State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

Utah Water Quality Board Meeting
Coalville Council Chambers
60 N Main
Coalville UT 84017
September 23, 2015

Work Meeting Begins @9:30 a.m.

DWQ 101C Storm Water & Surface Water Sections ....Jeff Studenka & Kim Shelley

Board Meeting Begins @ 1:00 p.m.
AGENDA

A. **Water Quality Board Meeting – Roll Call**

B. (Tab 1) **Minutes:**
Approval of Minutes for June 24, 2015 WQ Board Meeting .... Myron Bateman

C. **Executive Secretary's Report** ....Walt Baker

D. (Tab 2) **Rulemaking:**
1. **Amendment to Rule R317-4:** *permission to initiate rule making.* .... John Mackey

2. **Request for Change in Proposed Rule R317-2:** *Standards of Quality for Waters of the State* .... Chris Bittner

3. Request to Adopt Amendment to Rule 317-101: *Utah Wastewater Project Assistance Program* .... John Mackey

E. (Tab 3) **Other Business:**
1. **Gold King Mine Release**: *Effects on Utah's Waters* ....Erica Gaddis

2. **303d Vision** ....Carl Adams & Erica Gaddis

Next Meeting October 21, 2015
DEQ Building Board Room 1015
195 North 1950 West
Salt Lake City, Utah 84116

Revised 09/16/2015

In compliance with the American Disabilities Act, individuals with special needs (including auxiliary communicative aids and services) should contact Ashley Nelsen, Office of Human Resources, at (801) 903-3978, TDD (801) 903-3978, at least five working prior to the scheduled meeting

MINUTES
UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY
UTAH WATER QUALITY BOARD
DEQ Building Board Room – 1015
195 North 1950 West
Salt Lake City, UT 84116
June 24, 2015

UTAH WATER QUALITY BOARD MEMBERS PRESENT

Clyde Bunker
Steven Earley
Gregg Galecki
Myron Bateman
Jennifer Grant
Hugo Rodier
Michael Luers
Shane Pace

Excused: Alan Matheson

DIVISION OF WATER QUALITY STAFF MEMBERS PRESENT

Jenny Potter, Marsha Case, Nicole Froula, Allison Gagon, John Cook, John Kennington, John Mackey, Nicholas von Stackelberg, Svetlana Kopytkovskiy, Lisa Nelson, Hilary Arens, Sandy Wingert, Jim Bowcutt, Emily Cantón, Daniel Griffin, Kim Shelly.

OTHERS PRESENT

Name	Organization Representing
Jeremy Roberts	SLCO HD
Lloyd Berentzen	NL. City/BRHD
Amanda Smith	Former DEQ Director
Jeff Beckman	BC & A
Fred Smolka	Emig. Impr. Dist.
Rebecca Davidson	Moab City
David Olsen	Moab City
Alex Buxton	ZBF
John Guldner	Town of Alta
Eric Hawkes	EID
Rick Raile	ECCC
Gary Bowen	ECCC
Brad Rasmussen	Aqua Engineering
Gary Vance	J-U-B
Jesse Stewart	Salt Lake City
Patrick Leary	Township Services SL County
ISSA Hamud	Logan City
Craig Peterson	Logan City
Brian Greene	USU Water Quality
Craig Ashcroft	Carollo Engineers

Myron Bateman called the Board meeting to order at 9:06 AM and took roll call for the members of the Board and audience.

APPROVAL OF MINUTES OF THE APRIL 29 & MAY 25, 2015 MEETINGS

Motion: **It was moved by Mr. Galecki to approve the minutes for April and May 2015 board meetings. Mr. Pace seconded the motion. The motion was unanimously passed.**

RECOGNITION AWARDS

Amanda Smith: was recognized for her 6 years of service on the Board. She expressed appreciation for her opportunity to serve.

BOARD NOMINATIONS

Chair and Vice Chair Nominations: Nominations for Chair: Mr. Bunker made the motion that Myron Bateman remain chair, Mr. Pace seconded the motion. The motion was unanimously passed. Vice Chair nomination: Mr. Galecki made the motion that Shane Pace remain as Vice Chair, Mr. Bunker seconded the motion. The motion was unanimously passed.

EXECUTIVE SECRETARY REPORT

- EPA Budget for the next federal fiscal year. The house sub-committee voted to reduce the Clean Water SRF Fund by 30%. The President had asked for cuts to the budget, however, they were not as significant. Once voting in the Senate occurs we will know the final details. We will keep the board updated on the budget details when they are available.

- The Tax Review Commission (TRC) meeting will look at the sales tax to see if there are any changes that could be needed. In 2009 TRC was granted broader authority and now they review all tax law. Approximately $3.8 million per year of sales tax revenue comes to the board for allocation to projects. We use this as match on the federal grant. For every $1.00 of state money we get $5.00 federal money. This could impact the board if the TRC recommends that our sale tax revenue changes. Mr. Baker will keep the board informed.

FUNDING REQUESTS

Financial Reports: Ms. Cantón updated the Board on the Loan Funds, and Hardship Grant Funds, as seen in the Board Packet on pages F1-F3.

Logan City Authorization Update: Since the last Board meeting in May, Logan City and the six communities reached an agreement and the latter communities withdrew their previous request to the Board to stay the Board's loan authorization to Logan City. Logan then requested that the Board reaffirm the financing that was originally approved on January 22. 2014.

Motion: **Following a discussion Mr. Pace made the motion to reaffirm the loan for Logan City for $70,000.000 at 0.75% interest. Mr. Luers seconded the motion. The motion was unanimously passed.**

Moab City Project Introduction: Moab City introduced a request for a loan of $10,510,000 for the construction of its 2015 Wastewater Treatment Plant Project. The feasibility report was presented to the Board as an introduction, staff recommendations will be made at the August 2015 Board meeting.

Emigration Improvement District: Emigration Improvement District requested a hardship grant in the amount of $60,000 to complete a Wastewater Master Plan, to evaluate alternatives for wastewater management in Emigration Canyon. Emigration Creek is impaired for E.coli (pathogens). DWQ staff believes this impairment is due to discharges from onsite systems.

Motion: **Following a discussion Mr. Pace made the motion to approve the hardship grant for $60,000 to Emigration Improvement District. Ms. Grant seconded the motion. The motion was unanimously passed.**

RULEMAKING

R317-101 Utah Wastewater Project Assistance Request to Proceed to Rulemaking: Mr. Cook requested the Board's approval to initiate rulemaking for rule R317-101, "Utah Wastewater Project Assistance Program"

Motion: **Following a discussion, Mr. Rodier made the motion to approve to initiate rulemaking for rule R317-101. Mr. Luers seconded the motion. The motion was unanimously passed.**

OTHER BUSINESS

Non-point Source Annual Program Report: Mr. Bowcutt informed the board that the annual Nonpoint Source Report has been submitted to EPA it covers the accomplishments of the State's Nonpoint Source Program, as well as the funding tables for the 2016 fiscal year. As seen in the packet on pages H1-H29.

Volunteer Monitoring/Utah Water Watch: Mr. Greene with Utah Water Watch, a statewide volunteer water quality monitoring program, described the partnership between DWQ and Utah State University Water Quality Extension to engage the public in the importance of water quality, trained volunteers provide usable data for water scientists and managers by working as a network of partners helping monitor the conditions of lakes and streams across Utah on a monthly basis. This assists the Nonpoint Source Program by empowering the public to be active stewards of their local water bodies.

Next Meeting – August 26, 2015
Richins Building Room 133
6505 N Landmark Drive
Park City, UT 84098

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Myron Bateman, Chair
Utah Water Quality Board

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MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E.

FROM: John Kennington, P.E.

DATE: September 9, 2015

SUBJECT: Request to initiate Rulemaking for changes to R317-4, Onsite Wastewater Systems

The Division of Water Quality staff requests authorization to initiate rulemaking to implement various miscellaneous changes to the subject rule.

This rule underwent major revision on September 2013. This round of revisions is viewed as a fine-tuning of those major changes. The changes include formatting clarifications, some minor onsite system design changes and some minor changes to the percolation test procedures.

A summary list of the proposed changes and highlighted text of the rule changes are attached. The rule change document is presented in a user friendly format to view the changes. The final rule document that would be submitted to the Division of Administrative Rules will have slightly different formatting, but the same change content.

If you would like to discuss these changes please contact John Kennington at (801) 536-4380 or by email at jkennington@utah.gov.

Summary of R317-4 Proposed Changes

September 8, 2015

1.4 B: Wording changed to: “Issuing an operating permit, with a term not exceeding five years, with an inspection showing a satisfactory performance of the permitted system by the department’s staff before renewal;”

2.49: To streamline the definition of “Ground Water table, perched” the second sentence of the definition was deleted.

5.1: Changed Numbering

6.10(D)(2): Added ‘other design considerations approved by the regulatory authority that do not increase public health risks shall be installed.’

6.14(C)(4): Added ‘A cleanout or other means of access from the surface shall be provided for these devices.’

6.14(E)(2)(c): Added ‘The depth of cover may be reduced to no less than 6 inches, if approved by the regulatory authority, considering the protection of adsorption systems as required in 6.14 B. 2., and other activities, as determined by the authority.’

6.14(E)(2)(e): Added ‘The depth of cover may be reduced to no less than 6 inches, if approved by the regulatory authority, considering the protection of adsorption systems as required in 6.14 B. 2., and other activities, as determined by the authority.’

6.14(e)(4): Added ‘The setback to property line – 10 feet’

6.15(C): Moved the word ‘trench’ for clarification

Table 2 Note (c): added reference to rule R309-605.

Table 2 Note (e): The following was added after the first sentence: “A private or individual well is considered to be “grouted” if it meets the construction standards required in R655-4-11, which requires a minimum 30-foot deep grout surface seal. Private or individual wells not constructed to this minimum standard are considered to be “ungrouted”.

Table 2 Note (j): Added 53 foot

Table 4: Remove references to ‘Schedule 40’, consolidated reference to PVC ASTM D 2729(d) pipe.

