

**Utah Water Quality Task Force Meeting
Minutes**

August 25, 2014 9:00am-12:00am
Utah Division of Water Quality
195 N. 1950 W.
Salt Lake City, Utah

Attendance

Name	Representing
Jim Bowcutt	DEQ/DWQ
Gertrudys Adkins	Utah Division of Water Rights
Gordon Younker	UACD
Alan Saltzman	San Pitch Conservation District
Michelle Baker	USU
Carl Adams	DWQ
Rhonda Miller	USU Extension
Mike Luers	Snyderville Basin Water Reclamation District
Bill Zanotti	FFSL
Walt Baker	DEQ/DWQ
Erica Gaddis	DEQ/DWQ
Scott Daly	DEQ/DWQ
Kate Johnson	DEQ/DDW
Thayne Mickelson	UDAF
Jay Olsen	UDAF
Mike Larson	Sanpete Conservation District

Walt Baker- Welcome and Introductions

Alan Saltzman- Coordinated Resource Management Plan (CRMP)- San Pitch Watershed
(See attached presentation)

- The CRMP that is being developed in the San Pitch Watershed will address many resource concerns, not just water quality.
- The water quality issues that will be addressed in the plan include water quality, water quantity, irrigation efficiency, and reduction of TDS loading into the river.
- The entity that will be heading up the development of this plan is the local Conservation District.
- Snow College will be doing the research needed for the plan as well as the writing of the plan.

- \$50,000 was awarded to the Sanpete Conservation District to complete this CRMP. The grant needs to begin to be spent down within this fiscal year.
- One scoping meeting has already been held to discuss the CRMP, and another one is planned to take place in the next week or two.
- The County Commission has been heavily involved in the development of the plan.
- A watershed plan had been developed for the watershed back in 2004. They will refer to this during the development of the CRMP.
- The District hopes that having this plan in place will help entice other funding sources to put funding in the watershed as they implement the plan.
- The next scoping meeting will prioritize resource concerns and identify what they want to accomplish and where.
- Other agencies have expressed interest in the development of the plan and have become involved in the scoping meetings.
- When developing the plan they need to be careful not to make a plan that has so much information that it will be too hard to implement.
- They will make sure that the plan will meet the 9 elements required by EPA to be considered as an acceptable watershed plan.
- Source water protection will need to be addressed in the plan as well. The League of Cities and Towns should be involved in the development process.

Rhonda Miller- AFO/CAFO Producer Education (See Presentation)

- The purpose of the Extension AFO/CAFO program is to make producers aware of the rules and regulations, and what they need to do to comply with those regulations.
- To assist with this, USU Extension uses a producer's website, workshops, publications, and smart phone apps.
- The number of visitors to the website is increasing each month.
- There are 7 workshops scheduled to take place this winter.
- There are several publications available on the producers website to help inform local landowners of their responsibilities.

- A link to the producer's website should be available on the DWQ website.
- Critical Records of Animal Production (C.R.A.P.) is an app that allows landowners to use the app to track nutrient plan records and manure application.
- Lack of records is the most common violation for landowners.
- Currently the app has been downloaded around 400 times.
- This app was paid for using funding from the Division of Water Quality and USU.
- The cost of developing an app such as this is typically around \$10,000.

Mike Luers- Impacts of Pharmaceuticals on Water Quality (See Presentation)

- Recently a study was conducted in the East Canyon Creek Watershed near Jeremy Ranch on the impacts that pharmaceuticals / endocrine disrupting compounds (EDCs) are having on fish. The study mostly focused on the impacts to the Bonneville Cutthroat trout.
- One of the biggest water quality issues in the watershed is the dewatering of the stream. In 1988 the average flow was 16 CFS, and in 2003 it was only 1.8 CFS.
- There are many sources of EDCs, and they are measured in parts per trillion since it doesn't take a large concentration of EDCs to have an impact on organisms.
- EDCs are present in both human and animal waste.
- When a male fish is exposed to EDCs it can result in intersex fish, skewed sex ratios, and can ultimately result in a population collapse.
- Even with advanced tertiary treatment, pharmaceuticals are not removed from waste water effluent, and currently none of the plants are being required to remove it.
- Snyderville has begun to look at ways to breakdown the compounds, but it has proven to be very expensive.
- A study was done to expose fish to effluent. Their blood was sampled and evaluated to measure the concentrations of EDCs in their bodies. After 3 weeks effects were observed.
- Anti-depressants are also being found in these fish downstream from treatment plants.

- If a stream flow is maintained it can dilute the EDCs and reduce impacts to fisheries.
- The study that was conducted in the East Canyon Creek Watershed focused on a 10 mile reach of river. It does not appear as though the effluent has had a very bad impact on the fishery to date. Public health is not being compromised, but the public perception of pharmaceuticals in the water is very bad.
- The local entities are now looking at ways to keep minimum flows in the stream to be certain that the fishery will not crash.
- It would cost roughly \$10.1 million in plant upgrades to treat the effluent for pharmaceuticals.

Michelle Baker- The iUtah Project (See presentation)

- EPSCoR- This is a National Science Foundation program that helps states who receive lower than average funding for collaborative research and educational programs. Currently 23-24 states fall into this category.
- Utah became eligible in 2009, but will not be eligible in the future because of the grant award that they recently received.
- Utah is very large, diverse, and has a very concentrated population along the Wasatch Front.
- Utah received \$20 million to do a study to evaluate all the resources identified in the iUtah proposal.
- Large amounts of water quality data have been collected including precipitation measurements, and nutrient concentrations.
- Student projects are being funded to look at the nutrient uptake and sources of nutrients along the Wasatch Front.
- All of the data being collected can be found on the iUtah website.
- If any agencies or entities need additional research done they should contact USU and let them know.
- USU is also using data that is currently being collected by other agencies.
- Some of the sites that are currently being used for iUtah research will be adopted by other agencies when the study is complete.

- Some of the iUtah teams are looking at existing models and how they can be used together to obtain loading estimates around the state.
- The grant award was given to USU, and USU in turn works with other universities around the state to conduct the research.

Carl Adams- Future of Watershed Coordinators

- DWQ is planning to continue to fund watershed coordinator positions across the state, but one position (the Middle Sevier) will be cut at the end of the year due to budget constraints.
- There has historically been a high rate of turn over with local watershed coordinators.
- Originally when the funding for positions was initiated, it was intended that the positions be temporary, but now that we have moved to a targeted basin approach it is more effective to make these positions longer term.
- In order to keep coordinators on a longer term we need to come up with additional funding to make the positions more career oriented.
- DWQ is currently discussing the possibilities of bringing in additional funding from other partner agencies.

Other Business-

- A legislative audit was recently conducted for the Utah Conservation Commission and the Utah Department of Agriculture and Food that administers it. UDAF is currently in the process of making some changes suggested in the audit.
- The audit pointed out the importance of the Conservation Districts and UDAF is currently in the process of drafting a white paper asking the legislature for additional funding for the employees of the Conservation Districts that are involved in conservation planning around the state.
- The Annual UACD Convention will be held November 13th-14th in Layton. Contact Gordon Younker or Susan Jackson for more details.
- The latest Integrated Report (IR) / 303(d) list will be released within the month and submitted to EPA by October.
- Nutrient control strategy continues to move forward. This includes the ACES program, numerical standards for headwaters, and a technology based limit of 1 mg/L total phosphorus. Rules for the phosphorus limits in POTWs are expected to be on the books by mid-October.

- Division of Drinking Water has received a grant from the Division of Water Quality to develop a GIS based model looking at nitrate concentrations in wells, and how they are changing over time. They are currently focused on the Bothwell area, and working with Nancy Mesner at USU to gather additional data and information such as the nature of the wells. The results of the Bothwell study should be available in 6 more months. Additional funding was received from EPA to continue this study in other areas of the state.
- NPS Water Quality Awards will be awarded to one private citizen, one person from the professional sector, and one person that is an educator in October at the Water Quality Board meeting.
- The next Water Quality Task Force Meeting will be held on December 4th at the Division of Water Quality Building at 9:00.
- Meeting Adjourned

Sanpete Conservation District
Coordinated Resource Management
Plan
CRMP

Resource Concerns

- Water
- Fire
- Forest Management
- Weeds/Pests
- Pasture/Range/Grazing
- Wildlife/Fisheries
- Community Resource Education
- Transportation
- Soil Quality
- Energy
- Pollinators
- Planning and zoning
- Recycling
- Riparian improvement
- Nutrients Management
- Recreation
- Twelvemile Canyon Sediment
- Marketing of Agricultural Products
- Agricultural Land

