



Water Quality Management Plan
for the 2008 Water Year

2009 Water Quality Implementation Report

Provo River, Deer Creek Reservoir and Jordanelle Reservoir

Prepared For:
The Wasatch County Council
and
The Provo River Watershed Council

Prepared By:
Desert Rose Environmental, LLC

Final—June 2010

2009 Water Quality Implementation Report

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The Provo River Watershed Council Funding Agencies

Central Utah Water
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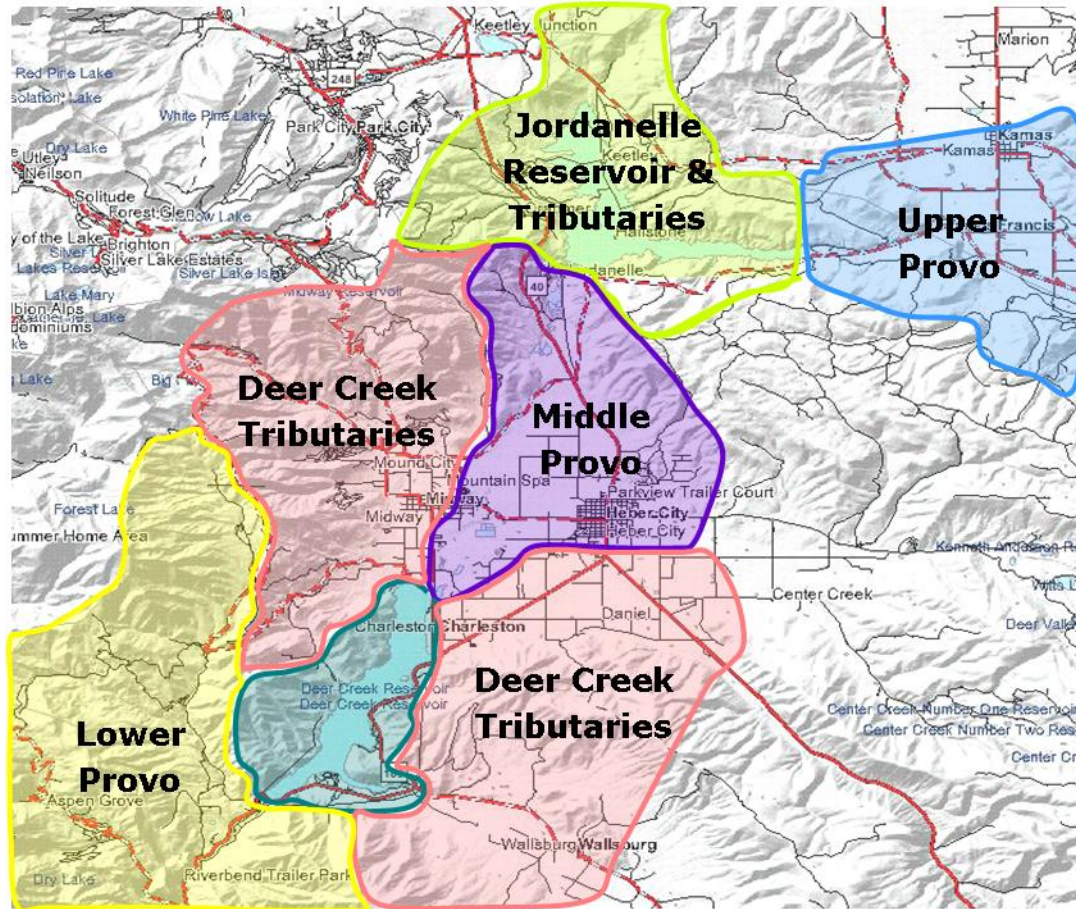
Jordan Valley Water
 Conservancy District

Metropolitan Water District of Orem

Metropolitan Water District of Provo

Metropolitan Water District of
 Salt Lake & Sandy

Projects In the Watershed



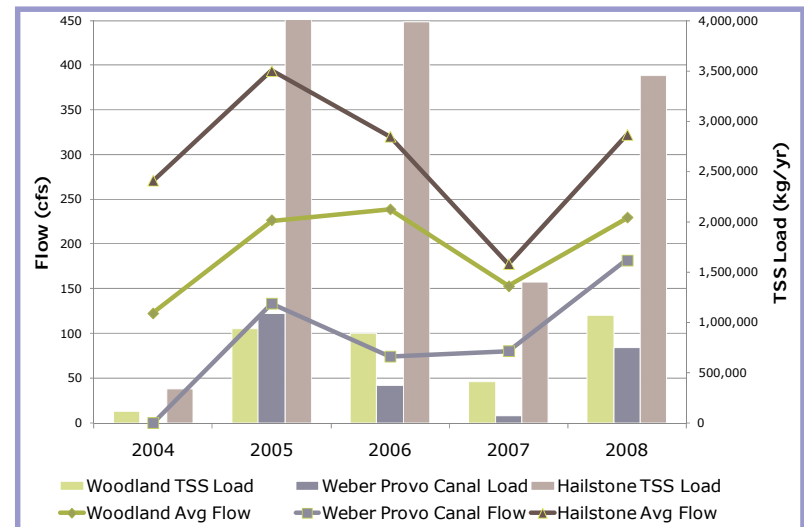
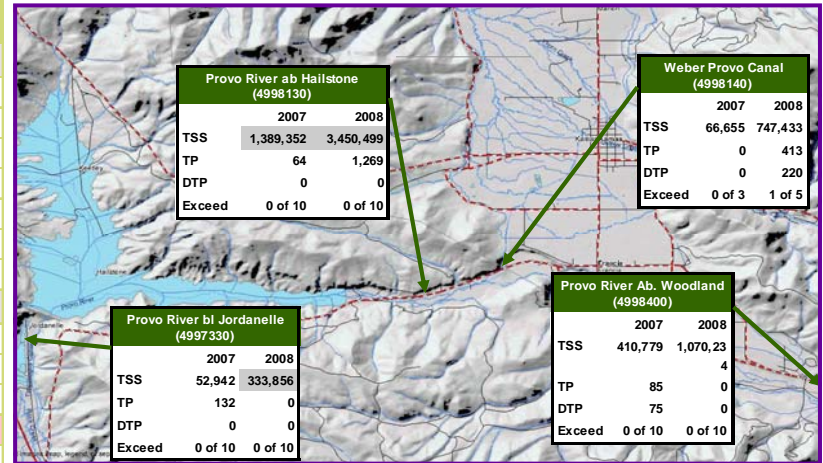
Important Projects and Activities in the Watershed

Each Year the Provo River Watershed Council monitors, advises and supports various projects and activities that are planned or implemented within the watershed. These projects and their sponsors deserve recognition for their attention that they give to monitoring, maintaining and/or improving water quality within the Provo River System.