Table 5 Title: Changed Minimum to Maximum

Table 5 Headings: Changed gal/day/ft2 to gal/ft2/day

Table 5 Note (a): Added ‘In no case shall the loading rate be greater than 1.0’. Deleted ‘For percolation rates faster than 1 minute per inch, 1 minute per inch shall be used in the formula.’

Table 5 Note (b): Added ‘In no case shall the loading rate be greater than 0.5’. Deleted ‘For percolation rates faster than 1 minute per inch, 1 minute per inch shall be used in the formula.’

Table 6 Title: Changed Minimum to Maximum

Appendix D 1.1(C)(9)(b): Deleted '…unless two successive water level drops do not vary more than 1/16 of an inch and indicate that an approximate stabilized rate has been obtained.'

Appendix D 1.1(C)(9)(b)i: Changed '15 minutes' to '30 minutes'.

Appendix D 1.1(C)(9)(b)ii: Changed '30 minutes' to '15 minutes'

Appendix D 1.1(C)(9)(b)iii: Added 'Eight consecutive time intervals shall be recorded unless two successive water level drops do not vary more than 1/16 of an inch and indicate that an approximate stabilized rate has been obtained.'

Appendix D 1.1(C)(10)(b)ii: Added 'Six consecutive time intervals shall be recorded unless two successive water level drops do not vary more than 1/16 of an inch and indicate that an approximate stabilized rate has been obtained.'

R317-4. Onsite Wastewater Systems.

Date of Enactment or Last Substantive Amendment: September 1, 2013

Table of Contents

R317-4-1. Authority, Purpose, Scope, and Administrative Requirements.

1.1. Authorization.
These rules are administered by the division authorized by Title 19 Chapter 5.

1.2. Purpose.
The purpose of this rule is to protect the public health and environment from potential adverse effects from onsite wastewater disposal within the boundaries of Utah.

1.3. Scope.
This rule shall apply to onsite wastewater systems.

1.4. Jurisdiction.
Local health departments have jurisdiction to administer this rule. Nothing contained in this rule shall be construed to prevent local health departments from:

A. adopting stricter requirements than those contained herein;

B. issuing an operating permit, withat a termfrequency not exceeding once every five years, with an inspection showing a satisfactory performance of the permitted system by the department's staff before renewal;

C. taking necessary steps for ground water quality protection:

1. through adoption of a ground water quality protection management policy based on a ground water management study; or

2. by an onsite wastewater systems management planning policy and land use planning through the county's agency;

D. prohibiting any alternative system within its jurisdiction;

E. assessing fees for administration of this rule;

F. requiring the onsite systems within its jurisdiction be placed under an umbrella of a:

1. responsible management entity overseen by the local health department;

2. contract service provider overseen by the local health department; or

3. management district body politic created by the county for the purpose of operation, maintenance, repairs and monitoring of alternative or all onsite wastewater systems;

G. requiring conventional and alternative systems to be serviced; and

H. receiving a request for a variance, conducting a review, and granting either an approval or denial.

1.5. Alternative System Administration.
Local health departments shall administer an alternative systems program.

A. The local board of health may restrict its administration of these systems by notifying the division that it is exempt from this requirement by:

1. adopting a resolution or regulation; or

2. presenting an ordinance.

B. An alternative systems program shall:

1. advise the owner of the:

type of alternative system;

information concerning risk of failure;

level of maintenance required;

financial liability for repair, modification or replacement of a failed system; and

periodic monitoring requirements;

2. ensure that a Notice of the existence of the alternative system is recorded in the chain of title for that property;

3. provide oversight of installed alternative systems;

4. inspect all installed alternative systems at frequency specified in this rule, through:

   the department's staff;

   contracted service providers;

   responsible management entities;

   a management district body politic created by the county for the purpose of managing onsite wastewater systems; or

   any combination of the above options;

5. maintain records of all installed alternative systems, failures, modifications, repairs and all inspections, recording the condition of the system at the time of inspection, such as overflow, surfacing, ponding, and nuisance;

6. submit an annual report to the division on or before September 1 for the previous state of Utah fiscal year's activities showing:

   the type and number of alternative systems approved, installed, modified, repaired, failed, and inspected;

   a summary of enforcement actions taken, pending and resolved; and

   a summary of performance of water quality data collected;

7. require all alternative systems to be inspected and serviced as detailed in Section R317-4-13 Table 7 and Section R317-4-11.

1.6. Variance Administration Authority.
The Water Quality Board delegates the authority to grant or deny variances to the design requirements provided for in this rule to the local health departments. The board may amend, suspend, or rescind this delegation of authority to a local health department if it is determined that the local health department is not accepting or conducting reviews as described in Section R317-4-12.

A. The local health department having jurisdiction shall accept applications for variance requests on lots that are deemed not feasible for permitting an onsite wastewater system. Upon completion of a review, the local health department will grant or deny a variance to this rule as outlined in Section R317-4-12. The local health department also will submit an annual report of completed variance determinations to the division.

B. If a local health department fails to evaluate variance requests according to Section R317-4-12, the director shall notify the local health department. The director on behalf of the board may thereafter amend, suspend, or rescind the delegation of variance authority to the local health department. The variance authority would then revert to the division, and requests will be reviewed as follows.

1. The director may appoint a variance advisory committee to consider variance requests and make recommendations to the director. Any such advisory committee shall include at least one representative from a local health department. The director may refer any variance request to the variance advisory committee.

2. Upon review of the recommendation submitted by the variance advisory committee, the director shall render a written determination of the requested variance. If no committee was appointed by the director, the director shall render a written determination. Written determinations must be given within 180 days of the receipt of a complete and technically adequate variance request.

3. The director's final written determination will be forwarded to the local health department that has jurisdiction. The local health department is not required to approve or deny an operating or construction permit based on the director's determination of a variance request.

R317-4-2. Definitions.

2.1. "Absorption area" means the entire area used for the subsurface treatment and dispersion of effluent by an absorption system.

2.2. "Absorption bed" means an absorption system consisting of large excavated areas utilizing drain media or chambers.

2.3. "Absorption system" means a covered system constructed to receive and to disperse effluent, from gravity or a pump, in such a manner that the effluent is effectively filtered and retained below the ground surface.

2.4. "Absorption trench" means an absorption system consisting of a series of narrow excavated trenches utilizing drain media, chambers, or bundled synthetic aggregate units.

2.5. "Alternative onsite wastewater system" means an onsite wastewater system that is not a conventional onsite wastewater system.

2.6. "At-grade system" means an alternative onsite wastewater system where the bottom of the absorption system is placed at or below the elevation of the existing site grade, and the top of the distribution pipe is above the elevation of existing site grade, and the absorption system is contained within fill that extends above that grade.

2.7. "Barrier material" means an effective, pervious material such as an acceptable synthetic filter fabric, or a two-inch layer of compacted straw.

2.8. "Bedrock" means the rock, usually solid, that underlies soil or other unconsolidated, superficial material.

2.9. "Bedroom" means any portion of a dwelling that is so designed as to furnish the minimum isolation necessary for use as a sleeping area. It may include a den, study, sewing room, or sleeping loft. Unfinished basements shall be counted as a minimum of one additional bedroom.

2.10. "Board" means the Utah Water Quality Board.

2.11. "Body politic" means the state or its agencies or any political subdivision of the state to include a county, city, town, improvement district, taxing district or other governmental subdivision or public corporation of the state.

2.12. "Building sewer" means the pipe that carries wastewater from the building to a public sewer, an onsite wastewater system or other point of dispersal. It is synonymous with "house sewer".

2.13. "Bundled synthetic aggregate trench" means an absorption trench utilizing bundled synthetic aggregate units.

2.14. "Bundled synthetic aggregate unit" means a cylindrically shaped manufactured unit of synthetic aggregate enclosed in polyolefin netting, which may contain a perforated pipe.

2.15. "Chamber" means an open bottom, chambered structure of an approved material and design.

2.16. "Chambered trench" means an absorption trench utilizing chambers.

2.17. "Cleanout" means a device designed to provide access for removal of deposited or accumulated materials, generally from a pipe.

2.18. "Closed loop distribution" means a distribution method where the absorption system layout has the inlet and outlet ends of each lateral connected creating a complete and continuous pathway for effluent flow.

2.19. "Coarse drain media" means drain media ranging from ¾ to 12 inches in diameter.

2.20. "Condominium" means the ownership of a single unit in a multi-unit project together with an undivided interest in common, in the common areas and facilities of the property.

2.21. "Connecting trench" means an absorption trench that is used to connect other absorption trenches, is less than 20 feet in length, and may be used to calculate total required absorption area.

2.22. "Construction permit" means the permit that authorizes an onsite wastewater system to be installed according to an approved design. An additional construction permit may also authorize activities associated with the repair or alteration of a malfunctioning or failing system.

2.23. "Conventional onsite wastewater system" means an onsite wastewater system typically consisting of a building sewer, a septic tank, and an absorption system utilizing absorption trenches, absorption beds, deep wall trenches, or seepage pits.

2.24. "Cover" means soils used to overlay the absorption area that is free of large stones 10 inches diameter or larger, frozen clumps of earth, masonry, stumps, or waste construction material, or other materials that could damage the system.

2.25. "Curtain drain" means any ground water interceptor or drainage system that is backfilled with gravel or other suitable material and is intended to interrupt or divert the course of shallow ground water or surface water away from the onsite wastewater system.

2.26. "Designer" means a person who fulfills the requirements of Rule R317-11.

2.27. "Deep wall trench" means an absorption system consisting of deep excavated trenches utilizing coarse drain media, with a minimum sidewall absorption depth of 24 inches of suitable soil formation below the distribution pipe.

2.28. "Director" means the director of the Division of Water Quality or, for purposes of groundwater quality at a facility licensed by and under the Division of Radiation Control, the director of the Division of Radiation Control.

2.29. "Distribution box" means a watertight structure that receives effluent and distributes it concurrently, in essentially equal portions, into two or more pipes leading to an absorption system.

2.30. "Distribution pipe" means an approved pipe, solid or perforated, used in the dispersion of effluent in an absorption system.