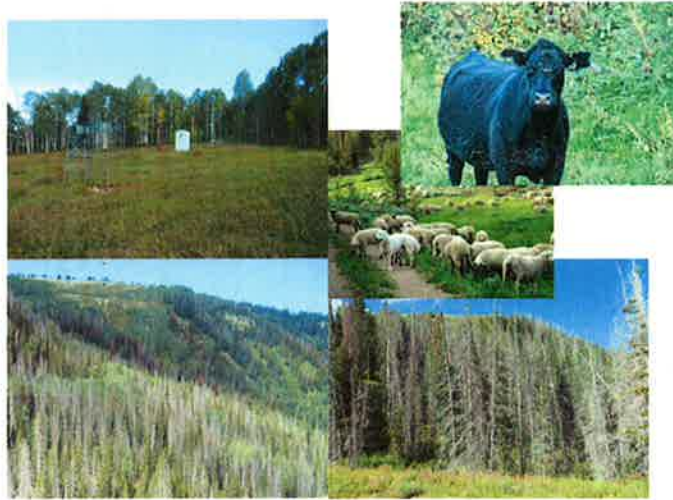
Water



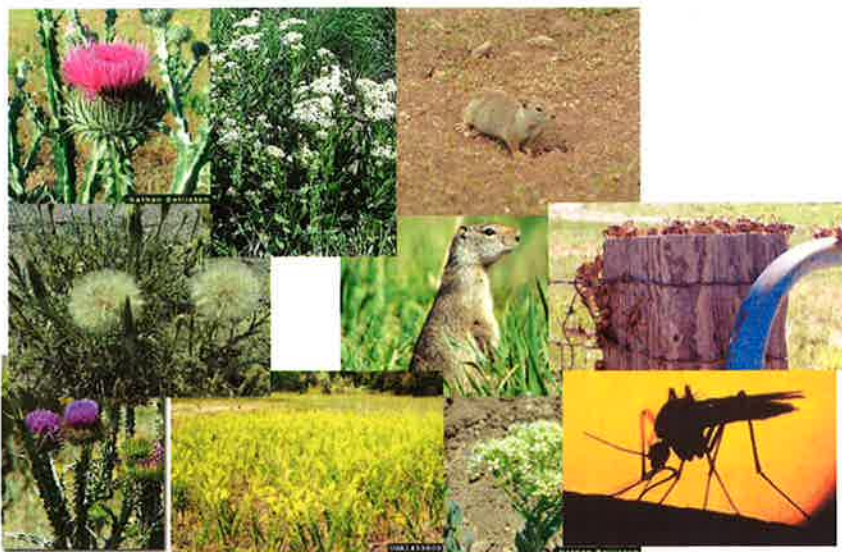
Fire



Forest Management



Weeds/Pests



Pasture/Range/Grazing



Wildlife/Fisheries



Community Resource Education



Transportation



Soil Quality



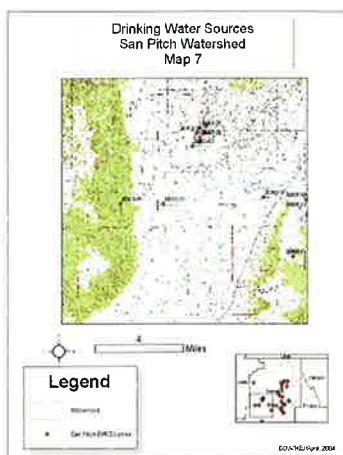
Energy



Pollinators



Planning and Zoning



Recycling



Riparian Improvement



Nutrients Management



Recreation



Twelvemile Canyon Sediment



Marketing of Agricultural Products



Agricultural Land



AFO/CAFO Outreach

Rhonda Miller, Ph.D., Utah State University

AFO/CAFO Outreach

- Producer Website
- Workshops
- Publications
- Apps

EXTENSION
UtahStateUniversity

USU Links >> USU Home A-Z Index calendars MyUSU directory contact

Extension Sites A-Z

Home Utah 4-H Food & Health Home & Family Gardening Ag Natural Resources Finance Business & Community

Ag Waste Management

Search
All Publications

Home
Rules and Regulations
Manure Management
Water Management
Air Quality
Permits
Best Management Practices (BMPs)
Additional Resources
Publications and Presentations
Contact Us

Ag Waste Management Producer's website

The purpose of this website is to help livestock producers with waste management issues and provide understandable information about the regulations. For more information, [Click](#) on the buttons below.

Regulations & Rules
Are you in compliance?

Manure Management
Learn about manure management practices

Water Management
Find solutions to water quality concerns

Air Quality
Learn how agriculture can improve air quality

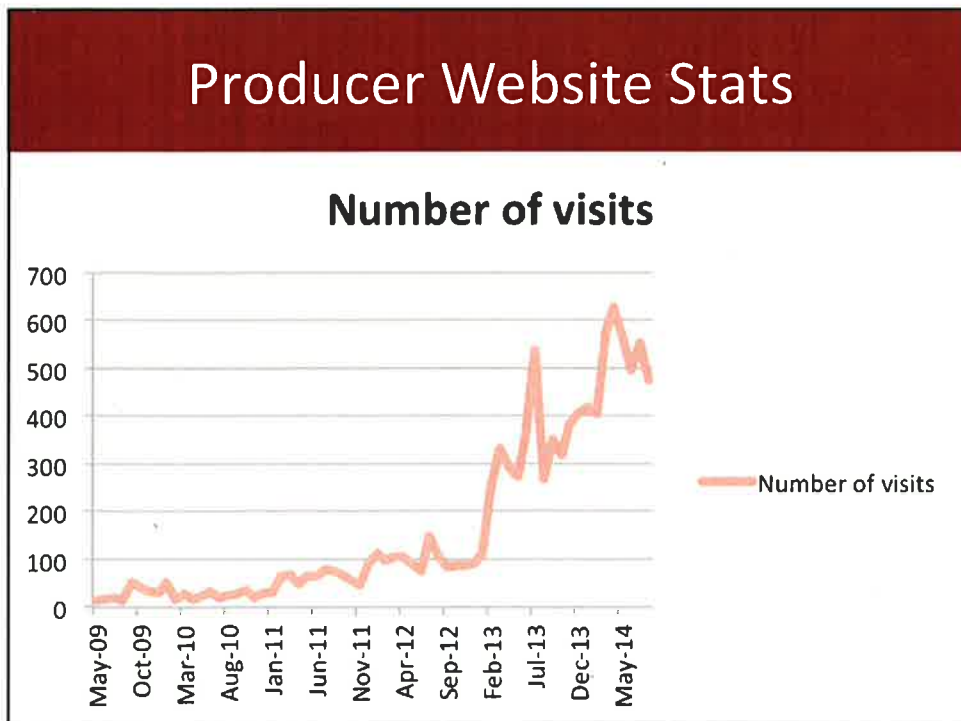
Permits
Find out if a permit is required for your operation

Recent News & Updates

Best Management Practices
Incorporated all the practices for environmental protection

Utah State University is an affirmative action/equal opportunity institution. © 2014 Utah State University

Producer Website Stats



Workshops

Seven workshops planned for this winter

- Logan
- Ogden
- Roosevelt
- Delta
- Ephraim
- Fillmore
- Beaver



Publications

- Utah Strategy – Phase II
- Nutrient Management Planning for Livestock Producers: A 10-Step Guide
- Factsheets



Critical Records of Animal Production (AKA – The C.R.A.P. App)



BACKGROUND:

Regulations require that most livestock producers account for, and document, their manure management.



Manure & Nutrient
Management Apps

Manure & Nutrient
Management Apps

PROBLEM:

- Even if no NMP, records needed to verify proper management in case of discharge.
- Lack of records most frequent violation.



Manure & Nutrient
Management Apps

PURPOSE:

- Simplify manure management record-keeping.



How does the C.R.A.P. App work?



The C.R.A.P. App

Highlights

Main Screen:

- Applications
- Incorporations
- Transfers
- Inspections

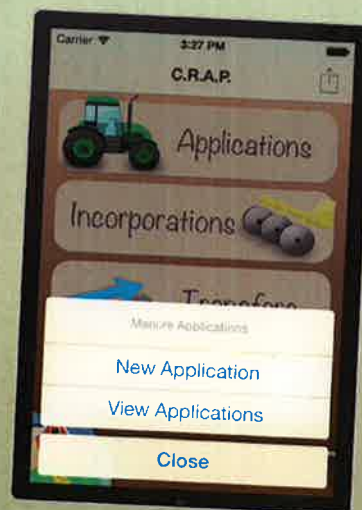


The C.R.A.P. App

Highlights

Applications:

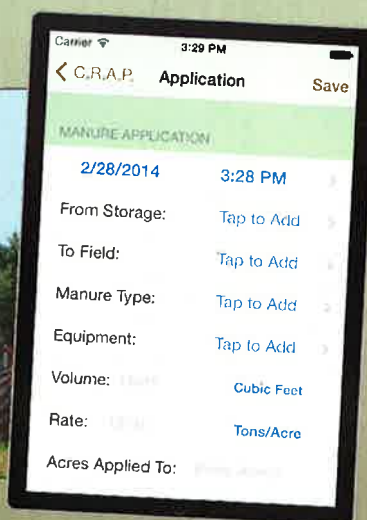
- New Application
- View Previous Applications