1. Alternative Wastewater Disposal Systems Rule Making and Implementation—Wasatch County Health Dept.
2. Quagga and Zebra Mussels, Utah Aquatic Invasive Species Management Plan—Utah Division of Wildlife Resources
3. Monitoring of Pollutants of Emerging Concern, Pharmaceuticals and PHCPs—Jordan Valley Water Conservancy District and Central Utah Water Conservancy District
4. Provo River Watershed Festival—Soldier Hollow Charter School
5. U.S. 189 Provo Canyon Highway Construction Project—Utah Department of Transportation
6. Deer Creek Dam Renovations—US Bureau of Reclamation and Provo River Water Users.
7. Deer Creek Reservoir Sediment Studies—US Bureau of Reclamation and Brigham Young University
8. Cascade Springs Road Restoration—Wasatch Mountain State Park and US Forest Service
9. Jordanelle Special Service District Water Reclamation Plant Permitting—JSSD and Utah Division of Water Quality
10. Wallsburg Watershed Plan—Wasatch Conservation District

Upper Provo River

	2005	2006	2007	2008
Provo River at Woodland, STORET 4998400				
Weighted Average Flow (cfs)	226	239	153	229
TP Weighted Average (mg/l)	0	0	0	0
TP Annual Load (kg/yr)	44	77	85	0
DTP Weighted Average (mg/l)	0	0	0	0
DTP Annual Load (kg/yr)	0	70	77	0
TSS Weighted Average (mg/l)	3.4	3	2.2	3.2
TSS Annual Load (kg/yr)	936,676	891,330	410,779	1,070,234
Weber Provo Canal, STORET 4998140				
Weighted Average Flow (cfs)	133	74	80	182
TP Weighted Average (mg/l)	0.01	0.00	0.00	0.00
TP Annual Load (kg/yr)	1,271	144	0	413
DTP Weighted Average (mg/l)	0	0.00	0.00	0.07
DTP Annual Load (kg/yr)	0	0	0	220
TSS Weighted Average (mg/l)	8.2	5	2	0
TSS Annual Load (kg/yr)	1,088,494	371,473	66,655	747,433
Provo River at Hailstone, STORET 4998130				
Weighted Average Flow (cfs)	394	320	178	322
TP Weighted Average (mg/l)	0	0.01	0.00	0.00
TP Annual Load (kg/yr)	1,198	1,000	64	1,269
DTP Weighted Average (mg/l)	0	0.00	0.00	0.00
DTP Annual Load (kg/yr)	0	589	0	0
TSS Weighted Average (mg/l)	5.8	7	6	7
TSS Annual Load (kg/yr)	4,174,295	3,978,884	1,389,352	3,450,499
Provo River below Jordanelle, STORET 4997330				
Weighted Average Flow (cfs)	285	425	305	339
TP Weighted Average (mg/l)	0	0.01	0.00	0.00
TP Annual Load (kg/yr)	86	2,216	132	0
DTP Weighted Average (mg/l)	0	0.00	0.00	0.00
DTP Annual Load (kg/yr)	0	0	0	0
TSS Weighted Average (mg/l)	0	7	0	1
TSS Annual Load (kg/yr)	0	1,955,230	52,942	333,856
Kamas Fish Hatchery, STORET 4929000				
Weighted Average Flow (cfs)	4.6	4.4	4	6.1
TP Weighted Average (mg/l)	0.06	0.06	0.07	0.05
TP Annual Load (kg/yr)	224	81	97	319
DTP Weighted Average (mg/l)	0.05	0.04	0.03	0.03
DTP Annual Load (kg/yr)	185	48	26	176
TSS Weighted Average (mg/l)	0.4	1.1	0	0
TSS Annual Load (kg/yr)	1,190	0	0	869



Provo River exhibited greater differences in TSS Load between Woodland and Hailstone in 2004-2008 as compared to previous years. This increase appears to be due to disturbance in the area above Hailstone and not due to water from the Weber Provo Canal.

Upper Provo River

	2005	2006	2007	2008
Provo River at Woodland, STORET 4998400				
Weighted Average Flow (cfs)	226	239	153	229
TP Weighted Average (mg/l)	0	0	0	0
TP Annual Load (kg/yr)	44	77	85	0
DTP Weighted Average (mg/l)	0	0	0	0
DTP Annual Load (kg/yr)	0	70	77	0
TSS Weighted Average (mg/l)	3.4	3	2.2	3.2
TSS Annual Load (kg/yr)	936,676	891,330	410,779	1,070,234
Weber Provo Canal, STORET 4998140				
Weighted Average Flow (cfs)	133	74	80	182
TP Weighted Average (mg/l)	0.01	0.00	0.00	0.00
TP Annual Load (kg/yr)	1,271	144	0	413
DTP Weighted Average (mg/l)	0	0.00	0.00	0.07
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Weighted Average Flow (cfs)	394	320	178	322
TP Weighted Average (mg/l)	0	0.01	0.00	0.00
TP Annual Load (kg/yr)	1,198	1,000	64	1,269
DTP Weighted Average (mg/l)	0	0.00	0.00	0.00
DTP Annual Load (kg/yr)	0	589	0	0
TSS Weighted Average (mg/l)	5.8	7	6	7
TSS Annual Load (kg/yr)	4,174,295	3,978,884	1,389,352	3,450,499
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Weighted Average Flow (cfs)	285	425	305	339
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TP Annual Load (kg/yr)	86	2,216	132	0
DTP Weighted Average (mg/l)	0	0.00	0.00	0.00
DTP Annual Load (kg/yr)	0	0	0	0
TSS Weighted Average (mg/l)	0	7	0	1
TSS Annual Load (kg/yr)	0	1,955,230	52,942	333,856
Kamas Fish Hatchery, STORET 4929000				
Weighted Average Flow (cfs)	4.6	4.4	4	6.1
TP Weighted Average (mg/l)	0.06	0.06	0.07	0.05
TP Annual Load (kg/yr)	224	81	97	319
DTP Weighted Average (mg/l)	0.05	0.04	0.03	0.03
DTP Annual Load (kg/yr)	185	48	26	176
TSS Weighted Average (mg/l)	0.4	1.1	0	0
TSS Annual Load (kg/yr)	1,190	0	0	869