2.31. "Diversion valve" means a watertight structure that receives effluent through one inlet and distributes it to two or more outlets, only one of which is used at a time.

2.32. "Division" means the Utah Division of Water Quality.

2.33. "Domestic wastewater" means a combination of the liquid or water-carried wastes from residences, business buildings, institutions, and other establishments with installed plumbing facilities, excluding non-domestic wastewater. It is synonymous with the term "sewage".

2.34. "Drain media" means media used in an absorption system. It shall consist of stone, crushed stone, or gravel, ranging from ¾ to 2½ inches in diameter. It shall be free from fines, dust, sand or organic material and shall be durable and inert so that it will maintain its integrity, will not collapse or disintegrate with time. The maximum fines in the media shall be 2% by weight passing through a US Standard #10 mesh or 2 millimeter sieve. It shall be protected by a barrier material.

2.35. "Drainage system" means all the piping within public or private premises that conveys sewage or other liquid wastes to a legal point of treatment and dispersal, but does not include the mains of a public sewer system or a public sewage treatment or disposal plant.

2.36. "Drop box" means a watertight structure that receives septic tank effluent and distributes it into one or more distribution pipes, and into an overflow leading to another drop box and absorption system located at a lower elevation.

2.37. "Dry wash" means the dry bed of an ephemeral stream that flows only after heavy rains and is often found at the bottom of a canyon.

2.38. "Dwelling" means any structure, building, or any portion thereof that is used, intended, or designed to be occupied for human living purposes including houses, mobile homes, hotels, motels, and apartments.

2.39. "Effluent" means the liquid discharge from any treatment unit including a septic tank.

2.40. "Effluent pump" means a pump used to lift effluent.

2.41. "Effluent sewer" means solid pipe that carries effluent to the absorption system.

2.42. "Ejector pump" means a device to elevate or pump sewage to a septic tank, public sewer, or other means of disposal.

2.43. "Ephemeral stream" means a stream that flows for a small period of time, a week or less, after a precipitation event.

2.44. "Excessively permeable soil" means soils having an excessively high permeability, such as cobbles or gravels with little fines and large voids, and having a percolation rate faster than 1 minute per inch.

2.45. "Experimental onsite wastewater system" means an onsite wastewater treatment and absorption system that is still in experimental use and requires further testing in order to provide sufficient information to determine its acceptance.

2.46. "Filter fabric" means a synthetic, non-degradable woven or spun-bonded sheet material that has adequate tensile strength to prevent ripping during installation and backfilling, adequate permeability to allow free passage of water and gases; and adequate particle retention to prevent downward migration of soil particles into the absorption system. The minimum physical properties for the fabric shall be 4.0 ounces per square yard or equivalent.

2.47. "Ground water" means that portion of subsurface water that is in the zone of soil saturation.

2.48. "Ground water table" means the surface of a body of unconfined ground water in which the pressure is equal to that of the atmosphere.

2.49. "Ground water table, perched" means unconfined ground water separated from an underlying body of ground water by an unsaturated zone. ~~Its water table is a perched water table.~~ It is underlain by a restrictive strata or impervious layer. Perched ground water may be either permanent, where recharge is frequent enough to maintain a saturated zone above the perching bed, or temporary, where intermittent recharge is not great or frequent enough to prevent the perched water from disappearing from time to time as a result of drainage over the edge of or through the perching bed.

2.50. "Gulch" means a small rocky ravine or a narrow gorge, especially one with an ephemeral stream running through it.

2.51. "Gully" means a channel or small valley, especially one carved out by persistent heavy rainfall or an ephemeral stream.

2.52. "Impervious strata" means a layer that prevents water or root penetration. In addition, it shall be defined as unsuitable soils or soils having a percolation rate slower than 60 minutes per inch for conventional systems.

2.53. "Installer" means a qualified person with an appropriate contractor's license and knowledgeable in the installation or repair of an onsite wastewater system or its components.

2.54. "Intermittent stream" means a stream that flows for a period longer than an ephemeral stream on a seasonal basis or after a precipitation event.

2.55. "Invert" means the lowest portion of the internal cross section of a pipe or fitting.

2.56. "Lateral" means a length of distribution pipe or chambered trenches in the absorption system.

2.57. "Local health department" means a county or multi-county local health department established under Title 26A.

2.58. "Lot" means a portion of a subdivision, or any other parcel of land intended as a unit for transfer of ownership or for development or both and may not include any part of the right-of-way of a street or road.

2.59. "Malfunctioning or failing system" means an onsite wastewater system that is not functioning in compliance with the requirements of this regulation and may include:

A. absorption systems that seep or flow to the surface of the ground or into waters of the state;

B. systems that overflow from any of their components;

C. systems that, due to failure to operate in accordance with their designed operation, cause backflow into any portion of a building drainage system;

D. systems discharging effluent that does not comply with applicable effluent discharge standards;

E. leaking septic tanks; or

F. noncompliance with standards stipulated on or by the construction permit, operating permit, or both.

2.60. "Maximum ground water table" means the highest elevation that the top of the "ground water table" or "ground water table, perched" is expected to reach for any reason over the full operating life of the onsite wastewater system at that site.

2.61. "May" means discretionary, permissive, or allowed.

2.62. "Mound system" means an alternative onsite wastewater system where the bottom of the absorption system is placed above the elevation of the original site, and the absorption system is contained in a mounded fill body above that grade.

2.63. "Non-closed loop distribution" means a distribution method where the absorption system layout has lateral ends that are not connected.

2.64. "Non-domestic effluent" means the liquid discharge from any treatment unit including a septic tank that has a BOD_5 equal or greater than 250 mg/L; or TSS equal to or greater than 145 mg/L; or fats, oils, and grease equal to or greater than 25 mg/L.

2.65. "Non-domestic wastewater" means process wastewater originating from the manufacture of specific products. Such wastewater is usually more concentrated, more variable in content and rate, and requires more extensive or different treatment than domestic wastewater.

2.66. "Non-public water source" means a culinary water source that is not defined as a public water source.

2.67. "Non-residential" means a building that produces domestic wastewater, and is not a single family dwelling.

2.68. "Onsite wastewater system" means an underground wastewater dispersal system that is designed for a capacity of 5,000 gallons per day or less, and is not designed to serve multiple dwelling units that are owned by separate owners except condominiums. It usually consists of a building sewer, a septic tank and an absorption system.

2.69. "Operating permit" means the permit that authorizes the operation and maintenance of an onsite wastewater system or wastewater holding tank. It may have a fee component that requires periodic renewal.

2.70. "Packed bed media system" means an alternative onsite wastewater system that uses natural or synthetic media to treat wastewater. Biological treatment is facilitated via microbial growth on the surface of the media. The system may include a pump tank, a recirculation tank, or both.

2.71. "Percolation rate" means the time expressed in minutes per inch required for water to seep into saturated soil at a constant rate during a percolation test.

2.72. "Percolation test" means the method used to measure the permeability of the soil by measuring the percolation rate as described in these rules. This is sometimes referred to as a "perc test".

2.73. "Permeability" means the rate at which a soil transmits water when saturated.

2.74. "Person" means an individual, trust, firm, estate, company, corporation, partnership, association, state, state or federal agency or entity, municipality, commission, or political subdivision of a state as defined in Section 19-1-103.

2.75. "Pollution" means any man-made or man-induced alteration of the chemical, physical, biological, or radiological integrity of any waters of the state, unless the alteration is necessary for public health and safety as defined in Section 19-5-102.

2.76. "Pressure distribution" means a method designed to uniformly distribute effluent under pressure within an absorption system.

2.77. "Public health hazard" means, for the purpose of this rule, a condition whereby there are sufficient types and amounts of biological, chemical, or physical agents relating to water or sewage that are likely to cause human illness, disorders or disability. These may include pathogenic viruses and bacteria, parasites, toxic chemicals and radioactive isotopes. A malfunctioning onsite wastewater system constitutes a public health hazard.

2.78. "Public water source" means a culinary water source, either publicly or privately owned, providing water for human consumption and other domestic uses, as defined in Title R309.

2.79. "Pump tank" means a watertight receptacle equipped with a pump and placed after a septic tank or other treatment component.

2.80. "Pump vault" means a device installed in a septic or pump tank that houses a pump and screens effluent with 1/8 inch openings or smaller before it enters the pump.

2.81. "Recirculation tank" means the tank that receives, stores, and recycles partially treated effluent and recycles that effluent back through the treatment process or to the absorption area.

2.82. "Regulatory authority" means either the Utah Division of Water Quality or the local health department having jurisdiction.

2.83. "Replacement area" means sufficient land with suitable soil, excluding streets, roads, easements and permanent structures that complies with the setback requirements of these rules, and is intended for the 100% replacement of absorption systems.

2.84. "Rotary tilling" means a tillage operation. Working land by plowing and harrowing in order to make land ready for cultivation, or employing power driven rotary motion of the tillage tool to loosen, shatter and mix soil.

2.85. "Sand lined trench system" means an alternative onsite wastewater system consisting of a series of narrow excavated trenches utilizing sand media and pressure distribution.

2.86. "Sand media" means sand fill meeting the ASTM C33/C33M – 11A Standard Specification for Concrete Aggregates.

2.87. "Saprolite" means weathered material underlying the soil that grades from soft thoroughly decomposed rock to rock that has been weathered sufficiently so that it can be broken in the hands, cut with a knife or easily dug with a backhoe and is devoid of expansive clay. It has rock structure instead of soil structure and does not include hard bedrock or hard fractured bedrock.

2.88. "Scarification" means loosening and breaking up of soil compaction in a manner that prevents smearing and maintains soil structure.

2.89. "Scum" means a mass of sewage solids, which is buoyed up by entrained gas, grease, or other substances, floating on the surface of wastes in a septic tank.

2.90. "Seepage pit" means an absorption system consisting of one or more deep excavated pits, either hollow-lined or filled, utilizing coarse drain media, with a minimum sidewall absorption depth of 48 inches of suitable soil formation below the distribution pipe.