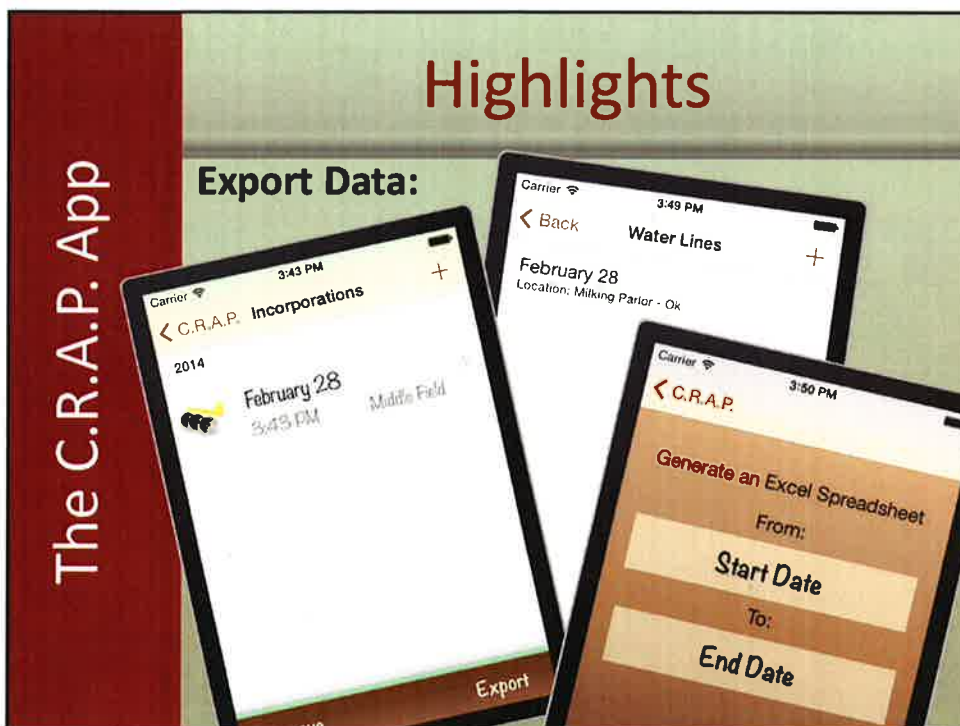


The C.R.A.P. App

Highlights

Applications:





CROP App

Crop History, Yields

Fertilizer
Applications

Pesticide
Applications

Irrigation



Questions?



Are Downstream Fish Under the Influence of Drugs?

Utah Water Quality Task Force Meeting

August 25, 2014

Michael Luers
mluers@sbwrdd.org

7/29/2014 2:07

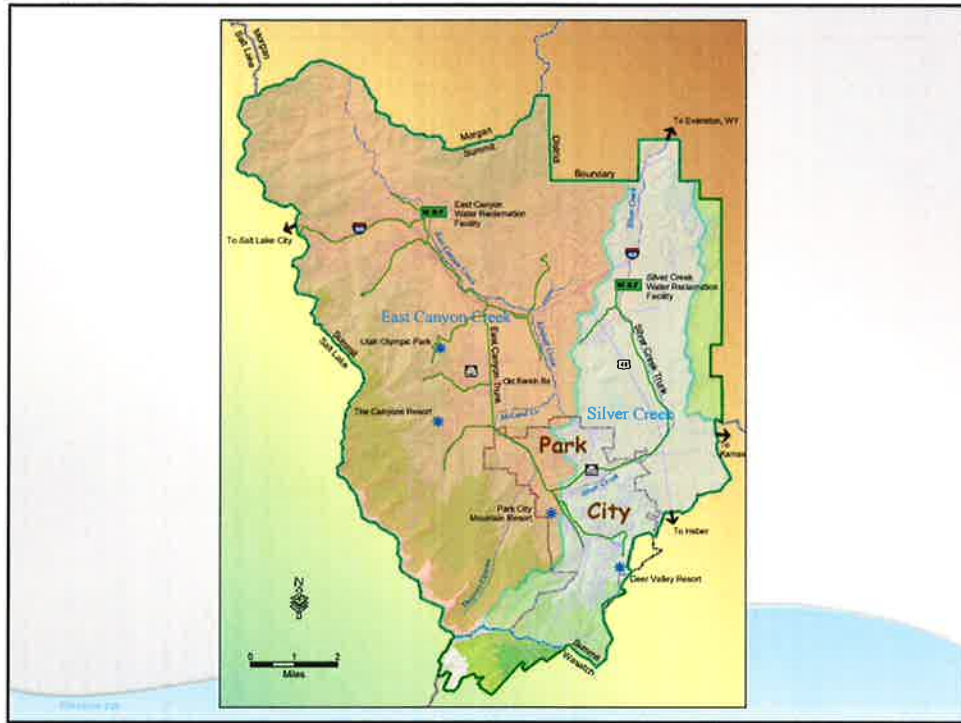


7/29/2014 2:07



Presentation Summary

- ◆ Introduction to Endocrine Disrupting Compounds (EDCs)
- ◆ Case Study – Impact of EDC's on East Canyon Creek



East Canyon Creek Provides Habitat for Sensitive Trout Species



Brown Trout
(*Salmo trutta*)



Bonneville Cutthroat
(*Oncorhynchus clarki*)



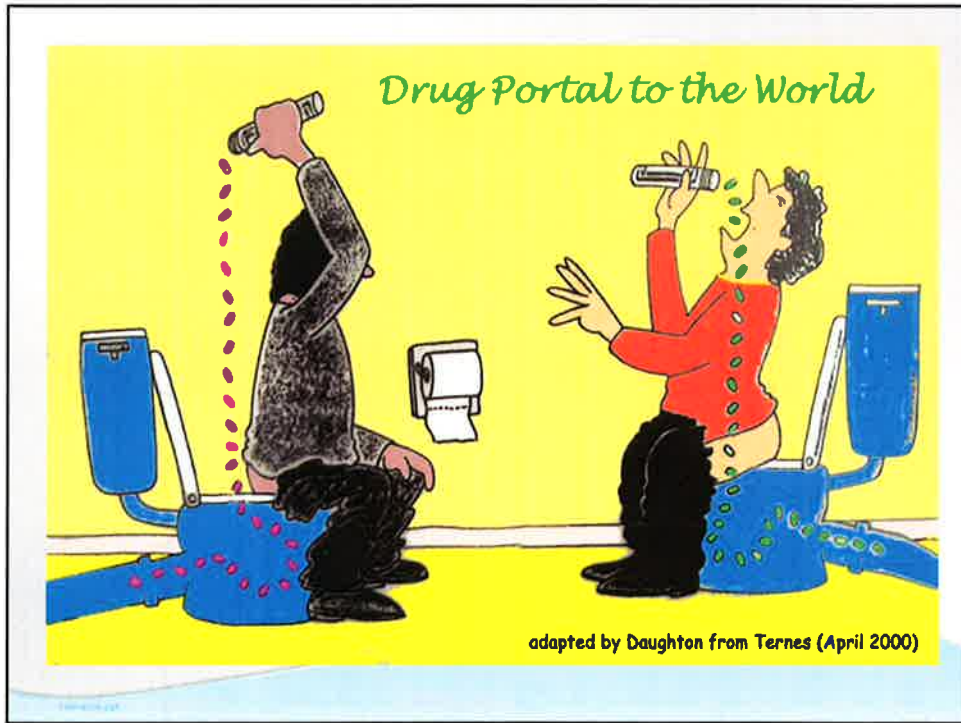
Major Issue Facing the District: Low Stream Flows



Historical Stream Flows

East Canyon Creek

<u>Year</u>	<u>7Q10</u>
1988	16.0 cfs
1993	3.5 cfs
2003	1.8 cfs



Potential Sources of Endocrine Disrupting Compounds (EDCs)

Natural Hormones

Pharmaceuticals and
Personal Care Products

Pesticides

Detergents

Industrial Compounds

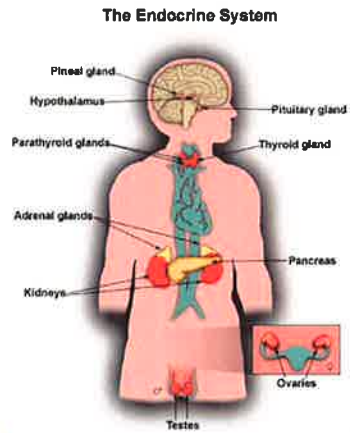
(Natural and synthetic estrogen based hormones
are of greatest concern in our situation)



What Is The Endocrine System?

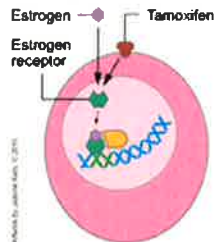
The Endocrine System: System of glands each of which secrete a type of hormone

Compounds that block, mimic, stimulate or inhibit the endocrine system – Endocrine Disrupting Compounds (EDCs)



Estrogen Receptors

Estrogen target cell
(e.g., breast, uterine lining, liver, etc.)



Non-target cell
(contains no estrogen receptor)



Detection of EDCs Possible by Advances in Analytical Methods



Liquid Chromatography/Mass Spectrometer

Public Perception of EDCs in Water is a Growing Concern

AP: Drugs found in drinking water
By Jeff Davis, Martha Mendez and Justin Pritchard, Associated Press

A vast array of pharmaceuticals — including antibiotics, pain relievers, blood thinners and sex hormones — have been found in the drinking water supplies of at least 17 states, according to an Associated Press investigation shows.

To be sure, the concentrations of these pharmaceuticals are tiny, measured in a number of parts per billion or trillion, far below the levels of a medical dose. They remain in the water to date.

