014 – August 2016
Decrease TDS inputs in Duchesne River-4 by coordinating plan of work to identify and prioritize project areas needing restoration with UWDR	Fly 30 river miles, interpret photos, prioritize eroded sites, restore 2 river miles	April 2013 – August 2016
Improve fish habitat in the main stem of the Duchesne River by developing and ensuring maintenance of pool, riffle, and run complexes	Use photographs to identify and restore fish habitat	April 2013 – August 2016
Inform and educate local landowners and the community concerning non-point source pollution and the importance of maintaining and improving water quality within the watershed	Conduct demonstration tour, develop fact sheets, hold Energy BMP workshop	2014 - 2016
Monitor Duchesne River to determine project effectiveness	Collect water quality samples, monitor fisheries, survey physical habitat, and take photos	April 2013 – August 2016
Administration services to track match and write progress reports	Documented match records, ongoing for duration of project. Semi-annual, annual, and final reports.	April 2013 – August 2016

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. This will be accomplished by conducting tours of the restoration work, disseminate information via fact sheets and articles, and hold workshop for energy development on proper BMP implementation in July 2014.

7.0 MONITORING

7.1 Interim Milestones

An analysis of water quality data will be prepared using DWQ monitoring data and any DWR IABAT data 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 Duchesne River. This will include examination of TDS loading, benthic invertebrate data, and cold water fishery data.

The Interim Duchesne River 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:

1. Non-Point Source Criteria - TDS concentrations in Duchesne River will be less than or equal to 1,200 mg/l. This will be a measure of the effectiveness of non-point source controls in the upper watershed.
2. Cold water fishery criteria – Temperature will be less than or equal to 20° Celsius

7.3 Long Term Water Quality Monitoring Program

Table 24. Sampling Matrix for the Duchesne River.

Activity	Schedule	Responsible Agency	Methods
Sample Water Quality for NO_3/NO_2, NH_4,TDS,Total P, Total dis. P, TSS. Sampling will be conducted at selected site in the water-shed to evaluate changes in water quality and attainment of beneficial uses.	Total at least 10 times per year 2013- 2017. Post project monitoring will continue according to DWQ intensive basin 6-year rotation.	DWQ, UB Watershed Coordinator	Refer to Utah DWQ's Standard Operating Procedures
Field water quality parameters to include Temp., DO, Conductivity and pH.	Same time as sample collection occurs	DWQ, UB Watershed Coordinator	DWQ's SOPs
Monitor fisheries, channel geomorphology, substrate size, riparian greenline and transect vegetation, stream shading and photopoints.	Every two years, unless site specific response necessitates frequency adjustment.	UDWR, DWQ UCASE Team	Trend analysis for channel adjustment data, riparian vegetation transect data, fishery population/ production data and HQI to document BMP effectiveness, and habitat quality improvement according to DWQ monitoring SOPs.
Evaluate chemical water quality data to document BMP effectiveness to improve water quality.	Every year	DWQ and project sponsors	Examine chemical data against beneficial use criteria, trend analysis.
Evaluate monitoring program and determine where and when additional water quality monitoring may be needed to document BMP effectiveness	Annually	DWQ	Feedback loop analysis
Consolidate chemical, biological and physical data for reporting process	Biennially - Inclusion in the 303(d), 305(b) Integrated report. Compile all environmental results data, analyze and report in project FINAL REPORT	DWQ UCASE assessment team and WCs	NA
Animal waste, upland and stream/riparian erosion modeling	Frequency based on expected response time of BMPs watershed recovery	Local sponsor and support agencies	PSIAC, stream volume method, Erosion pins, UAFRRI, STEPL, photo-points

A total of 9 sampling sites will be established to support the project. These sites are located upstream and downstream of major areas scheduled for BMP implementation or have known contributions of NPS pollutants. These sites are part of the Intensive Basin Rotational Sampling that is scheduled for FY 2016-17. See Figure 20.

Table 25. Duchesne River Restoration WQMS.

Site ID	Site Description
4936790	West Fork Duchesne River AB Confluence North Fork Duchesne River
4936770	North Fork Duchesne River AB Confluence West Fork Duchesne River
4935270	Duchesne River @ U35 Xing
4934500	Duchesne River AB Confluence Strawberry River
4935200	Duchesne River @ Bridgeland
4934190	Duchesne River @ Myton
4934050	Duchesne River AB Confluence Green River
4939136	Cottonwood Creek below SR121
4934600	Dry Gulch Creek at 1500 East crossing

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 seven sites on the Duchesne 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

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.

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.

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.

Figure 19. WQMS Sampled for Duchesne River Restoration Plan.

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