2.91. "Septage" means the semi-liquid material that is pumped out of a septic or pump tank, generally consisting of the sludge, liquid, and scum layer.

2.92. "Septic tank" means a watertight receptacle that receives the discharge of a drainage system or part thereof, designed and constructed so as to retain solids, digest organic matter through a period of detention and allow the liquids to discharge into the soil outside of the tank through an absorption system.

2.93. "Sequential distribution" means a distribution method in which effluent does not pass through an absorption area before it enters the succeeding areas through a distribution box or relief line allowing for portions of the absorption area to be isolated.

2.94. "Serial distribution" means a distribution method in which effluent passes through an absorption area before entering the succeeding areas through a distribution box or relief line creating a single uninterrupted flow path.

2.95. "Shall" means a mandatory requirement.

2.96. "Should" means recommended or preferred and is intended to mean a desirable standard.

2.97. "Single-family dwelling" means a building designed to be used as a home by the owner or lessee of such building.

2.98. "Sludge" means the accumulation of solids that have settled in a septic tank or a wastewater holding tank.

2.99. "Slope" means the ratio of the rise divided by the run between two points, typically described as a percentage (rise divided by run multiplied by 100).

2.100. "Soil exploration pit" means an open pit dug to permit examination of the soil to evaluate its suitability for absorption systems. This is also referred to as a "test pit".

2.101. "Soil log" means a detailed description of soil characteristics and properties.

2.102. "Soil structure" means the way in which the individual particles, sand, silt, and clay, are arranged into larger distinct aggregates called peds. The main types of soil structure are granular, platy, blocky, prismatic, and columnar. Soil may not have a visible structure because it is either single grain or massive.

2.103. "Soil texture" means the percent of sand, silt, and clay in a soil mixture. Field methods for judging the texture of a soil are found in Section R317-4-14 Appendix C.

2.104. "Standard trench" means an absorption trench utilizing drain media into which effluent is discharged through specially designed distribution pipes.

2.105. "Suitable soil" means undisturbed soil that through textural and structural analysis or percolation rate meets the requirements for placement of an absorption system.

2.106. "Test pit" see "soil exploration pit".

2.107. "Unapproved system" means any onsite wastewater system that is deemed by the regulatory authority to be any:

A. installation without the required regulatory oversight, permits, or inspections;

B. repairs to an existing system without the required regulatory oversight, permits, or inspections; or

C. alteration to an existing system without the required regulatory oversight, permits, or inspections.

2.108. "USDA system of classification" means the system of classifying soil texture used by the United States Department of Agriculture.

2.109. "Waste" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water as defined in Section 19-5-102.

2.110. "Wastewater" means sewage, industrial waste or other liquid substances that might cause pollution of waters of the state. Intercepted ground water that is uncontaminated by wastes is not included.

2.111. "Wastewater holding tank" means a watertight receptacle designed to receive and store wastewater to facilitate treatment at another location.

2.112. "Waters of the state":

A. means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, that are contained within, flow through, or border upon this state or any portion of the state; and

B. does not include bodies of water confined to and retained within the limits of private property, and that do not develop into or constitute a nuisance, or public health hazard, or a menace to fish or wildlife.

2.113. "Wind-blown sand" means sand that is formed by the weathering and erosion of sandstone typically found in sand-dune or sand-sheet deposits and is capable of producing sand and dust storms when disturbed.

R317-4-3. General Standards, Prohibitions, Requirements, and Enforcement.

3.1. Failure to Comply With Rules.
Any person failing to comply with this rule shall be subject to enforcement action as specified in Sections 19-5-115 and 26A-1-123.

3.2. Feasibility.
Onsite wastewater systems are not feasible in some areas and situations. If property characteristics indicate conditions that may fail in any way to meet the requirements specified herein, the use of onsite wastewater systems shall be prohibited.

3.3. Onsite Wastewater System Required.
The drainage system of each dwelling, building or premises covered herein shall receive all wastewater, including bathroom, kitchen, and laundry wastes, and shall have a connection to a public sewer except when such sewer is not available or practicable for use, in which case connection shall be made:

A. to an onsite wastewater system found to be adequate and constructed in accordance with this rule; or

B. to any other type of wastewater system acceptable under Rules R317-1, R317-3, R317-5, R317-401, or R317-560.

3.4. Flows Prohibited From Entering Onsite Wastewater Systems.
No ground water drainage, drainage from roofs, roads, yards, or other similar sources shall discharge into any portion of an onsite wastewater system, but shall be disposed of so they will in no way affect the system. Non-domestic wastes such as chemicals, paints, or other substances that are detrimental to the proper functioning of an onsite wastewater system may not be disposed of in such systems.

3.5. Increased Flows Prohibited.
A person may not connect or expand the use of a single-family dwelling or nonresidential facility connected to an existing onsite wastewater system if the projected wastewater flows would be greater than the original design flow. When the design flow is exceeded, expansion may occur if the onsite wastewater system is modified, permitted, and approved by the regulatory authority for the increased flow.

3.6. Material Standards.
All materials used in onsite wastewater systems shall comply with the standards in this rule.

3.7. Property Lines Crossed.
Systems, including replacement areas, shall be located on the same lot as the building served unless, when approved by the regulatory authority, a perpetual utility easement and right-of-way is established on an adjacent or nearby lot for the construction, operation, and continued maintenance, repair, alteration, inspection, relocation, and replacement of an onsite wastewater system, including all rights to ingress and

egress necessary or convenient for the full or complete use, occupation, and enjoyment of the granted easement. The easement shall be large enough to accommodate the proposed onsite wastewater system and replacement area. The easement shall meet the setbacks specified in Section R317-4-13 Table 2.

3.8. Initial Absorption Area and Replacement Area.

A. All properties that utilize onsite wastewater systems shall be required to have a replacement area.

B. The absorption area, including installed system and replacement area, may not be subject to activity that is likely to adversely affect the soil or the functioning of the system. This may include vehicular traffic, covering the area with asphalt, concrete, or structures, filling, cutting or other soil modifications.

3.9. Operation and Maintenance.
Owners of onsite wastewater systems shall operate, maintain, and service their systems according to the standards of this rule.

3.10. No Discharge to Surface Waters or Ground Surface.
Effluent from any onsite wastewater system may not be discharged to surface waters or upon the surface of the ground. Wastewater may not be discharged into any abandoned or unused well, or into any crevice, sinkhole, or similar opening, either natural or artificial.

3.11. Repair of a Malfunctioning or Unapproved System.
Upon determination by the regulatory authority that a malfunctioning or unapproved onsite wastewater system creates or contributes to any dangerous or unsanitary condition that may involve a public health hazard, or noncompliance with this rule, the regulatory authority shall order the owner to take the necessary action to cause the condition to be corrected, eliminated or otherwise come into compliance.

A. For malfunctioning systems, the local health department shall require and order:

1. all necessary steps, such as maintenance, servicing, repairs, and replacement of system components to correct the malfunctioning system, to meet all rule requirements to the extent possible and may not create any new risk to the environment or public health;

2. effluent quality testing as required by Subsection R317-4-11.4;

3. evaluation of the system design including non-approved changes to the system, the wastewater flow, and biological and chemical loading to the system;

4. additional tests or samples to troubleshoot the system malfunction.

B. The regulatory authority may require fees for additional inspections, reviews, and testing.

3.12. Procedure for Wastewater System Abandonment.

A. When a dwelling served by an onsite wastewater system is connected to a public sewer, the septic tank shall be abandoned and shall be disconnected from and bypassed with the building sewer unless otherwise approved by the regulatory authority.

B. Whenever the use of an onsite wastewater system has been abandoned or discontinued, the owner of the real property on which such wastewater system is located shall render it safe by having the septic tank, any other tanks, hollow seepage pit, or cesspool wastes pumped out or otherwise disposed of in an approved manner. Within 30 days the tanks shall be:

1. crushed in place and the void filled;

2. completely filled with earth, sand, or gravel; or

3. removed.

C. The regulatory authority may require oversight, permit, or inspection of the abandonment process.

3.13. Septage Management.
A person shall only dispose of septage, or sewage contaminated materials in a location or manner in accordance with the regulations of the division and the local health department having jurisdiction.

3.14. Multiple Dwelling Units.
Multiple dwelling units under individual ownership, except condominiums, may not be served by a single onsite wastewater system except where that system is under the sponsorship of a body politic. Plans and specifications for such systems shall be submitted to and approved by the division. Issuance of a construction permit by the board shall constitute approval of plans and authorization for construction. Before the permit is

issued, the division shall review plans with the local health department having jurisdiction over the proposed onsite wastewater system.

R317-4-4. Feasibility Determination.

4.1. General Criteria for Determining Onsite Wastewater System Feasibility.
The regulatory authority shall determine the feasibility of using an onsite wastewater system. The regulatory authority will review required information for any existing or proposed lot to determine onsite wastewater system feasibility. The required information shall be prepared at the owner's expense by, or under the supervision of, a qualified person approved by the regulatory authority.

A. General Information.
The required information shall include:

1. the county recorder's plat and parcel ID and situs address if available;

2. name and address of the property owner and person requesting feasibility; and

3. the location, type, and depth of all existing and proposed non-public water supply sources within 200 feet of the proposed onsite wastewater systems, and of all existing or proposed public water supply sources within 1,500 feet of the proposed onsite wastewater systems.

If the lot is located in aquifer recharge areas or areas of other particular geologic concern, the regulatory authority may require such additional information relative to ground water movement, or possible subsurface wastewater flow.

If the proposed onsite wastewater system is located within any drinking water source protection zone two, this zone shall be shown.

4. The location and distance to nearest sewer, owner of sewer, whether property is located within service boundary, and size of sewer.

5. Statement of proposed use if other than a single-family dwelling.

B. Soil and Site Evaluation.

1. Soil Exploration Pit and Percolation Test.

A minimum of one soil exploration pit shall be excavated to allow the evaluation of the soil. The soil exploration pit shall be constructed and soil log recorded as detailed in Section R317-4-14 Appendix C.

The regulatory authority shall have the option of requiring a percolation test in addition to the soil exploration pit.