Senators rip EPA over lack of knowledge on drugs in water
By JEFFREY HINDS — 17 hours ago

WASHINGTON (AP) — The Environmental Protection Agency was lambasted during a Senate hearing Tuesday for allowing the American public to learn that traces of pharmaceuticals are in much of the nation's drinking water from an Associated Press investigation across the country.

Intersex Fish Raises Pollution Concerns in US

[Mail this story to a friend](#) | [Printer friendly version](#)

U.S. | September 8, 2006

TODAY'S ENVIRONMENT NEWS

AUSTRALIA:
Takes Election As
Bitter Aesop's Fable Test



Natural and Synthetic Hormones Thought to be the EDCs of Greatest Concern

Microconstituent	Type/Purpose
Acetaminophen	Pain Relief
Caffeine	Stimulant
Carbamazepine	Anti-Epileptic
Cotinine	Stimulant
Diazepam	Anti-Anxiety
Estrone	Natural Hormone
Estradiol	Natural Hormone
Ethinyl Estradiol - 17 α	Synthetic Hormone
Fluoxetine	Anti-Depressant
Progesterone	Natural Hormone
Sulfamethoxazole	Antibiotic
Testosterone	Natural Hormone
Trimethoprim	Antibiotic
Triclosan	Anti-Microbial

Sources of Estrogens

- ◆ **Mature woman**
 - 4.8 μg estriol
 - 3.5 μg estradiol
 - 8.0 μg estrone
- ◆ **Post Menopause Woman**
 - 7 $\mu\text{g}/\text{day}$ (all 3)
- ◆ **Men**
 - 7 $\mu\text{g}/\text{day}$ (all 3)
- ◆ **Pregnant Woman**
 - 6,000 μg estriol
 - 600 μg estrone
 - 259 μg estradiol
- ◆ **Synthetic Hormones**
 - 26% of ethyl estradiol in birth control pills is excreted
- ◆ **Hormone & estrogen replacement therapy**
 - 65% estradiol excreted
 - 15% estrone excreted

Current Literature Describes Potential Effects of EDC Exposure for Male Fish

Estrogenicity (feminization)

G
R
E
A
T
E
R

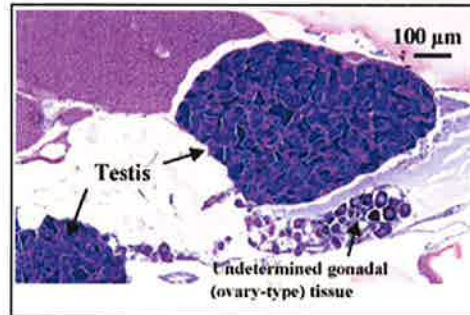
I
M
P
A
C
T

Vitellogenin induction in male fish

Intersex fish

Skewed sex ratios

Population collapse



(Nash et al, 2004)

Concentrations of Estrogens that begin to affect Male Fish

Inducement of vitellogenin production

- ≈ 5 ng/L 17β -estradiol
- estriol is 30 times less potent than above
- ≈ 3.2 ng/L for estrone
- ≥ 1 ng/L for 17α -ethinyl estradiol

Inducement of intersex

- ≈ 10 ng/L for estrone, or 17β -estradiol
- estriol is 100 times less potent than above
- ≈ 4 ng/L for 17α -ethinyl estradiol
- estrogenic substances are additive



White
sucker



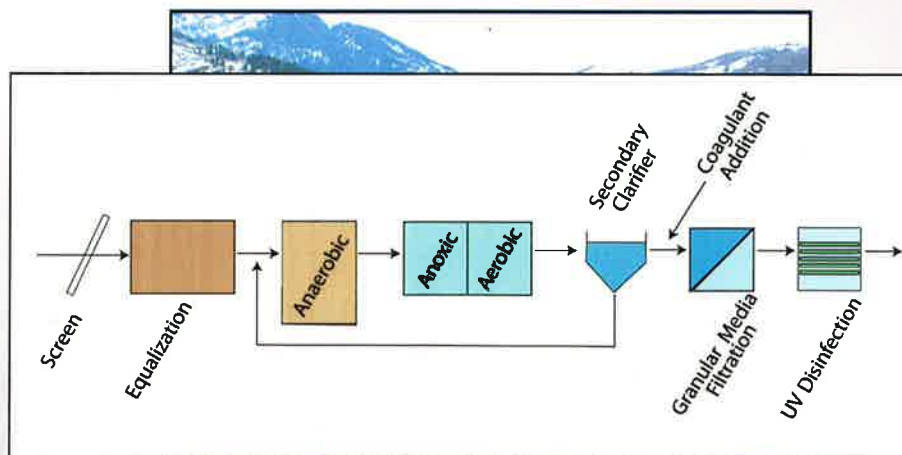
Boulder Creek

Estrogenicity and the Environment

“The occurrence of feminized fish is associated with effluent discharges ... the incidence and severity is positively correlated with the proportion of treated sewage effluent in receiving waters.”

This is the situation in the Park City area!!

Despite advanced treatment, EDC detected in the effluent to East Canyon Creek



Vitellogenin (Vtg) is a Biomarker of Estrogen Exposure in Male Fish



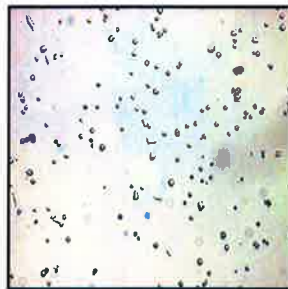
Egg yolk protein

Vtg not normally found in male fish

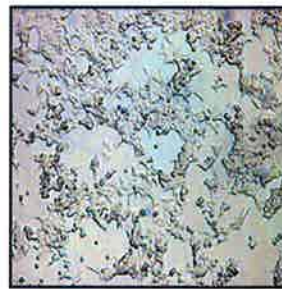
Vtg detected after exposures less than 1.0 ng/L (ppt)

Estrogen activity measured by E-screen bioassay

Breast cancer cell line with growth response to estrogen



Negative Control



Positive Control

Reported as estradiol equivalents
(MRL = 0.030 ppt)

Summary of Effluent Test Results

Constituent	Samples	Detection Frequency	AVG (ng/L)	MRL (ng/L)
E-Screen Bioassay	18	100%	0.69	0.03
Cotinine	15	100%	29	1.0
Sulfamethoxazole	24	100%	846	1.0
Gemfibrozil	19	95%	85	1.0
Trimethoprim	22	95%	73	1.0
Carbamazepine	34	94%	81	5.0
Triclosan	20	90%	36	5.0
Ibuprofen	19	89%	29	1.0
Caffeine	24	88%	23	3.0
Fluoxetine	24	88%	50	1.0
Diazepam	17	47%	87	1.0
Ethinyl Estradiol- 17 α -	34	29%	6.6	1.0
Estrone	34	26%	47	1.0
Estradiol	34	18%	1.6	1.0
Acetaminophen	24	13%	2.9	1.0
Iopromide	20	n/a	12 ¹	5.0
Testosterone	28	n/a	1.2 ¹	1.0

¹Result shown is a single detection (not an average)

Ozone Oxidation Recommended as Treatment Technology of Choice

GAC Filtration



Ozone/Peroxide



UV/Peroxide



NF/RO not considered due to cost and concentrate disposal constraints

Recent Efforts to Identify Impacts of EDCs on Downstream Trout



Sex Ratio Investigation



Sentinel Study

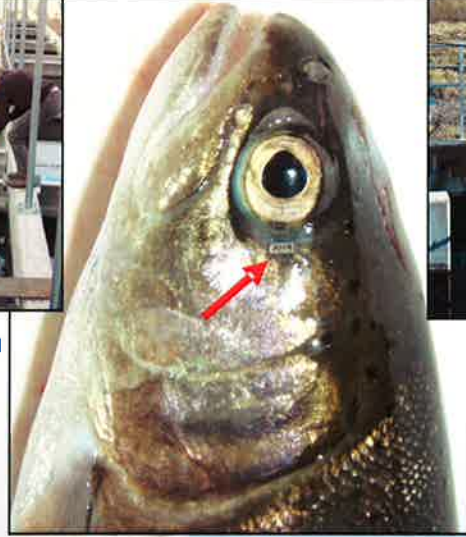
Study Objectives

- **Sentinel Study** conducted to determine if EDC concentrations in treated wastewater (effluent) are high enough to induce vitellogenesis in sentinel (caged) fish?
- **Sex Ratio Study** conducted to determine if there is a sex ratio problem (males vs. females) downstream? – worse case scenario!
- **Are EDCs accumulating in the tissues of downstream fish?**

Sentinel Study Methods



**Holding pen
at fish
hatchery**



**Holding pen
in effluent
aeration
basin**

Sentinel Study Methods



Blood Sample (0.5mL) Collected From Each Fish

Sentinel Study Results (Rainbow Trout)

	Control		ECWRF	
	Baseline	3 weeks	Baseline	3 weeks
Vitellogenin (ng/ml)	0.343 ± 0.09	0.110 ± 0.03	0.136 ± 0.05	
Total length (mm)	255.2 ± 3.6	265.6 ± 3.9	250.0 ± 4.9	263.9 ± 5.3
Total weight (g)	188.3 ± 8.0	207.9 ± 9.8	181.4 ± 9.6	216.6 ± 11.8
GSI		0.21 ± 0.07		0.19 ± 0.06