Kamas Fish Hatchery

Avg Flow	6.1	CFS
Avg TP	0.05	mg/l
Max TP	0.09	mg/l
Min TP	0.00	mg/l
Avg DTP	0.03	mg/l
Max DTP	0.05	mg/l
Min DTP	0.02	mg/l

The Kamas Fish Hatchery has the potential to impact the Provo River System through return flow into the Weber Provo Canal. The Hatchery is currently exceeding the TMDL target of 173 kg/year of phosphorus.

TMDL Target Loads (Kg/yr)

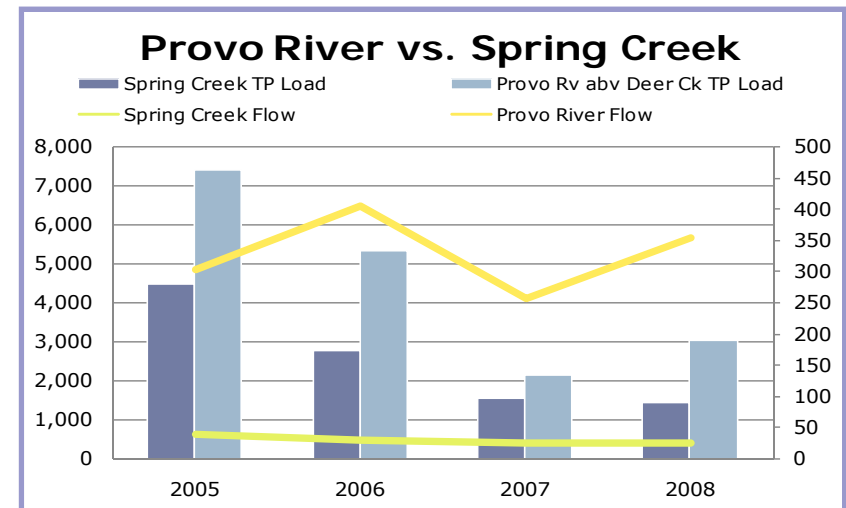
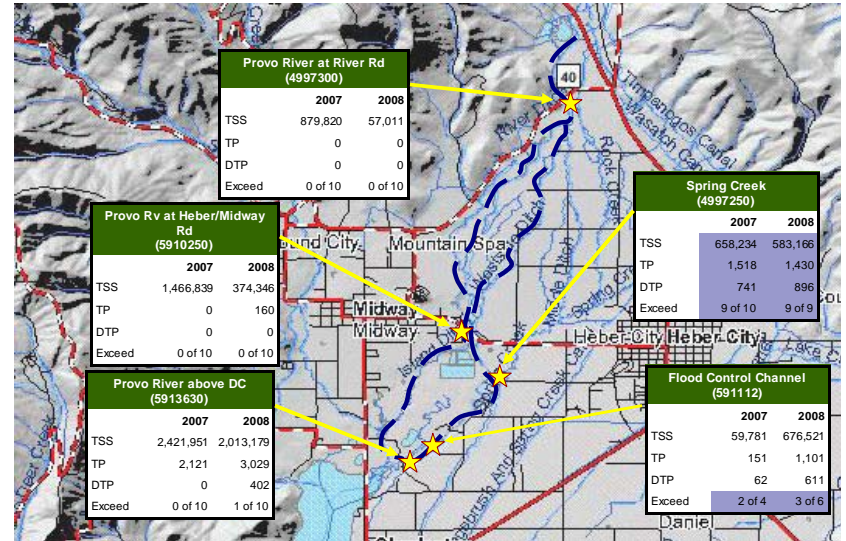
Site	Provo Rv Woodland	Kamas Fish Hatchery	Provo Rv Hailstone
Target Load	7,681	173	9,837
2007 Loads	85	97	64
2008 Loads	0	319	1,269

Provo River Through Heber Valley

	2005	2006	2007	2008
Provo River at River Road Crossing STORET 4997300				
Weighted Average Flow (cfs)	238	367	244	297
TP Weighted Average (mg/l)	0.01	0	0	0
TP Annual Load (kg/yr)	1,922	526	0	0
DTP Weighted Average (mg/l)	0.00	0	0	0
DTP Annual Load (kg/yr)	0	0	0	0
TSS Weighted Average (mg/l)	1.07	2	3.6	0.4
TSS Annual Load (kg/yr)	288,228	38,649,064	879,820	57,011
Provo River at Heber - Midway Road Crossing, STORET 5910250				
Weighted Average Flow (cfs)	249	380	246	331
TP Weighted Average (mg/l)	0.06	0.01	0	0
TP Annual Load (kg/yr)	23,771	1,091	0	160
DTP Weighted Average (mg/l)	0.00	0	0	0
DTP Annual Load (kg/yr)	0	187	0	0
TSS Weighted Average (mg/l)	0.93	4	6.5	1
TSS Annual Load (kg/yr)	158,563	2,070,313	1,466,839	374,346
Spring Creek at Provo River, STORET 4997250				
Weighted Average Flow (cfs)	38	30	26	26
TP Weighted Average (mg/l)	0.13	0.09	0.08	0.07
TP Annual Load (kg/yr)	4,478	2,770	1,518	1,430
DTP Weighted Average (mg/l)	0.07	0.05	0.04	0.04
DTP Annual Load (kg/yr)	2,257	1,217	741	896
TSS Weighted Average (mg/l)	46.22	35	28.6	27
TSS Annual Load (kg/yr)	1,563,909	1,383,817	658,234	583,166
Provo River above Deer Creek, STORET 5913630				
Weighted Average Flow (cfs)	304	406	257	355
TP Weighted Average (mg/l)	0.03	0.02	0.01	0.01
TP Annual Load (kg/yr)	7,382	5,300	2,121	3,029
DTP Weighted Average (mg/l)	0.01	0.01	0	0
DTP Annual Load (kg/yr)	2,042	1,460	0	402
TSS Weighted Average (mg/l)	33.82	15	10.6	6.8
TSS Annual Load (kg/yr)	8,536,044	5,715,132	2,421,951	2,013,179
Provo River TP Increase Ratio	86.30	2.39	16.07	n/a

Spring Creek is the major contributor of phosphorus and solids to the Provo River in the Heber Valley. PRWC is conducting additional monitoring to identify the source.