The regulatory authority:

shall require additional soil exploration pits, percolation tests, or both where flows are greater than 1,000 gallons per day; and

may require additional pits, tests, or both where:

soil structure varies;

limiting geologic conditions are encountered; or

the regulatory authority deems it necessary.

The percolation test shall be conducted as detailed in Section R317-4-14 Appendix D.

Soil exploration pits and percolation tests shall be conducted as closely as possible to the proposed absorption system site. The regulatory authority shall have the option of inspecting the open soil exploration pits and monitoring the percolation test procedure. All soil logs and percolation test results shall be submitted to the regulatory authority.

When there is a substantial discrepancy between the percolation rate and the soil classification, it shall be resolved through additional soil exploration pits, percolation tests, or both.

Absorption system feasibility shall be based on Section R317-4-13 Table 5 or 6.

2. Wind-Blown Sand.
The extremely fine grained wind-blown sand found in some parts of Utah shall be deemed not feasible for

absorption systems. This does not apply to lots that have received final local health department approval prior to the effective date of this rule.

Percolation test results in wind-blown sand will generally be rapid, but experience has shown that this soil has a tendency to become sealed with minute organic particles within a short period of time. For lots that have received final local health department approval prior to the effective date of this rule, systems may be constructed in such material provided it is found to be within the required range of percolation rates specified in these rules, and provided further that the required area shall be calculated on the assumption of minimum acceptable percolation rate of 60 minutes per inch for standard trenches, deep wall trenches, and seepage pits, and 40 minutes per inch for absorption beds.

3. Suitable Soil Depth.
For conventional systems, effective suitable soil depth shall extend at least 48 inches or more below the bottom of the dispersal system to bedrock formations, impervious strata, or excessively permeable soil. Some alternative onsite wastewater systems may have other requirements.

4. Ground Water Requirements.
The elevation of the anticipated maximum ground water table shall meet the separation requirements of the anticipated absorption systems. Local health departments and other local government entities may impose stricter separation requirements between absorption systems and the maximum ground water table when deemed necessary. Building lots recorded or having received final local health department approval prior to May 21, 1984 shall be subject to the ground water table separation requirements of the then Part IV of the Code of Waste Disposal Regulations dated June 21, 1967, that states "high ground water elevation shall be at least 1 foot below the bottom of absorption systems and at least 4 feet below finished grade". Notwithstanding this grandfather provision for recorded or other approved lots, the depth to ground water requirements are applicable if compelling or countervailing public health interests would necessitate application of the more stringent requirements of this regulation.

Maximum Ground Water.
Maximum ground water table shall be determined where the anticipated maximum ground water table, including irrigation induced water table, might be expected to rise closer than 48 inches to the elevation of the bottom of the onsite wastewater system. Maximum ground water table shall be determined where alternative onsite wastewater systems may be considered based on groundwater elevations. The maximum ground water table shall be determined by the following.

Regular monitoring of the ground water table, or ground water table, perched, in an observation well for a period of one year, or for the period of the maximum groundwater table.

Previous ground water records and climatological or other information may be consulted for each site proposed for an onsite wastewater system and may be used to adjust the observed maximum ground water table elevation.

Direct visual observation of the maximum ground water table in a soil exploration pit for:

evidence of crystals of salt left by the maximum ground water table; or

chemically reduced iron in the soil, reflected by redoxmorphoric features i.e., a mottled coloring.

Previous ground water records and climatological or other information may be consulted for each site proposed for an onsite wastewater system and may be used to adjust the observed maximum ground water table elevation in determining the anticipated maximum ground water table elevation.

In cases where the anticipated maximum ground water table is expected to rise to closer than 34 inches from the original ground surface and an alternative or experimental onsite wastewater system would be considered, previous ground water records and climatological or other information shall be used to adjust the observed maximum ground water table in determining the anticipated maximum ground water table.

Curtain Drains.
A curtain drain or other effective ground water interceptor may be allowed as an attempt to lower the groundwater table to meet the requirements of this rule. The regulatory authority shall require that the effectiveness of such devices in lowering the ground water table be demonstrated during the season of maximum ground water table.

5. Ground Slope.
   Absorption systems may not be placed on slopes where the addition of fluids is judged to create an unstable slope.

   Absorption systems may be placed on slopes between 0% and 25%, inclusive.

   Absorption systems may be placed on slopes greater than 25% but not exceeding 35% if:

   all other requirements of this rule can be met;

   effluent from the proposed system will not contaminate ground water or surface water, and will not surface or move off site before it is adequately treated to protect public health and the environment;

   no slope will fail, and there will be no other landslide or structural failure if the system is constructed and operated adequately, even if all properties in the vicinity are developed with onsite wastewater systems; and

   a report is submitted by a professional engineer or professional geologist that is licensed to practice in Utah. The report shall be imprinted with the engineer's or geologist's registration seal and signature and shall include the following.

   Predictions and supporting information of ground water transport from the proposed system and of expected areas of ground water mounding.

   A slope stability analysis that shall include information about the geology of the site and surrounding area, soil exploration and testing, and the effects of adding effluent.

   The cumulative effect on slope stability of added effluent if all properties in the vicinity were developed with onsite wastewater systems.

   Absorption systems may not be placed on slopes greater than 35%.

6. Other Factors Affecting Onsite Wastewater System Feasibility.

   The locations of all rivers, streams, creeks, dry or ephemeral washes, lakes, canals, marshes, subsurface drains, natural storm water drains, lagoons, artificial impoundments, either existing or proposed, that will affect building sites, shall be provided.

   Areas proposed for onsite wastewater systems shall comply with the setbacks in Section R317-4-13 Table 2.

   If any part of a property lies within or abuts a flood plain area, the flood plain shall be shown within a contour line and shall be clearly labeled on the plan with the words "flood plain area".

7. Unsuitable.
   Where soil and other site conditions are clearly unsuitable for the placement of an onsite wastewater system, there is no need for conducting soil exploration pits or percolation tests.

C. Lot Size.
One of the following two methods shall be used for determining minimum lot size. Determination of minimum lot size by the regulatory authority would not preempt local governments from establishing larger minimum lot sizes.

1. Method 1.
   The local health department having jurisdiction may determine minimum lot size. Under this method, local health departments may elect to involve other affected governmental entities and the division in making joint lot size determinations. The division will develop technical information, training programs, and provide engineering and geohydrologic assistance in making lot size determinations that will be available to local health departments upon their request. Individuals or developers requesting lot size determinations under this method will be required to submit to the local health department, at their own expense, a report that accurately takes into account at least the following factors:

   soil type and depth;

   area drainage, lot drainage, and potential for flooding;

   protection of surface and ground waters;

   setbacks from property lines, water supplies, etc.;

   source of culinary water;

topography, geology, hydrology and ground cover;

availability of public sewers;

activity or land use, present and anticipated;

growth patterns;

individual and accumulated gross effects on water quality;

reserve areas for additional subsurface dispersal;

anticipated wastewater volume;

climatic conditions;

installation plans for wastewater system; and

area to be utilized by dwelling and other structures.

2. Method 2.

Whenever local health departments do not establish minimum lot sizes for single-family dwellings that will be served by onsite wastewater systems, the requirements of Section R317-4-13 Tables 1.1 and 1.2 shall be met.

For non-residential facilities, one-half of the buildable area of the lot must be available for the absorption system and replacement area.

The area required for the absorption system and replacement area may be adjusted during the permitting process.

4.2. Subdivision Onsite Wastewater System Feasibility Determination.

A. In addition to information in Subsection R317-4-4.1, the following information must be provided on a plat map:

1. the proposed street and lot layout with all lots consecutively numbered;
2. size and dimensions of each lot, with the minimum required area sufficient to permit the safe and effective use of an onsite wastewater system, including a replacement area for the absorption system;
3. location of all water lines;
4. location of any easements; and
5. areas proposed for wastewater dispersal, including replacement area.

B. Surface drainage systems shall be included on the plan, as naturally occurring, and as altered by roadways or any drainage, grading or improvement, installed or proposed by the developer. The details of the system shall show the surface drainage structures, whether ditches, pipes, or culverts, will in no way affect onsite wastewater systems on the property.

C. Each proposed lot shall have at least one soil exploration pit, percolation test, or both.

1. The regulatory authority may allow fewer tests based on the uniformity of prevailing soil and ground water characteristics and available percolation or soil log test data.
2. If soil conditions and surface topography indicate, a greater number of soil exploration pits or percolation tests may be required by the regulatory authority.
3. The location of all soil exploration pits and percolation test holes shall be clearly identified on the subdivision final plat and identified by a key number or letter designation.

   The results of such soil tests, including stratified depths of soils and final percolation rates for each lot shall be recorded on or with the final plat.
4. Soil exploration pits and percolation tests shall be conducted as closely as possible to the dispersal system sites on the lots or parcels.

D. Whenever available, information from published soil studies of the area of the proposed subdivision shall be submitted for review.

E. If soil or site conditions exist in or near the project so as to complicate design and location of an onsite wastewater system, a detailed system layout shall be provided for those lots presenting the greatest design difficulty by meeting rules in Section R317-4-5.

4.3. Statement of Feasibility.
After review of all information, plans, and proposals, the regulatory authority shall make a written determination of feasibility stating the results of the review or the need for additional information.

A. An affirmative statement of feasibility for a subdivision does not imply that it will be possible to install onsite wastewater systems on all of the proposed lots, but shall mean that such onsite wastewater systems may be installed on the majority of the proposed lots in accordance with minimum state requirements and any conditions that may be imposed.

B. The regulatory authority shall establish the expiration, if any, of the statement of feasibility.

R317-4-5. Plan Review and Permitting.

5.1. Plan Review and Permitting.

A. Designer Certification.
All plans and specifications shall be prepared by an individual certified in accordance with Rule R317-11.

B. Domestic Wastewater.
Plans and specifications for the construction, alteration, extension, or change of use of onsite wastewater systems that receive domestic wastewater shall be submitted to the regulatory authority.