Sentinel Study Results (Rainbow Trout)

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Total weight (g)	188.3 ± 8.0	207.9 ± 9.8	181.4 ± 9.6	216.6 ± 11.8
GSI		0.21 ± 0.07		0.19 ± 0.06

Sex Ratio Investigation Methods

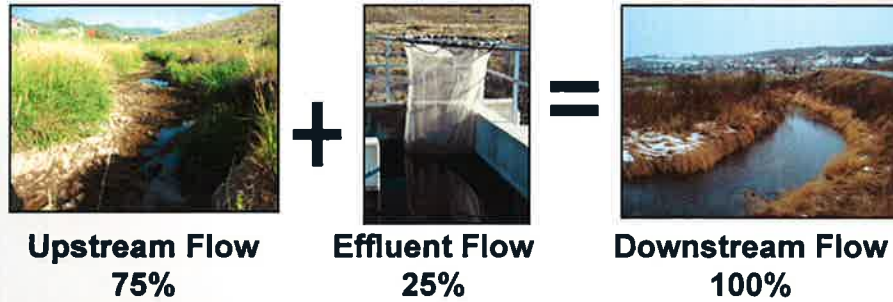


Gender Determination: Palpitation or Necropsy

Excess Number of Female Fish Not Seen in the Downstream Population

Description	Number	Percentage
Total Fish Captured	71	
Male Fish	33	46.5%
Female Fish	38	53.5%

4:1 Dilution of Effluent in East Canyon During Sex Ratio Study



Future Research: Sample Vitellogenin During Periods of Low Stream Flow

Pharmaceuticals Found in Sentinel and Stream Fish Tissues*

Common Name	Pharmaceutical Name	Fillet Downstream	Liver Downstream	Sentinel Fillet	Sentinel Liver
Caffeine	Caffeine		1.2		2.4
Benadryl	Diphenhydramine	0.295	2.85	0.187	6.77
Hypertension	Propranolol		0.90		1.2
Blood pressure control	Diltiazem		0.205	0.03	0.46
Tegretol	Carbamazepine			0.49	1.0
Antidepressant	Paroxetine			0.66	8.8
Prozac (metabolite)	Norfluoxetine		20.0		81.7
Prozac	Fluoxetine		18.5		61.0
Zoloft (metabolite)	Desmethylsertraline		140.0	10.2	533.3
Zoloft	Sertraline				92.0
Valium	Diazepam			2.6	9.0
Cholesterol control	Gemfibrozil				22.3

*Results are presented as an average of all positive test results, results in units of nanograms/gram

Summary and Conclusions:

- EDCs detected at low concentrations in tertiary treated wastewater
- Effluent (100%) EDCs concentrations are high enough to induce vitellogenesis in Rainbow Trout
- Concentration of EDCs don't appear to have altered the sex ratio of downstream Brown Trout (4:1, stream flow/effluent ratio)
- Stream flow can attenuate the EDC problem

Developing an Understanding of Spatio-temporal Bioaccumulation of Pharmaceuticals by Aquatic Life in East Canyon Creek, Utah

Study Objectives

The *overarching objective* of this research is to determine if effluent from the East Canyon Water Reclamation Facility is causing or has the potential to cause permanent or long term negative impacts to native fish populations and aquatic life.

Specific Objectives:

1. To determine the seasonal and longitudinal levels of targeted CECs in East Canyon Creek;
2. To determine the accumulation and trophic transfer of CECs in East Canyon Creek; and
3. To determine and predict impacts and risks of CEC exposure to trout residing in East Canyon Creek.

Questions?



For more info visit: <http://www.sbwrtd.org>

Sex Ratio Investigation Results

- **Altered Sex Ratio Not Seen in Brown Trout**
38 Female (54%) to 33 Male (46%)
- **Vtg Not Detected in Male Brown Trout (4 to 1 ratio stream flow/effluent)**

Given the Potential Impact to Fish SBWRD has Implemented Steps for Source Control of EDCs

- **Established unused medication take back programs with local law enforcement and Recycle Utah**
- **Working to establish a minimum base stream flow**
- **Identified all health care facilities and met with hospital officials to review disposal practices**
- **Continue with research during low stream flow periods of the year**

Recent Federal Activities:

Endocrine-Disrupting Chemicals Exposure Elimination Act of 2011 (S. 1361) (H.R. 2521) on July 13, 2011 to facilitate cooperation between the National Institute of Environmental Health Sciences and EPA, and other regulatory agencies to reduce exposure to chemicals identified as endocrine disruptors.

Pharmaceuticals Found in Both Sentinel and Downstream Fish Tissues

Analyte	Brand Name	Downstream		Sentinel	
		Fillet	Liver	Fillet	Liver
Diphenhydramine	Benadryl	2.8		0.1	
Diltiazem	Cardizem, Dilacor		0.3		0.3
Carbamazepine	Tegretol			0.6	1.1
Paroxetine	Paxil				6.4
Norfluoxetine	Prozac (metabolite)		25		69
Fluoxetine	Prozac		19		48
Desmethylsertraline	Zoloft (metabolite)		140	12	540
Sertraline	Zoloft				75
Diazepam	Valium				9.8
Gemfibrozil	Lopid				10.6

Results in units of nanograms/gram



Science for Utah's Water Future

EPSCoR



**Experimental Program
to Stimulate
Competitive Research**



State oversight,
alignment, investment

Research and
economic
development



Multidisciplinary and
multi-institutional

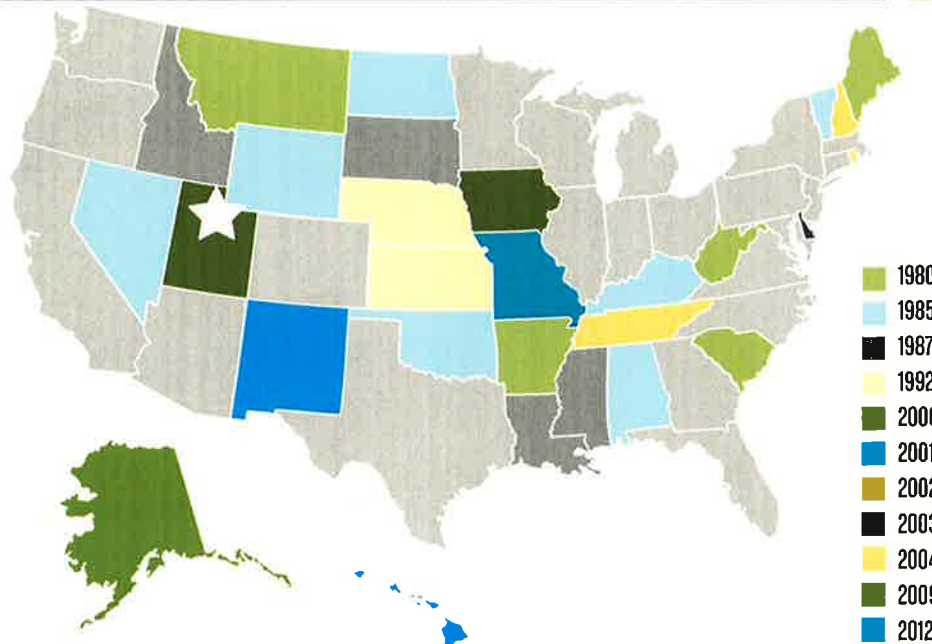
NSF EPSCoR



- Est. 1978
- States with less NSF funding
- Close interaction with NSF

- Sustainable capacity
- Human and physical infrastructure

Utah eligible for NSF EPSCoR in 2009



EPSCoR's role in Utah



Build statewide
research capacity

Strengthen STEM
workforce

Enhance economic
competitiveness
and sustainability

Utah's Science & Technology strengths



Water
Research

Atmospheric
Sciences

Earth Science

Ecology

Range &
Forest Science

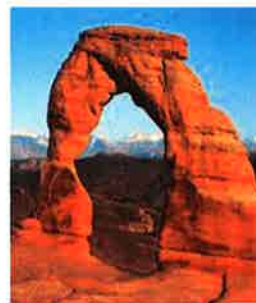
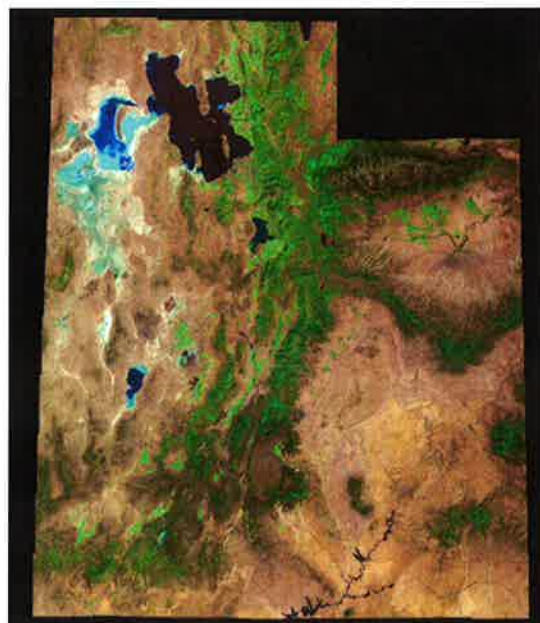
Animal Health
& Sustainability