The flood control channel is another major contributor.

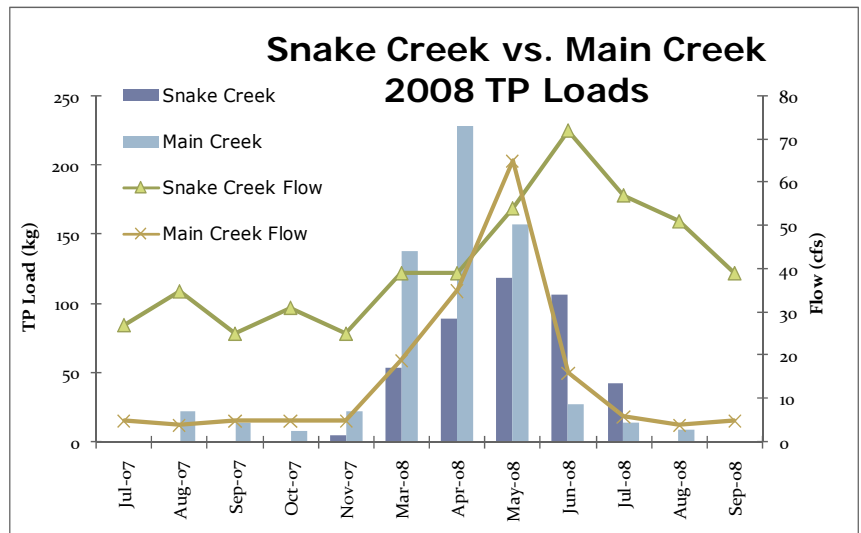


Deer Creek Tributaries

	2004	2005	2006	2007	2008
Main Creek abv Deer Creek STORET 5913460					
Weighted Average Flow (cfs)	8	17	23	9	18
TP Weighted Average (mg/l)	0.04	0.054	0.07	0.05	0.04
TP Annual Load (kg/yr)	194	765	2339	439	682
DTP Weighted Average (mg/l)	0.03	0.022	0.03	0.03	0.03
DTP Annual Load (kg/yr)	141	332	562	131	126
TSS Weighted Average (mg/l)	21.4	27	47	24.6	32
TSS Annual Load (kg/yr)	111,289	598,638	2,234,868	290,895	898,695
Snake Creek above Deer Creek STORET 5910160					
Weighted Average Flow (cfs)	34	52	54	37	43
TP Weighted Average (mg/l)	0.01	0.021	0.02	0.01	0.01
TP Annual Load (kg/yr)	155	795	958	252	435
DTP Weighted Average (mg/l)	0	0	0	0	0
DTP Annual Load (kg/yr)	0	100	77	41	111
TSS Weighted Average (mg/l)	6.46	13.2	12	11.9	8.7
TSS Annual Load (kg/yr)	198,515	549,453	742,117	303,457	316,901
Provo River abv Deer Creek STORET 5913630					
Weighted Average Flow (cfs)	247	304	406	257	355
TP Weighted Average (mg/l)	0.041	0.035	0.02	0.01	0.01
TP Annual Load (kg/yr)	7,767	7382	5,300	2,121	3,029
DTP Weighted Average (mg/l)	0	0.006	0.01	0	0
DTP Annual Load (kg/yr)	0	2,042	1460	0	402
TSS Weighted Average (mg/l)	19.85	33.8	15	10.6	6.8
TSS Annual Load (kg/yr)	4,373,323	8,536,044	5,715,132	2,421,951	2,013,179

Tributary	TP Load	% TP load	DTP Load	% DTP	% DTP Load
Provo	3,029	41%	402	13%	10%
Snake	435	6%	111	26%	3%
Daniels	176	2%	76	43%	2%
Main	682	9%	126	18%	3%
Groundwater	2,725	37%	2,725	100%	71%
Storm	400	5%	400	100%	10%
Total	7,447	100%	3,840		100%

Snake Creek & Main Creek



Tributary	TMDL Target Loads	2007 TP Load	2008 TP Load
Provo	11,136	2,121	3,029
Snake	2,308	252	435
Daniels	645	24	176
Main	1,210	439	682
Total	15,299	2,836	4,322

Main creek continues to exhibit high total phosphorus concentrations. Compared to Snake Creek, which has much higher flows, Main Creek's overall loading is higher. See chart at top. A Watershed Plan is being prepared to identify mitigation measures that may be put into place to control phosphorus coming from Main Creek.

Provo River and Tributaries Below Deer Creek

	2005	2006	2007	2008
Provo River below Deer STORET 5913210				
Weighted Average Flow (cfs)	378	369	332	347
TP Weighted Average (mg/l)	0.03	0.02	0.01	0.01
TP Annual Load (kg/yr)	7,904	6813	2749	1813
DTP Weighted Average (mg/l)	0.02	0.02	0.01	0
DTP Annual Load (kg/yr)	4820	5332	1679	153
TSS Weighted Average (mg/l)	0	3	4.6	3
TSS Annual Load (kg/yr)	74,100	734,680	949,652	547,638
Little Deer Creek Above Provo River STORET 4996870				
Weighted Average Flow (cfs)	27	25	21	15
TP Weighted Average (mg/l)	0.02	0.02	0	0.01
TP Annual Load (kg/yr)	469	429	40	84
DTP Weighted Average (mg/l)	0.01	0.01	0	0
DTP Annual Load (kg/yr)	206	197	0	0
TSS Weighted Average (mg/l)	14	18	7.2	7
TSS Annual Load (kg/yr)	482,686	499,871	147,684	124,724
Provo River at Utah Co. Line STORET 4996890				
Weighted Average Flow (cfs)			332	347
TP Weighted Average (mg/l)			0.01	0.01
TP Annual Load (kg/yr)			2794	2421
DTP Weighted Average (mg/l)			0.01	0
DTP Annual Load (kg/yr)			1685	153
TSS Weighted Average (mg/l)			4.5	2
TSS Annual Load (kg/yr)			965,630	498,713
Lower North Fork of Provo River at Wildwood STORET 4996850				
Weighted Average Flow (cfs)	23	28	16	17
TP Weighted Average (mg/l)	0.01	0.01	0	0
TP Annual Load (kg/yr)	106	265	0	56
DTP Weighted Average (mg/l)	0	0	0	0
DTP Annual Load (kg/yr)	0	0	0	0
TSS Weighted Average (mg/l)	17	9	3.3	4
TSS Annual Load (kg/yr)	386,249	259,701	52,317	73,095