C. Non-Domestic Wastewater.
Plans and specifications for the construction, alteration, extension, or change of use of onsite wastewater systems that receive non-domestic wastewater shall be submitted to and approved by the local health department having jurisdiction and the division.

D. Construction Permit Required.
The regulatory authority shall review said plans and specifications as to their adequacy of design for the intended purpose, and shall, if necessary, require such changes as are required by these rules. When the reviewing regulatory authority is satisfied that plans and specifications are adequate for the conditions under which a system is to be installed and used, a construction permit shall be issued to the individual making the submittal.

1. Construction may not commence until the construction permit has been issued by the regulatory authority.

E. Information Required.
Plans submitted for review shall be drawn to scale, 1" = 10', 20' or 30', or other scale as approved by the regulatory authority. Plans shall be prepared in such a manner that the contractor can read and follow them in order to install the system properly. Depending on the individual site and circumstances, or as determined by the regulatory authority, some or all of the following information may be required.

1. Applicant Information.

The name, current address, and telephone number of the applicant.

Complete address, legal description of the property, or both to be served by this onsite wastewater system.

2. Onsite Wastewater System Site Plan.

Submittal date of plan.

North arrow.

Lot size and dimensions.

Legal description of property.

Ground surface contours, preferably at 2 foot intervals, of both the original and proposed final grades of the property, or relative elevations using an established bench mark.

Location and explanation of type of dwelling or structure to be served by an onsite wastewater system.

Maximum number of bedrooms, including statement of whether a finished or unfinished basement will be provided, or if other than a single family dwelling, the number of occupants expected and the estimated gallons of wastewater generated per day.

Location and dimensions of paved and unpaved driveways, roadways and parking areas.

Location and dimensions of the essential components of the wastewater system including the replacement area for the absorption system.

Location of all soil exploration pits and all percolation test holes.

Location of building sewer and water service line to serve the building.

Location of easements or drainage right-of-ways affecting the property.

Location of all intermittent or year-round streams, ditches, watercourses, ponds, subsurface drains, etc. within 100 feet of proposed onsite wastewater system.

The location, type, and depth of all existing and proposed non-public water supply sources within 200 feet of onsite wastewater systems, and of all existing or proposed public water supply sources within 1500 feet of onsite wastewater systems and associated source protection zones.

Distance to nearest public water main and size of main.

Distance to nearest public sewer, size of sewer, and whether accessible by gravity.

3. Statement with Site Plan.
Statement indicating the source of culinary water supply, whether a well, spring, non-public or public system, its location and distances from all onsite wastewater systems within 200 feet.

4. Site Assessment and Soil Evaluation.

Soil Logs, Percolation Test Certificates, or both.

Statement with supporting evidence indicating the maximum anticipated ground water table and the flooding potential for onsite wastewater system sites.

~~4.~~5. Relative Elevations.
Show relative elevations of the following, using an established bench mark.

Building drain outlet.

The inlet and outlet inverts of any septic tanks.

Septic tank access cover, including height and diameter of riser, if used.

Pump tank inlet, if used, including height and diameter of riser.

The outlet invert of the distribution box, if provided, and the ends or corners of each distribution pipe lateral in the absorption system.

The final ground surface over the absorption system.

~~5.~~6. System Design.
Details for said site, plans, and specifications are listed in Section R317-4-6.

Schedule or grade, material, diameter, and minimum slope of building sewer and effluent sewer.

Septic tank and pump tank capacity, design, cross sections, etc., materials, and dimensions. If tank is commercially manufactured, state the name and address of manufacturer.

Absorption system details, including the following:

details of drop boxes or distribution boxes, if provided;

schedule or grade, material, and diameter of distribution pipes;

length, slope, and spacing of each absorption system component;

maximum slope across ground surface of absorption system area;

distance of absorption system from trees, cut banks, fills, or subsurface drains; and cross section of absorption system showing the:

depth and width of absorption system excavation;

depth of distribution pipe;

depth of filter material;

barrier material, i.e., synthetic filter fabric, straw, etc., used to separate filter material from cover; and

depth of cover.

Pump, if provided, details as referenced in Section R317-4-14 Appendix B.

If an alternative system is designed, include all pertinent information to allow plan review and permitting for compliance with this rule.

F. Plans Submitted.

1. All applicants requesting plan approval for an onsite wastewater system shall submit a sufficient number of copies of the above required information to enable the regulatory authority to retain one copy as a permanent record.

2. Applications may be rejected if proper information is not submitted.

R317-4-6. Design Requirements.

6.1. System Location.

A. Onsite wastewater systems are not suitable in some areas and situations. Location and installation of each system shall be such that with reasonable maintenance, it will function in a sanitary manner and will not create a nuisance, public health hazard, or endanger the quality of any waters of the State.

B. In determining a suitable location for the system, due consideration shall be given to such factors as:

1. the minimum setbacks in Section R317-4-13 Table 2;
2. size and shape of the lot;
3. slope of natural and final grade;
4. location of existing and future water supplies;
5. depth of ground water and bedrock;
6. soil characteristics and depth;
7. potential flooding or storm catchment;
8. possible expansion of the system; and
9. future connection to a public sewer system.

6.2. Minimum Setback Distances.
All systems, including the replacement area, shall conform to the minimum setback distances in Section R317-4-13 Table 2.

6.3. Maximum Ground Slope.
All absorption systems, including the replacement area, shall conform to the ground slope requirements in Section R317-4-4.

6.4. Estimates of Wastewater Quantity.

A. Single Family Dwellings.
A minimum of 300 gallons per day, 1 or 2 bedroom, and 150 gallons per day for each additional bedroom shall be used.

B. Non-Residential Facilities.
The quantity of wastewater shall be determined accurately, preferably by actual measurement. Metered water supply figures for similar installations can usually be relied upon, providing the non-disposable consumption, if any, is subtracted. Where this data is not available, the minimum design flow figures in Section R317-4-13 Table 3 shall be used to make estimates of flow.

C. Design Capacity.
In no event shall the anticipated maximum daily wastewater flow exceed the capacity for which a system is designed.

6.5. Non-Domestic Effluent.
Effluent shall be treated to levels at or below the defined parameters of non-domestic effluent before being discharged into an absorption system.

6.6. Building Sewer.

A. The building sewer shall have a minimum inside diameter of 4 inches and shall comply with the minimum standards in Section R317-4-13 Table 4.

1. If the sewer leaving the house is three inches, the building sewer may be three inches.

B. Building sewers shall be laid on a uniform minimum slope of not less than 1/4 inch per foot or 2.08% slope.

C. The building sewer shall have a minimum of one cleanout and cleanouts every 100 feet.

1. A cleanout is also required for each aggregate horizontal change in direction exceeding 135 degrees.

2. Ninety degree ells are not recommended.

D. Building sewers shall be separated from water service pipes in separate trenches, and by at least 10 feet horizontally, except that they may be placed in the same trench when all of the following conditions are met.

1. The bottom of the water service pipe, at all points, shall be at least 18 inches above the top of the building sewer.

2. The water service pipe shall be placed on a solid shelf excavated at one side of the common trench with a minimum clear horizontal distance of at least 18 inches from the sewer or drain line.

3. The number of joints in the water service pipe should be kept to a minimum, and the materials and joints of both the sewer and water service pipes shall be of strength and durability to prevent leakage under adverse conditions.

4. If the water service pipe crosses the building sewer, it shall be at least 18 inches above the latter within 10 feet of the crossing. Joints in water service pipes should be located at least 10 feet from such crossings.

E. Building sewer placed under driveways or other areas subjected to heavy loads shall receive special design considerations to ensure against crushing or disruption of alignment.

6.7. Septic Tank.
All septic tanks shall meet the requirements of Section R317-4-14 Appendix A and be approved by the division. Septic tanks shall be constructed of sound, durable, watertight materials that are not subject to excessive corrosion, frost damage, or decay. They shall be designed to be watertight, and to withstand all expected physical forces.

A. Liquid capacity.

1. A septic tank that serves a non-residential facility shall have a liquid capacity of at least 1-½ times the designed daily wastewater flow. In all cases the capacity shall be at least 1,000 gallons.

2. The capacity of a septic tank that serves a single family dwelling shall be based on the number of bedrooms that can be anticipated in the dwelling served, including the unfinished space available for conversion as additional bedrooms. Unfinished basements shall be counted as a minimum of one additional bedroom.

The minimum liquid capacity of the tank shall be 1,000 gallons for up to three bedroom homes.

The minimum liquid capacity of the tank shall be 1,250 gallons for four bedroom homes.

Two hundred fifty gallons per bedroom shall be added to the liquid capacity of the tank for each additional bedroom over four bedrooms.

3. The regulatory authority may require a larger capacity than specified in this subsection as needed for unique or unusual circumstances.

B. Tanks in Series.

1. No tank in the series shall be smaller than 1,000 gallons.

2. The capacity of the first tank shall be at least two-thirds of the required total septic tank volume. If compartmented tanks are used, the compartment of the first tank shall have this two-thirds capacity.

3. The connecting pipes between each successive tank shall meet the slope requirements of the building sewer and shall be unrestricted except for the inlet to the first tank and the outlet for the last tank.

C. Maximum Number of Tanks or Compartments.
The maximum number of tanks and compartments in series may not exceed three.

D. Inlets and Outlets.
Inlet or outlet devices shall conform to the following:

1. Approved tanks with offset inlets may be used where they are warranted by constraints on septic tank location.

2. Multiple outlets from septic tanks shall be prohibited unless preauthorized by the regulatory authority.

3. A gas deflector may be added at the outlet of the tank to prevent solids from entering the outlet pipe of the tank.

E. Effluent Screens.
All septic tanks may have an effluent screen installed at the outlet of the terminal tank. The screen shall prevent the passage of solid particles larger than a nominal 1/8 inch diameter sphere. The screen shall be easily removable for routine servicing by installing a riser to the ground surface, with an approved cover. Effluent screens are required for non-domestic wastewater systems, unless screening is achieved by some other means acceptable to the regulatory authority.