Source: Utah S&T plan 2012

Utah's Economic strengths



Utah's geography: vast and diverse

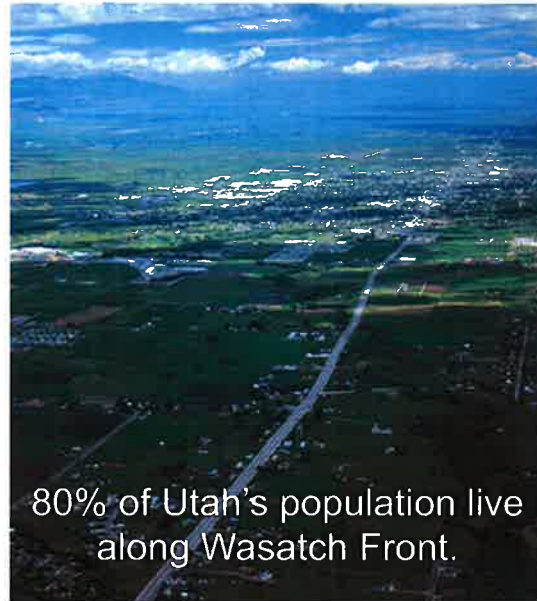


13th-largest state

270 miles x 350 miles

Sparse population density

Population is concentrated in urban corridor



80% of Utah's population live along Wasatch Front.

Population: Young and homogenous

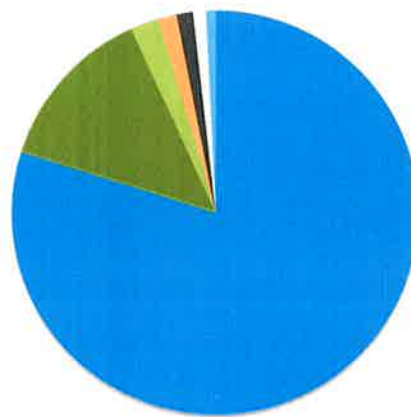
2.86M people

28.8 average age

youngest in nation

8 years younger than national average

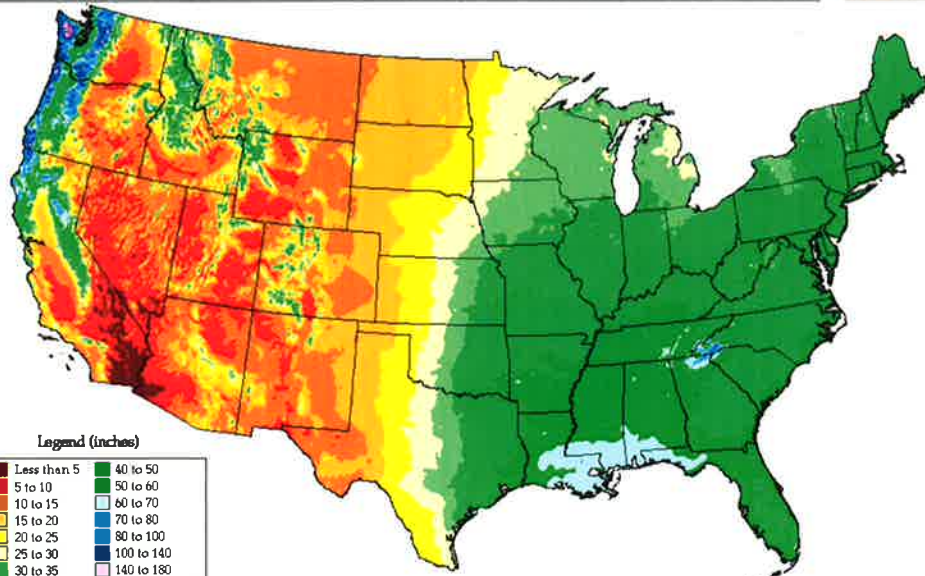
Highest fertility rate in U.S.



- White, non-Hispanic
- Hispanic or Latino
- Asian
- American Indian, Alaska Native
- African American
- Native Hawaiian, Pacific Islander

Source: 2010 US Census

We live in a desert



Legend (inches)

Less than 5	40 to 50
5 to 10	50 to 60
10 to 15	60 to 70
15 to 20	70 to 80
20 to 25	80 to 100
25 to 30	100 to 140
30 to 35	140 to 180
35 to 40	More than 180

Period: 1961-1990
Copyright 2000 by Spatial Climate Analysis
Service, Oregon State University

Utah's water depends on snow



Most of our precipitation currently occurs as snow

Snowmelt fills the reservoirs for use the rest of year



Utah: In a nutshell



Growing

Limited water

Changing climate

Decreasing snowmelt

Decreasing water quality

What we need



Climate models

- Downscaled
- Predict precipitation

Water models

- Snowmelt to surface
- Quality and quantity

Understanding

- Urbanization
- Water decisions
- Water quality policies

How can EPSCoR help?

iUTAH: Exploring how population growth, changing climate, and urbanization affect water sustainability

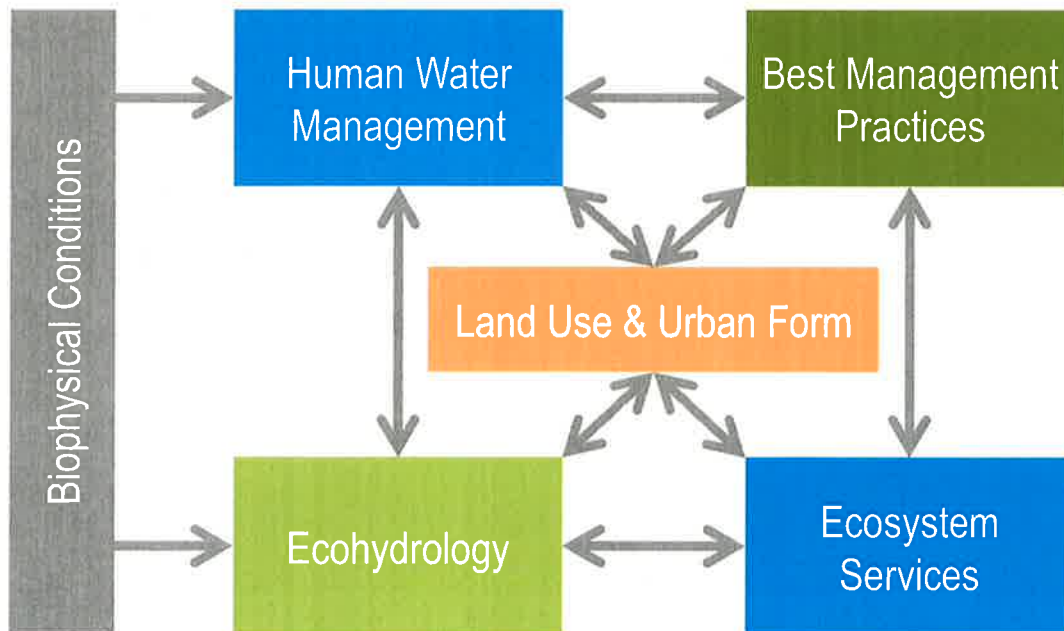


**innovative Urban Transitions and
Arid-region Hydro-sustainability**

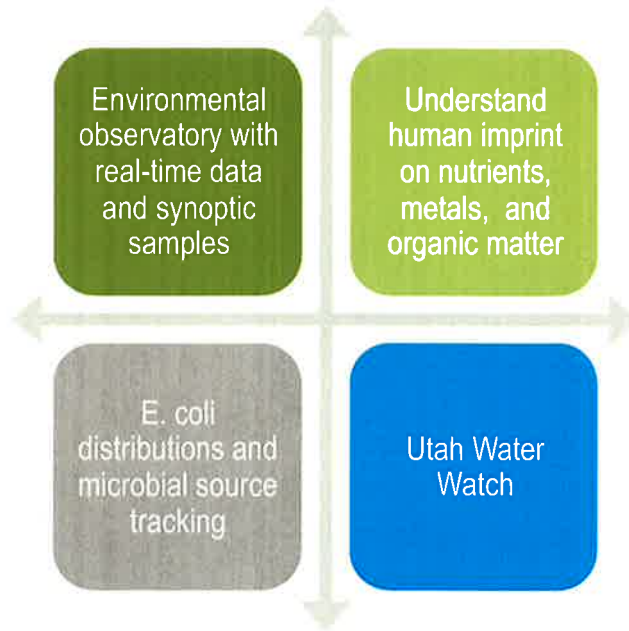
Awarded August 1, 2012

\$20M multi-university effort to boost statewide research infrastructure to understand impacts on Utah's water resources