	2005	2006	2007	2008
Lower South Fork Provo River at Vivian Park STORET 4996830				
Weighted Average Flow (cfs)	20	24	14	18
TP Weighted Average (mg/l)	0.11	0	0	0
TP Annual Load (kg/yr)	1,821	0	0	0
DTP Weighted Average (mg/l)	0	0	0	0
DTP Annual Load (kg/yr)	0	0	0	0
TSS Weighted Average (mg/l)	5	5	2.6	3
TSS Annual Load (kg/yr)	93,578	113,090	32,493	30,397
Provo River at Murdock Diversion STORET 4996780				
Weighted Average Flow (cfs)	195	80	25	35
TP Weighted Average (mg/l)	0.02	0.02	0.01	0
TP Annual Load (kg/yr)	2,844	263	60	0
DTP Weighted Average (mg/l)	0	0.01	0	0
DTP Annual Load (kg/yr)	58	84	31	0
TSS Weighted Average (mg/l)	4	3	6.5	3
TSS Annual Load (kg/yr)	836,393	220,894	250,917	56,843
Provo River at Olmsted Diversion STORET 4996810				
Weighted Average Flow (cfs)	230	184	146	142
TP Weighted Average (mg/l)	0.12	0.03	0.01	0.01
TP Annual Load (kg/yr)	64,246	3977	727	826
DTP Weighted Average (mg/l)	0	0.01	0	0.03
DTP Annual Load (kg/yr)	327	1578	414	442
TSS Weighted Average (mg/l)	1	18	3	2
TSS Annual Load (kg/yr)	394,019	944,843	287,773	343,278

The lower Provo River below Deer Creek and the tributaries generally have good water quality. However, water released below Deer Creek Dam is high in dissolved phosphorus during the later summer and early spring .

Deer Creek Reservoir Trophic State

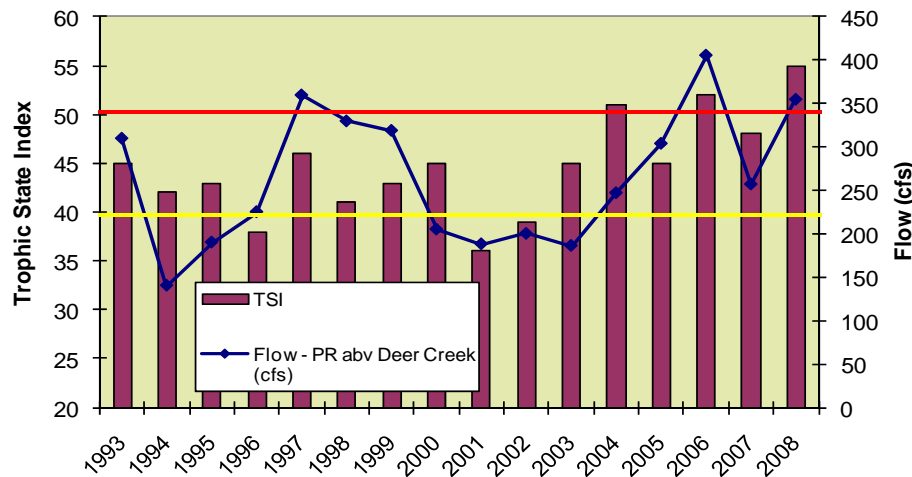
Year	Average TSI	Upper End		Midlake		Above Dam	
		Chlorophyll a	Secchi Disk Depth	Chlorophyll a	Secchi Disk Depth	Chlorophyll a	Secchi Disk Depth
May-07		3.40	3.70	3.00	3.80	4.30	3.00
Jun-07		9.30	2.20	2.90	4.40	3.15	3.60
Jul-07		7.20	1.60	5.40	2.20	5.00	2.50
Aug-07		17.00	0.90	8.20	2.00	9.10	1.80
Aug-07						7.20	2.00
Sep-07						6.30	3.30
2007	48	9.2	2.1	4.9	3.1	5.8	2.7
		51.6	48.0	48.9	44.2	48.9	45.6
Oct-07		17.50	0.80	9.30	1.70	8.10	1.60
May-08						14.10	1.70
Jun-08		6.00	3.50	5.30	4.40	4.20	3.60
Jul-08		5.30	1.90	4.10	5.70	3.50	5.00
Aug-08		17.90	0.60	30.90	1.70	9.90	1.90
Sep-08		281.70	0.90	108.40	0.90	15.80	2.80
2008	55.4	65.7	1.5	31.6	2.9	9.3	2.8
		71.7	53.8	64.5	44.8	52.4	45.3



For the past few years, in the Spring, there have been high levels of chlorophyll-a in Deer Creek Reservoir. These spring time algae bloom began in 2006. There are also typically large algal blooms in the autumn which correspond to reservoir stratification. See table to left.

Deer Creek TMDL Targets

Parameter	Meeting TMDL Yes or No
Dissolved Oxygen >50% Water Column with D.O. <4.0 mg/l Abv Dam (Aug & Sept) Midlake (Aug)	NO
Fish Habitat No Fish Kills	YES
In-lake Phosphorus Concentration 0.025 mg/l TP (All Depths)	YES
Average TSI 40-45	NO
Algae Biomass 5.1 µg/l Chlorophyll a	NO



The concept of trophic status is based on the fact that changes in nutrient levels (total phosphorus) causes changes in algal biomass (chlorophyll a) which in turn causes changes in reservoir clarity (Secchi disk transparency). A trophic state index is a convenient way to quantify this relationship.