F. Access to Tank Interior.
Adequate access to the tank shall be provided to facilitate inspection, pumping, servicing, and maintenance, and shall have no structure or other obstruction placed over it and shall conform to all of the following requirements.

1. Riser Heights.
Watertight risers are required, extending to within 6 inches of the surface of the ground when soil covering the septic tank is greater than 6 inches. Preferably, the riser should be brought up to the final grade to encourage periodic servicing and maintenance.

If a septic tank is located under paving or concrete, risers shall be extended up through the paving or concrete.

If non-domestic wastewater is generated, risers shall be extended to the final grade.

2. Riser Diameter.
The inside diameter of the riser shall be a minimum of 20 inches.

3. Riser Covers.
Riser covers shall be designed and constructed in such a manner that:

they cannot pass through the access openings;

when closed will be child-proof;

will prevent entrance of surface water, dirt, or other foreign materials; and

seal odorous gases in the tank.

4. Riser Construction.
The risers shall be constructed of durable, structurally sound materials that are approved by the regulatory authority and designed to withstand expected physical loads and corrosive forces.

5. Multiple Risers Required.
When the tank capacity exceeds 3,000 gallons, a minimum of two access risers shall be installed.

G. Other Requirements.
Tank installation shall conform to all of the following requirements.

1. Ground Water.

Septic tanks located in high groundwater areas shall be designed with the appropriate weighted or anti-buoyancy device to prevent flotation in accordance with the manufacturer's recommendations.

The building sewer inlet of the tank may not be installed at an elevation lower than the highest anticipated groundwater elevation.

If the tank serves a mound or packed bed alternative system and has an electronic control panel capable of detecting water intrusion the building sewer inlet of the tank may be installed below the maximum anticipated groundwater elevation.

Any component below the anticipated maximum ground water elevation shall be water tightness tested.

2. Depth of Septic Tank.
The minimum depth of cover over the septic tank shall be at least 6 inches and a maximum of 48 inches at final grading. For unusual situations, the regulatory authority may allow deeper burial provided the following conditions are met.

The tank shall be approved by the division for the proposed depth and burial cover load.

Risers shall:

be installed over the access openings of the inlet and outlet baffles or sanitary tees; and

conform to Subsection R317-4-6.7.F, except risers shall be at least 24 inches in diameter.

6.8. Grease Interceptor Tanks.
A grease interceptor tank or automatic grease removal device may be required by the regulatory authority to receive the drainage from fixtures and equipment with grease-laden waste. It shall be sized according to the current Plumbing Code.

A. Accessibility and Installation.
Tanks installed in the ground shall conform to Subsection R317-4-6.7.F for accessibility and installation, except risers are required and shall be brought to the surface of the ground. All interior compartments shall be accessible for inspecting, servicing, and pumping.

6.9. Pump and Recirculation Tanks.

A. Tanks shall be constructed of sound, durable, watertight materials that are not subject to excessive corrosion, frost damage, or decay. They shall be designed to be watertight, and to withstand all expected physical forces.

B. Pump tank volume shall have a liquid capacity adequate for the minimum operating volume, that includes the dead space, dosing volume, and surge capacity, and shall have the emergency operation capacity of:

1. storage capacity for the system design daily wastewater flow;

2. at least two independent power sources with appropriate wiring installed; or

3. other design considerations approved by the regulatory authority that do not increase public health risks in the event of pump failure.

C. Accessibility and Installation.
Tanks shall conform to Subsection R317-4-6.7.F for accessibility and installation, except risers are required and shall be brought to the surface of the ground. All interior compartments shall be accessible for inspecting, servicing, and pumping.

D. Outlets of septic tanks upstream of pump tanks shall be fitted with an effluent screen, unless a pump vault is used in a pump tank.

6.10. Pump Vaults.
Pump vaults may be used when approved by the regulatory authority.

A. The vault shall be constructed of durable material and resistant to corrosion.

B. The vault shall have an easily accessible screen with 1/8 inch openings or smaller.

C. All components of the vault shall be accessible from the surface.

D. When a pump vault is used in a septic tank :

1. The tank size shall be increased by the larger of the following:

two hundred fifty gallons; or

ten percent of the required capacity of the tank.

2. At least two independent power sources with appropriate wiring, or other design considerations approved by the regulatory authority that do not increase public health risks, shall be installed.

~~shall be installed.~~

other design considerations approved by the regulatory authority that do not increase public helathhealth risks in the event of pump failure.

~~2.~~3. The maximum drawdown within the tank shall be no more than 3 inches per dose.

6.11. Pumps.
See Section R317-4-14 Appendix B for details.

6.12. Sampling Ports.
When a system is required to have effluent sampling or receives non-domestic wastewater, the system shall include a sampling port at an area approved by the regulatory authority capable of sampling effluent prior to the absorption system.

6.13. Effluent Sewer.

A. The effluent sewer shall have a minimum inside diameter of 4 inches and shall comply with the minimum standards in Section R317-4-13 Table 4.

B. The effluent sewer shall extend at least 5 feet beyond the septic tank before entering the absorption system.

C. Effluent sewers shall be laid on a uniform minimum slope of not less than 1/4 inch per foot or 2.08% slope. When it is impractical, due to structural features or the arrangement of any building, to obtain a slope of 1/4 inch per foot, a sewer pipe of 4 inches in diameter or larger may have a slope of not less than 1/8 inch per foot or 1.04% slope when approved by the regulatory authority.

D. The effluent sewer lines shall have cleanouts at least every 100 feet.

E. Effluent sewer placed under driveways or other areas subjected to heavy loads shall receive special design considerations to ensure against crushing or disruption of alignment.

6.14. Absorption Systems.

A. System Types.

1. Absorption Trenches.

Standard Trenches.

Chambered Trenches.

Bundled Synthetic Aggregate Trenches.

2. Absorption Beds.

3. Deep Wall Trenches.

4. Seepage Pits.

B. General Requirements.

1. Replacement Area for Absorption Systems.
Adequate and suitable land shall be reserved and kept free of permanent structures, traffic, or adverse soil modification for 100% replacement of each absorption system. If approved by the regulatory authority, the area between standard trenches or deep wall trenches may be regarded as replacement area.

In lieu of a replacement area, two complete absorption systems shall be installed with a diversion valve. The valve shall be accessible from the final grade. The valve should be switched at least annually.

2. Protection of Absorption Systems.
The site of the initial and replacement absorption system may not be covered by asphalt, concrete, or structures, or be subject to vehicular traffic, or other activity that would adversely affect the soil, such as construction material storage, soils storage, etc. This protection applies before and after construction of the onsite wastewater system.

3. Sizing Criteria for Absorption Systems.
   Absorption systems shall be sized based on Section R317-4-13 Table 5 or 6.

4. Design Criteria for Absorption Systems.
   Many different designs may be used in laying out absorption systems, the choice depending on the size and shape of the available areas, the capacity required, and the topography of the dispersal area.

   Horizontal Setbacks.
   Absorption systems shall comply with the setbacks in Section R317-4-13 Table 2.

   Sloping Ground.
   Absorption systems placed in 10% or greater sloping ground shall be designed so that there is a minimum of 10 feet of undisturbed earth measured horizontally from the bottom of the distribution line to the ground surface. This requirement does not apply to drip irrigation.

   Undisturbed Natural Earth.
   That portion of absorption systems below the top of distribution pipes shall be in undisturbed natural earth.

   Tolerance.
   All piping, chambers, and the bottoms of absorption system excavations shall be designed level.

   Distribution Pipe.
   Distribution pipe for gravity-flow absorption systems shall be 4 inches in diameter and shall comply with the minimum standards in Section R317-4-13 Table 4.

   The pipe shall be penetrated by at least two rows of round holes, each ½ inch in diameter, and located at approximately 6 inch intervals. The perforations should be located at about the five o'clock and seven o'clock positions on the pipe.

   The open ends of the pipes shall be capped.

   Absorption System Laterals.
   Absorption system laterals should be designed to receive proportional flows of wastewater.

   Drain Media Protection.
   Drain media shall be covered with a barrier material before being covered with earth backfill.

   Prohibitions.

   In gravity-flow absorption systems with multiple distribution lines, the effluent sewer may not be in direct line with any one of the distribution pipes, except where drop boxes or distribution boxes are used.

   Any section of distribution pipe laid with non-perforated pipe may not be considered in determining the required absorption area.

   Perforated distribution pipe may not be placed under driveways or other areas subjected to heavy loads.

   Exceptions.
   Deep wall trenches and filled seepage pits may be allowed beneath unpaved driveways on a case-by-case basis by the regulatory authority, if the top of the distribution pipe is at least 3 feet below the final ground surface.

C. Effluent Distribution Devices.

1. Distribution Boxes.
   Distribution boxes may be used on level or nearly level ground. They shall be watertight and constructed of durable, corrosion resistant material. They shall be designed to accommodate the inlet pipe and the necessary distribution lines.

   The outlet inverts of the distribution box shall be not less than 1 inch below the inlet invert.

   Distribution boxes shall have risers brought to final grade.

2. Drop Boxes.
   Drop boxes shall be watertight and constructed of durable, corrosion resistant material and may be used to distribute effluent within the absorption system and shall meet the following requirements:

   Drop boxes shall be designed to accommodate the inlet pipe, an outlet pipe leading to the next drop box, except for the last drop box, and one or two distribution pipes leading to the absorption system.

The inlet pipe to the drop box shall be at least 1 inch higher than the outlet pipe leading to the next drop box.

The invert of the distribution pipes shall be 1 through 6 inches below the outlet invert. If there is more than one distribution pipe, their inverts shall be at exactly the same elevation.

Drop boxes shall have risers brought to final grade.

3. Effluent Pump to Absorption System.

a. If a pump is used to lift effluent to an absorption system, the pump tank or pump vault shall meet the requirements of Subsection R317-4-6.9 or R317-4-6.10 and the pump and controls shall meet the requirements of Section R317-4-14 Appendix B.

b. Pumping to an absorption system may not warrant any reductions to the absorption area.

c. Other Devices.
~~a.~~ Tees, wyes, ells, or other distributing devices may be used as needed to permit proportional flow to the branches of the absorption system. A clean out or other means of access from~~to~~ the surface shall be provided for these devices.