Guiding Framework



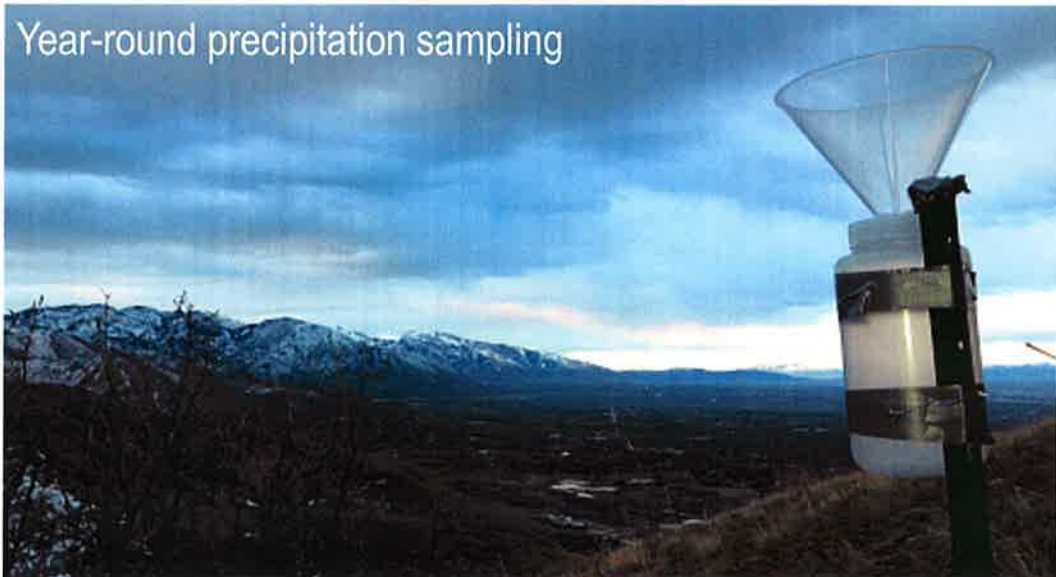
Water Quality Research in iUTAH



Water Quality Research in iUTAH



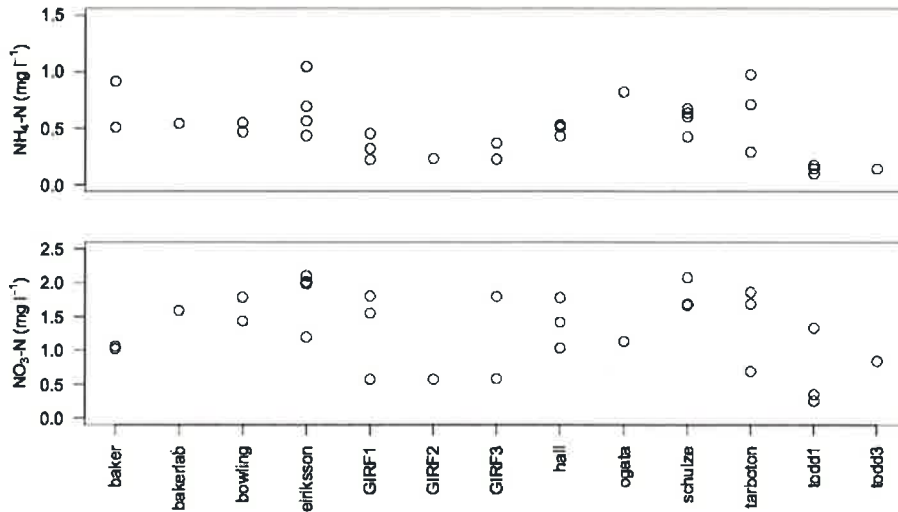
Year-round precipitation sampling



Water Quality Research in iUTAH

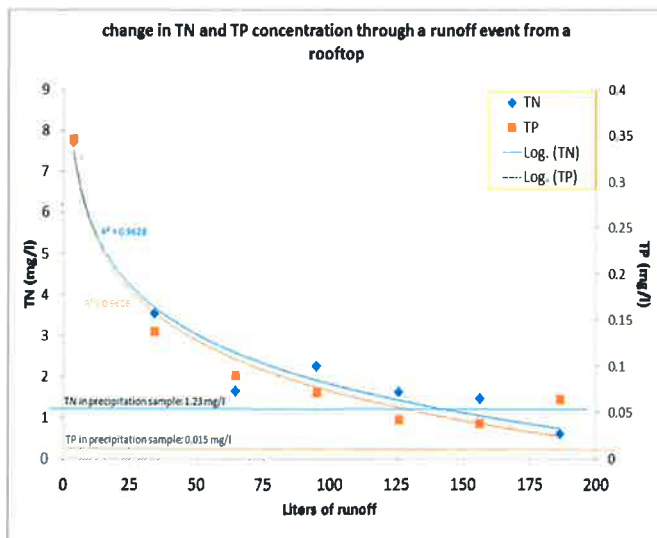


Inorganic N concentrations in snow, winter 2014



Steven Hall et al. unpublished

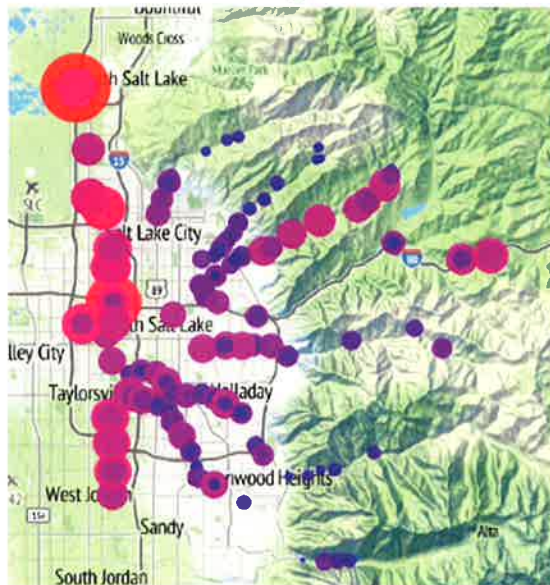
Water Quality Research in iUTAH



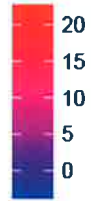
- N and P concentrations are initially high on urban surfaces

Dasch Houdeshelet al. unpublished

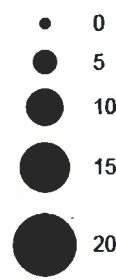
Water Quality Research in iUTAH



$\delta^{15}\text{N}$ (‰)



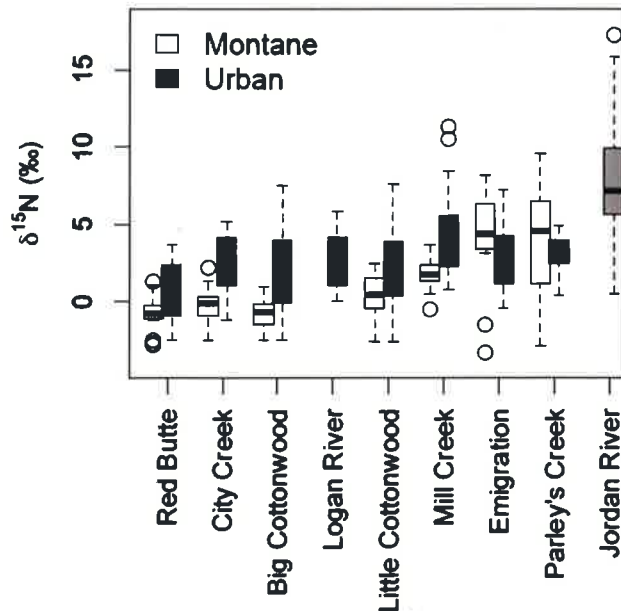
$\delta^{15}\text{N}$ (‰)



Steven Hall et al. unpublished

- ^{15}N in riparian plants
- Enriched in valley reaches and those with access to dogs

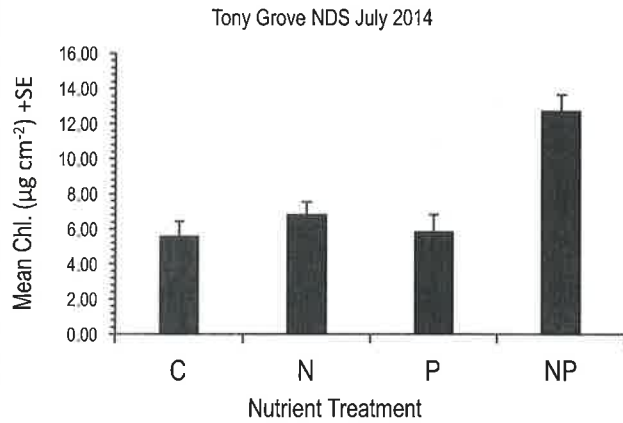
Water Quality Research in iUTAH



Steven Hall et al. unpublished

- ^{15}N in riparian plants
- Enriched in most urban reaches compared to mountain reaches