A lake is usually classified as being in one of three possible classes: oligotrophic (TSI<40), mesotrophic (TSI between 40 & 50) or eutrophic

Deer Creek Loadings and TMDL

Phosphorus Loads to Deer Creek Reservoir	Met TMDL Targets in 2007?	Met TMDL Targets in 2008?
15,300 Kg/YR Total Phosphorus	YES	YES
9,700 Kg/YR Dissolved Total Phosphorus	YES	YES
560 Kg/Month TP August–October	NO	NO
350 Kg/Month Dissolved Total Phosphorus August–October	NO	YES

Tributary	TMDL Target Loads	2007 TP Load	2008 TP Load
Provo	11,136	2,121	3,029
Snake	2,308	252	435
Daniels	645	24	176
Main	1,210	439	682
<i>Total</i>	15,299	2,836	4,322

Monthly Phosphorus Loads to Deer Creek

Date	Total TP Load per Month	Total DTP Load per Month
Jul-07	438	342
Aug-07	580	444
Sep-07	717	496
Oct-07	460	298
Nov-07	268	268
Mar-08	428	272
Apr-08	825	281
May-08	1458	306
Jun-08	1347	314
Jul-08	900	334
Aug-08	679	312
Sep-08	417	276

Comments:

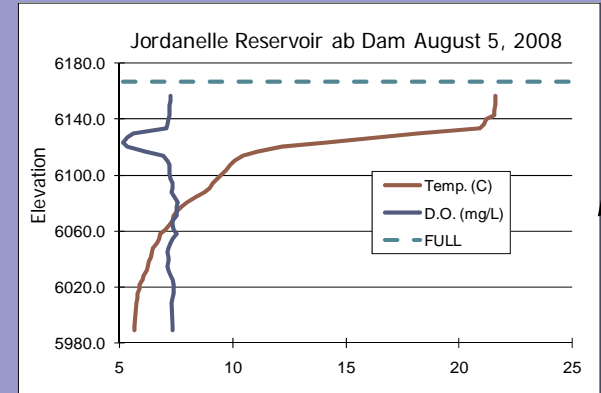
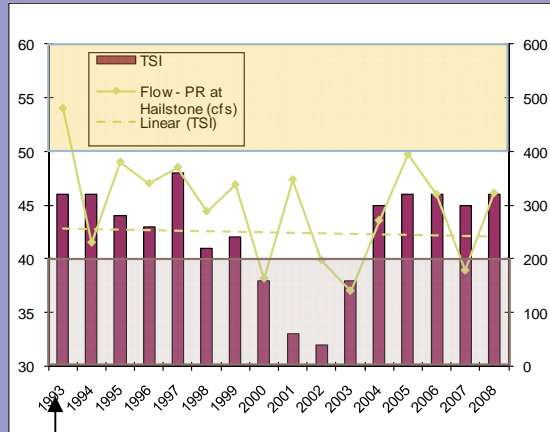
1. The Trophic State Index, an indicator of biological productivity, in Deer Creek has indicated eutrophic conditions three (3) out of the last five (5) years. This may be a product of the recent draining of Deer Creek for construction. With construction completed operation of the reservoir will return to normal. If there are average weather conditions the reservoir should level out at a mesotrophic state.
2. The trend in TSI over the last 15 years has been increasing. If this trend continues, even once the reservoir is operated under normal conditions, then a mitigation and restoration plan should be considered for the reservoir. Since nutrient loadings to the reservoir have been high during the August to October time frame the mitigation plan should focus on measures that can reduce the late summer and early fall nutrients. The question arises as to whether new suburban development is having a big impact on nutrient loadings.
3. High Temperatures (nearly 22 degrees C in summer) in a significant portion of the water column (down to 23-feet) combined with Low Dissolved Oxygen Concentrations have been a consistent reoccurring problem. This situation may lead to fish kills in the future since much of the water column is not favorable fish habitat.



Jordanelle Reservoir Trophic State

Jordanelle	North End		Provo Arm		Above Dam	
	Chlorophyll a	Secchi Disk Depth	Chlorophyll a	Secchi Disk Depth	Chlorophyll a	Secchi Disk Depth
Average	4.0	2.3	5.1	2.4	4.7	2.7
TSI	44	48	47	47	46	46

Jordanelle Res ab Dam		Chlorophyll a	Secchi Disk Depth	Phosphorus	Temperature
Date	Data				
5/7/2008	Average	7.9	1.7	0.03	4.6
	Max			0.22	6.9
	Min			0.00	3.8
10/18/2007	Average	3.7	4.2	0.00	8.9
	Max			0.00	11.6
	Min			0.00	5.3
6/3/2008	Average	9.0	1.8	0.00	7.0
	Max			0.00	11.6
	Min			0.00	4.4
7/8/2008	Average	1.6	3.7	0.00	9.2
	Max			0.00	20.3
	Min			0.00	5.2
8/5/2008	Average	3.5	2.3	0.00	10.6
	Max			0.00	21.6
	Min			0.00	5.3
9/2/2008	Average	2.4	2.5	0.00	10.9
	Max			0.00	18.1
	Min			0.00	5.2
Total Average		4.7	2.7	0.00	8.9
Total Max		9.0	4.2	0.22	21.6



Comments:

- Jordanelle is a rather healthy lake. Its Trophic State Index has been consistently around 45 (in the middle of the mesotrophic zone) for the past five years. This, even though the flows into the reservoir have been quite different over that five year period. See Figure above.
- Even though the Jordanelle Reservoir is healthy we still see algae blooms occurring in the late spring and early summer as indicated in the Trophic State Table. The algae bloom in May corresponded to high phosphorus levels at the surface of the reservoir.
- Surface temperatures in Jordanelle also rise during the summer months. Temperatures in both July and August of 2008 were above the State's Water Quality Standard.
- The profiles within the reservoir exhibit a strange phenomenon as shown in the figure above. In the area of the thermocline there is also an area where the dissolved oxygen is reduced. However, the D.O. rises in the lower portions of the water column.

Groundwater

USGS GROUNDWATER SAMPLING

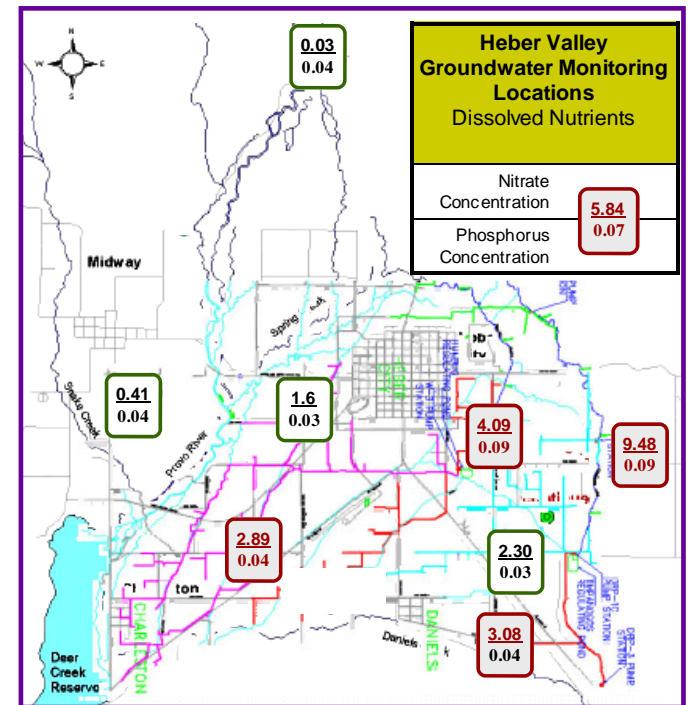
USGS Station Number	Depth (Feet)	Dissolved Nitrates (mg/l)								DTP (mg/l)				
		2001	2002	2003	2004	2005	2007	2008	Avg.	2004	2005	2007	2008	Avg.
403146111272701		1.16	1.31	1.48	-	2.32	1.74		1.60	-	0.02	<0.04		0.02
402842111263101		1.92	1.74	1.81	1.83	1.85	2.2	2.89	2.14	0.04	0.04	0.05	0.04	0.05
402937111214901	75	4.33	4.7	5.58	5.49	7.78	5.84	9.48	6.64	0.08	0.1	0.07	0.09	0.08
402946111233901	217	1.97	2.15	2.52	2.76	3.17	4.14	4.09	3.10	0.08	0.08	0.08	0.09	0.08
402842111223601		-	-	0.18	Discontinued				0.18	Discontinued				0.05
403003111255801		2.1	2.33	2.07	2.12	1.62	1.6	1.6	1.92	0.03	0.04	0.03	0.03	0.03
402904111225801		1.38	1.71	Discontinued				1.55	Discontinued				0.05	
403325111254601	140	-	-	<0.06	<0.06	<0.06	0.05*	0.03	N/A	<0.04	0.04	<0.04	0.04	<0.04
402840111232201		2.19	2.34	-	2.12	2.19	2.09	2.3	2.21	0.03	0.03	0.03*	0.03	0.03
402750111232701	150	0.62	0.64	0.67	0.65	0.84	3.67	3.08	1.41	<0.04	0.04	0.02*	<0.04	<0.04
403004111280301	105	-	-	0.45	0.41	1.2	0.6	0.41	0.61	<0.04	0.04	<0.04	<0.04	<0.04

Groundwater Sampling

The table to the left shows results of groundwater sampling at the locations shown in the map below. There have been increasing levels of dissolved nitrates in four of the wells (highlighted). Also, levels of dissolved phosphorus are high in three of those same wells (highlighted). These wells are concentrated in the south and southeast areas of the Heber Valley.

Comments

- The map to the right shows the location of the groundwater monitoring wells in the Heber Valley along with the Dissolved Nitrates and Dissolved Total Phosphorus concentrations. Higher concentrations of both nitrates and phosphorus are continuing to increase along the southeastern and south side of the valley. The reasons that these increases are occurring has not been identified. A study of the impacts that localized projects have had on the groundwater quality in the area should be conducted to determine the cause of the increasing concentrations.
- Because there has been a lowering of the groundwater level in the southern portion of the Heber Valley, the amount and quality of the groundwater entering Deer Creek Reservoir may have changed over the years. Groundwater loading estimates for Deer Creek Reservoir were developed over 30 years ago. These estimates were based on the limited groundwater sampling available at the time and may be quite inaccurate. The annual loading attributed to groundwater is over 2,700 kg/year. This loading estimate is a significant portion of the overall loading to the reservoir. A new study to better estimate the nutrient loading from groundwater should be considered in the future.



Pharmaceuticals and Metals



PHARMACEUTICAL SAMPLING

Date	Samples Taken	Sum of Hits	Pharmaceuticals Found
31-Mar-08	4	0	N/A
1-Jul-08	4	3	Diazepam
2-Sep-08	4	1	Ibuprofen

Comments

1. Pharmaceutical sampling along the Provo River was initiated in 2008. Samples were taken four times at four sites including River Road, Above Deer Creek Reservoir, Below Deer Creek Reservoir and Olmsted Diversion. In 2008 only two constituents were found in measurable quantities, Ibuprofen and diazepam.
2. Arsenic levels in Snake Creek remain high, however, they appear to be naturally occurring. At the Snake Creek monitoring station above the confluence with the Provo River arsenic was detected each time in which it was sampled. Additionally, these results were over the water quality standard of 10 mg/l.
3. Cadmium and Zinc in Big Dutch Pete Stream below the Mayflower mine above Jordanelle Reservoir are a concern. 50% of the time the cadmium standard is exceeded. The average concentration is also above the cadmium standard of 2 ug/l. Zinc concentrations exceeded the 3A aquatic wildlife standard of 120 ug/l all of the time. This is drainage from mines in the area and consistently flows three (3) to five (5) cfs throughout the year.