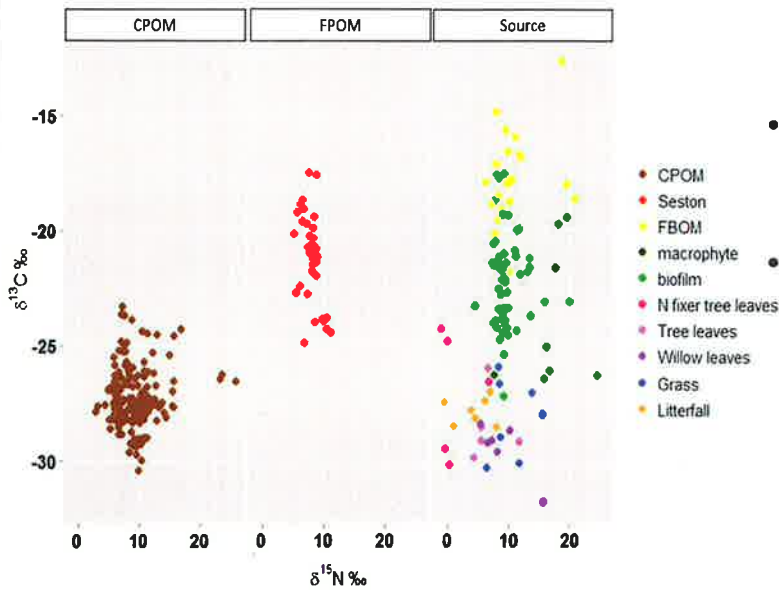
Water Quality Research in iUTAH



- Nutrient limitation of benthic algae along mountain-urban gradients
- Can we estimate nutrient saturation concentrations

Beth Ogata et al. unpublished

Water Quality Research in iUTAH



- Sourcing organic matter using isotopes
- In Jordan river CPOM and FPOM have different sources

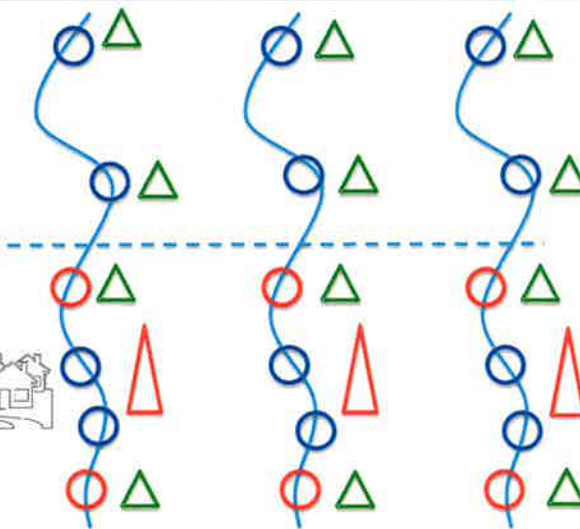
Julie Kelso et al. unpublished

GAMUT: Utah's Environmental Observatory



2500+ m

Mountain-to-Valley transition



- Fundamental aquatic sensors, *in situ*
- Fundamental aquatic sensors, relocatable
- Enhanced aquatic sensors, *in situ*
- Fundamental terrestrial sensors
- Urban tower and sensors

GAMUT: Utah's Environmental Observatory



Table 1. Parameters to be measured by the iUTAH GAMUT.

	Fundamental Suite	Enhanced/Urban Suite
Terrestrial Sensors	Barometric pressure Wind speed and direction Air temperature Relative humidity Precipitation Snow depth Soil temperature, moisture, conductivity Solar radiation (net radiation and PAR)	Barometric pressure Wind speed and direction Air temperature Relative humidity Precipitation Soil temperature, moisture, conductivity Solar radiation (net radiation and PAR) CO ₂ and H ₂ O
Aquatic Sensors	Stream stage Temperature Electrical Conductivity pH Dissolved oxygen Turbidity	Stream stage Temperature Electrical Conductivity pH Dissolved oxygen Turbidity Total algae (chlorophyll a + phycocyanin) fDOM Nitrate

GAMUT: Utah's Environmental Observatory



<http://gamut.iutahepscor.org>



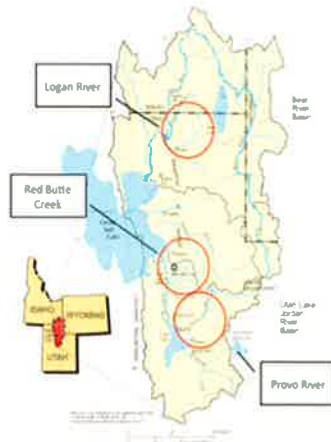
Modeling and Data Federation

innovative Urban Transitions and Aridregion Hydro-sustainability

[Home](#) [Development](#) [Data](#) [About](#)

The GAMUT Network

Gradients Along Mountain to Urban Transitions



GAMUT Background

iUTAH researchers have developed and deployed an ecohydrologic observatory to study water in 'Gradients Along Mountain to Urban Transitions' (GAMUT). The GAMUT Network measures aspects of climate, hydrology, and water quality along a mountain-to-urban gradient in three watersheds that share common water sources (winter-derived precipitation) but differ in the human and biophysical nature of land-use transitions. Designing GAMUT was a 12-month process involving faculty and technicians from across Utah's research-intensive institutions: Brigham Young University, the University of Utah, and Utah State University.

GAMUT Watersheds

There are three watersheds with sites in the GAMUT Network. Click on the links to preview data and learn more about each watershed.

- [The Logan River](#)
- [Red Butte Creek](#)
- [The Provo River](#)



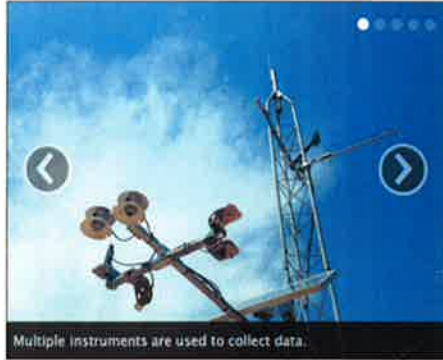
Modeling and Data Federation

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- Data**
- About

Red Butte Creek

Red Butte Creek watershed is 18.8 km² with elevations between 1500 and 2400 m. Average annual streamflow ranges from 0.058 m³/s to 0.416 m³/s. Red Butte Creek originates in the mountains of northeastern Salt Lake County, and Red Butte Canyon is a Research Natural Area managed by the U.S. Forest Service. Red Butte Reservoir, initially built to supply water to Fort Douglas, is currently used as a habitat for June sucker fish that are transported to other watersheds in the Wasatch Front. After exiting the canyon, the Creek makes a rapid transition to built-out, urbanized land use through the University of Utah campus and into Salt Lake City before discharging to the Jordan River.



Visualize Red Butte Creek data

iUTAH
Time Series Analyst

Map
Datasets
Visualization

Filters

Network

- Red Butte Creek 407
- Logan River 403
- Provo River 149
- USGS Groundwater 118
- USGS Daily 66
- USGS Instantaneous 66

Site

- Todds Meadow Climate 71
- Knowlton Fork Climate 71
- Green Infrastructure Climate 71
- Above Red Butte Reservoir Climate 71
- Foothill Drive Advanced Aquatic 63
- Red Butte Gate Basic Aquatic 63

Show more

Variable Category

- Hydrology 155
- Instrumentation 119
- Climate 66
- Water Quality 66

Legend

● Aquatic Site	● Climate Site	● Other
■ Red Butte Creek	■ Logan River	■ Provo River
■ USGS Instantaneous	■ USGS Daily	■ USGS Groundwater

Map data © 2014 Google [Terms of Use](#) [Report a map error](#)

iUTAH Time Series Analyst

Map Datasets Visualization

Filters

- Network**
 - Red Butte Creek (28)
- Site**
 - Foothill Drive Advanced Aquatic (28)
 - Todds Meadow Climate (71)
 - Knowlton Fork Climate (71)
 - Green Infrastructure Climate (71)
 - Above Red Butte Reservoir Climate (71)
 - Red Butte Gate Basic Aquatic (28) [Show more](#)
- Variable Category**
 - Water Quality (17)
 - Instrumentation (7)
 - Hydrology (3)
- Variable**
 - Temperature, WaterTemp_PT (1)
 - Offset, StageOffset (1)
 - Counter, StageNaNCounter (1)

Show All Show Selected Clear Selected Show / hide columns

Plot	Series	Network	Site Code	Variable Code	Variable Name
<input type="checkbox"/>	131	Red Butte Creek	RB_FD_AA	RH_enc	Relative Humidity
<input type="checkbox"/>	132	Red Butte Creek	RB_FD_AA	SpCond	Specific Conductance
<input type="checkbox"/>	133	Red Butte Creek	RB_FD_AA	Stage	Gage height
<input type="checkbox"/>	134	Red Butte Creek	RB_FD_AA	StageNaNCounter	Counter
<input type="checkbox"/>	135	Red Butte Creek	RB_FD_AA	StageOffset	Offset
<input checked="" type="checkbox"/>	136	Red Butte Creek	RB_FD_AA	TurbAvg	Turbidity
<input type="checkbox"/>	137	Red Butte Creek	RB_FD_AA	TurbBES	Turbidity
<input type="checkbox"/>	138	Red Butte Creek	RB_FD_AA	TurbMax	Turbidity
<input type="checkbox"/>	139	Red Butte Creek	RB_FD_AA	TurbMed	Turbidity
<input type="checkbox"/>	140	Red Butte Creek	RB_FD_AA	TurbMin	Turbidity

iUTAH Time Series Analyst

Map Datasets Visualization

Plot Options

All Last Month Last Week

Begin Date: 7/24/2014

End Date: 8/24/2014

Visualization: Time Series

Plot

Legend

- TurbAvg: Turbidity
- RB_FD_AA: Foothill Drive Advanced Aquatic

Summary Statistics

Arithmetic Mean: 15.74

Geometric Mean: 4.60

What do you need?



www.iUtahEPSCoR.org