SNAKE CK AB CNFL/ PROVO R AT USBOR	
Standards Limit	10.0
Arsenic	
10/23/2007	17.9
2/27/2008	15.8
5/28/2008	13.6
8/27/2008	13.2
Average	15.1

Big Dutch Pete Stream bl Mayflower in Jordanelle State Park			
Standards Limit	2.0	13.0	120.0
	Cadmium	Copper	Zinc
10/23/2007	0.9	2.0	200.0
11/28/2007	0.9	1.8	164.0
4/29/2008	10.5	28.3	1250.0
5/28/2008	7.1	8.9	861.0
6/26/2008	5.4	3.3	629.0
7/29/2008	4.2	3.0	570.0
8/27/2008	2.7	2.1	474.0
9/25/2008	1.9	2.3	330.0
Average	4.2	6.5	559.8

Pharmaceutical	Units	2008 Average Concentration
Atenolol	ng/L	
Carbamazepine	ng/L	
Estrone	ng/L	
Estradiol	ng/L	
Ethinyl estradiol-17 alpha	ng/L	
Progesterone	ng/L	
Testosterone	ng/L	
Gemfibrozil	ng/L	
Ibuprofen	ng/L	2.5
Iopromide	ng/L	
Triclosan	ng/L	
Acetaminophen	ng/L	
Caffeine	ng/L	
Diazepam	ng/L	1.4
Fluoxetine	ng/L	
Sulfamethoxazole	ng/L	
Trimethoprim	ng/L	
Cotinine	ng/L	
Bis Phenol A (BPA)	ng/L	
Butalbital	ng/L	
Perfluoro octanesulfonate-PFOS	ng/L	
USGS4MOD -EDC-Phenols-waste parm screen		
2,6-di-tert-butylphenol	ng/L	
4-Methylphenol	ng/L	
4-Nonyl Phenol	ng/L	
Alpha Chlordane	ng/L	
BHT-d21 (70-130)	%	
Bis Phenol A (BPA)	ng/L	
Caffeine by GCMS LLE	ng/L	
Caffeine-C13	%	
Carbaryl	ng/L	
Chlorpyrifos	ng/L	
DEET	ng/L	
Diazinon	ng/L	
Dieldrin	ng/L	
Methyl Parathion	ng/L	
Phenol	ng/L	
TDCPP	ng/L	
Triclosan	ng/L	
Triphenylphosphate	ng/L	
Tris (2-butoxyethyl) phosphate	ng/L	
Tris (2-chloroethyl) phosphate	ng/L	

Summary

Problems, Conclusions & Recommendations Summary

STORET Number	Station Name	Problem	Exceedence Rate	Responsible Organization	Comments
Upper Provo River and Jordanelle Reservoir					
4997675	Big Dutch Pete Hollow below Mayflower in State Park	High Heavy Metals Concentrations	Cadmium – 50% Zinc – 100% Copper – 1 time	US Bureau of Reclamation	Standards for cadmium and zinc were exceeded 50% and 100% of the time. Copper exceeded once.
4929000	Kamas Fish Hatchery Effluent		TP - 60% DTP - 80%	State of Utah Division of Water Quality Division of Wildlife Resources	The Kamas Fish Hatchery has the potential to impact the Provo River System through return flow into the Weber Provo Canal. The Hatchery is currently exceeding the TMDL target of 173 kg/year of phosphorus.
4998130	Provo River at Hailstone	High Total Suspended Solids Concentrations and Loads	No Standard	Wasatch County & Summit County	Site visit to observe land disturbances. Possible source may be gravel pit. Also, look at loading from Weber Work with developers and agencies to correct problem.
Middle Provo River through Heber Valley					
5911120	County Flood Control Channel at Provo River	High Phosphorus Concentrations	TP – 50% DTP – 18%	Wasatch County	This monitoring station is difficult at best to estimate loads and to get accurate readings. This is due to the fact that it is a stormwater channel. The PRWC does not monitor stormwater events. This type of monitoring may be considered in the future for sites such as this.
4997250	Spring Creek at Entrance to Provo River	High Phosphorus Concentrations	TP – 95% DTP – 52%	Provo River Watershed Council Members	Average TP equals 0.07 mg/l. Average DTP equals 0.04 mg/l. Spring Creek is contributing 50% to 60% Total Phosphorus Load and 80% - 90% Dissolved Total Phosphorus Load to the Provo River system. Spring Creek is the major contributor of phosphorus and solids to the Provo River in the Heber Valley. PRWC is conducting additional monitoring to identify the source.
Deer Creek Reservoir & Tributaries					
5913460	Main Creek	High Phosphorus Concentrations	TP – 53% DTP – 32%	Wasatch County Conservation District Natural Resources Conservation Service	Average TP equals 0.04 mg/l. Max TP equal 0.08 mg/l. Main creek continues to exhibit high total phosphorus concentrations. Compared to Snake Creek, which has much higher flows, Main Creek's overall loading is higher.
		High Total Suspended Solids Concentrations and Loads	No Standard	Wasatch County Conservation District Natural Resources Conservation Service	Main Creek's total TSS load is 45% that of the Provo River's total TSS load. But, Main Creek's average flow is only 18 cfs compared to the Provo River's at 355 cfs. There is a large percentage of solids coming from the Main Creek watershed.
5910160	Snake Creek above Provo River	High Arsenic Concentrations	Arsenic - 100%	Wasatch County & Wasatch County Conservation District	Snake Creek's arsenic concentration exceeds the State's Water Quality Standard by 50% on average. About 70% of the world production of arsenic is used in timber treatment and approximately 22% in agricultural chemicals. An analysis should be completed to determine the source of the arsenic.
5913220	Deer Creek Reservoir	High Phosphorus Loads Aug – Oct	Up to 260% of Target	Water Districts and Provo River Water Users	Summer loadings from all inputs to Deer Creek exceed TMDL
		High Algae Biomass	More than 28 times		Chlorophyll a average equaled 65.7 µg/l for 2008 and 9.2 µg/l for 2007 at the upper end.
Groundwater					
402937111214901 402946111233901 402750111232701	Groundwater monitoring wells	High Dissolved Nitrates	N/A	Wasatch County Water Efficiency Project Central Utah Water Conservancy District	Higher concentrations of both nitrates and phosphorus are continuing to increase along the southeastern and south side of the valley. The reasons that these increases are occurring has not been identified. A study of the impacts that localized projects have had on the groundwater quality in the area should be conducted to determine the cause of the increasing concentrations.
		High Phosphorus Concentrations	N/A		