~~A clean out or other means of access fromto the surface shall be provided for these devices.~~

D. Effluent Distribution Methods.

1. Closed Loop.
In locations where the slope of the ground over the absorption system area is relatively flat, the trenches should be interconnected to produce a closed loop system and the trenches shall be installed at the same elevations.

2. Non-Closed Loop.
If a non-closed loop design is used, effluent shall be proportionally distributed to each lateral.

3. Serial or Sequential.
Serial or sequential distribution may be used in absorption systems designed for sloping areas, or where absorption system elevations are not equal.

Serial trenches shall be connected with a drop box or watertight overflow line in such a manner that a trench will be filled before the effluent flows to the next lower trench.

The overflow line shall be a 4 inch solid pipe with direct connections to the distribution pipes. It should be laid in a trench excavated to the exact depth required. Care must be exercised to ensure a block of undisturbed earth remains between trenches. Backfill should be carefully tamped.

4. Pressure Distribution.

General Requirements.

Conformance to Applicable Requirements.
All requirements stated elsewhere in this rule for design, setbacks, construction and installation details, performance, repairs, and abandonment shall apply.

Design Criteria.
All systems that use this method shall be designed by a person certified at Level 3 in accordance with Rule R317-11.

The designer shall submit details of all system components with the necessary calculations.

The designer shall provide to the local health department and to the owner operation and maintenance instructions that include the minimum inspection levels in Section R317-4-13 Table 7 for the system.

Record in the Chain of Title.
When a system utilizing pressure distribution exists on a property, notice of the existence of that system shall be recorded in the chain of title for that property.

Design.

Pressure distribution may be permitted on any site meeting the requirements for an onsite wastewater system if conditions in this rule can be met.

Pressure distribution should be considered when:

effluent pumps are used;

the flow from the dwelling or structure exceeds 3,000 gallons per day;

soils are a Type 1 or have a percolation rate faster than five minutes per inch; or

soils are a Type 5 or have a percolation rate slower than 60 minutes per inch.

The Utah Guidance for Performance, Application, Design, Operation & Maintenance: Pressure Distribution Systems document shall be used for design requirements, along with the following:

Dosing pumps, controls and alarms shall comply with Section R317-4-14 Appendix B.

Pressure distribution piping.

All pressure transport, manifold, lateral piping, and fittings shall meet PVC Schedule 40 standards or equivalent.

The ends of lateral piping shall be constructed with sweep elbows or an equivalent method to bring the end of the pipe to final grade. The ends of the pipe shall be provided with threaded plugs, caps, or other devices acceptable to the regulatory authority to allow for access and flushing of the lateral.

E. Design of Absorption Systems.

An absorption system shall be designed to approximately follow the ground surface contours so that variation in excavation depth will be minimized. The excavations could be installed at different elevations, but the bottom of each individual excavation shall be level throughout its length.

Absorption systems should be constructed as shallow as is possible to promote treatment and evapotranspiration.

Observation ports may be placed to observe the infiltrative surfaces of the trenches or beds.

1. Absorption Trenches.

Absorption trenches shall conform to the following:

The minimum required effective absorption area shall be calculated using Section R317-4-13 Table 5 or 6.

The effective absorption area of absorption trenches shall be calculated as the total bottom area of the excavated trench system in square feet.

Minimum number of absorption trenches	2.
Maximum length of absorption trenches, not including connecting trenches	150 feet.
Minimum spacing of absorption trenches from wall to wall	7 feet.
Minimum width of absorption trench excavations	24 inches.
Maximum width of absorption trench excavations	36 inches.
Minimum depth of absorption trench excavations below original, natural grade	10 inches.
Minimum depth of soil cover over the absorption trenches	6 inches.
Minimum separation from the bottom of the absorption trenches to:	
the anticipated maximum ground water table	24 inches; and
unsuitable soil or bedrock formations	48 inches.

Standard Trenches.
Standard trenches shall conform to the following:

Top of distribution pipe may not be installed above original, natural grade.

The distribution pipe shall be centered in the absorption trench and placed the entire length of the trench.

Drain media shall extend the full width and length of the trenches to a depth of at least — 12 inches.

Minimum depth of drain media under the distribution pipe — 6 inches.

Minimum depth of drain media over the distribution pipe — 2 inches.

Minimum depth of cover over the barrier material — 6 inches.

Chambered Trenches.
Chambered trenches shall conform to the following:

All chambers shall meet International Association of Plumbing and Mechanical Officials (IAPMO) Standard PS 63-2005, which is hereby incorporated into this rule by reference.

The minimum required effective absorption area of chambered trenches shall be calculated:

for Type A Chambers as — 36 inches; and

for Type B Chambers as — 24 inches;

using Section R317-4-13 Table 5 or 6 and may be reduced by — 30%.

The chambered trenches shall be designed and installed in conformance with manufacturer recommendations, as modified by these rules.

Type A Chambers.

Minimum width of chambers — 30 inches.

Maximum width of trench excavations — 36 inches.

Type B Chambers.

Minimum width of chambers — 22 inches.

Maximum width of trench excavations — 24 inches.

Minimum elevation of the inlet pipe invert from the bottom of the chamber — 6 inches.

All chambers shall have a splash plate under the inlet pipe or another design feature to avoid unnecessary channeling into the trench bottom.

Inlet and outlet effluent sewer pipes shall enter and exit the chamber endplates.

Minimum depth of cover over the chambers — 12 inches.

The depth of cover may be reduced to no less than 6 inches, if approved by the regulatory authority, considering the protection of adsorption systems as required in 6.14 B. 2., and other activities, as determined by the authority.

Bundled Synthetic Aggregate Trenches.
Bundled synthetic aggregate trenches shall conform to the following:

All synthetic aggregate bundles shall meet IAPMO Standards for the General, Testing and Marking & Identification of the guide criteria for Bundled Expanded Polystyrene Synthetic Aggregate Units.

The effective absorption area of bundled synthetic aggregate trenches shall be calculated as the total bundle length times the total bundle width in square feet.

The bundled synthetic aggregate trenches shall be designed and installed in conformance with manufacturer recommendations, as modified by these rules.

Only 12 inch diameter bundles are approved in this rule.

For bundles with perforated pipe the minimum depth of synthetic aggregate under pipe — 6 inches.

Width of trenches.

When designed for a 3 foot wide trench, three bundles are laid parallel to each other with the middle bundle containing perforated pipe.

When designed for a 2 foot wide trench, two bundles are placed on the bottom, with one bundle containing perforated pipe.

Minimum depth of cover over the bundles	12 inches

The depth of cover may be reduced to no less than 6 inches, if approved by the regulatory authority, considering the protection of adsorption systems as required in 6.14 B. 2., and other activities, as determined by the authority.

~~6" with reg auth.~~

2. Absorption Beds.
Absorption beds shall conform to the requirements applicable to absorption trenches, except for the following.

The minimum required effective absorption area shall be calculated using Section R317-4-13 Table 5 or 6.

The effective absorption area of absorption beds shall be considered as the total bottom area of the excavated bed system in square feet.

Absorption beds may be built over naturally existing soil types per Section R317-4-13 Table 5 or 6.

The bottom of the entire absorption bed shall be level.

The distribution pipes or chambers shall be interconnected to produce a closed loop distribution system.

Minimum number of laterals in an absorption bed	2.
Maximum length of laterals in an absorption bed	150 feet.
Maximum distance between laterals	6 feet.
Minimum distance between laterals and sidewalls	1 foot.
Maximum distance between laterals and sidewalls	3 feet.
Minimum distance between absorption beds	7 feet.
Minimum depth of an absorption bed excavation from original, natural grade	10 inches.

Absorption beds with drain media:

Minimum depth of drain media under distribution pipe	6 inches.
Minimum depth of drain media over distribution pipe	2 inches.
Minimum depth of cover over the barrier material	6 inches.

Absorption beds with chambers:

Chambers shall be installed with sides touching, no separation allowed.

All chambers shall be connected in a closed loop distribution system.

The outlet side of the chamber runs shall be connected through the bottom port of the end plates.

No absorption area reduction factor shall be given for using chambers in absorption beds.

Minimum depth of cover over the chambers	12 inches.

3. Deep Wall Trenches.
Deep wall trenches shall conform to the following:

The minimum required effective absorption area shall be calculated using Section R317-4-13 Table 5 or 6.

The effective absorption area of deep wall trenches shall be calculated using the total trench vertical sidewall area below the distribution pipe. The bottom area and any highly restrictive or impervious strata or bedrock formations may not be considered in determining the effective sidewall absorption area.

If percolation tests are used, they shall be conducted in accordance with Section R317-4-14 Appendix D and in the most restrictive soil horizon.

Maximum length of trenches 150 feet.

Does not include connecting trenches.

Minimum spacing of trenches from wall to wall 12 feet or three times the depth of the media under the distribution pipe, whichever is the larger distance.

Vertical depth of trenches

Minimum effective sidewalls 2 feet.

Maximum effective sidewalls 10 feet.

Calculate using only suitable soil formation.

Minimum width of trench excavations 24 inches.

Minimum separation from the bottom of deep wall trench to:

the anticipated maximum ground water table 48 inches;

unsuitable soil or bedrock formations 48 inches.

Drain media shall cover the coarse drain media to permit leveling of the distribution pipe and shall extend the full width and length of the trenches.

Minimum depth of drain media 12 inches.

Minimum depth of drain media under the distribution pipe 6 inches.

Minimum depth of drain media over the distribution pipe 2 inches.

Minimum depth of cover over the barrier material 6 inches.

The distribution pipe shall be centered in the trench and placed the entire length of the trench.

The setback to property lines 10 feet

4. Seepage Pits.
Seepage pits shall be considered as modified deep wall trenches and shall conform to the requirements applicable to deep wall trenches, except for the following:

The effective absorption area of seepage pits shall be calculated using the total pit vertical sidewall area below the distribution pipe. The bottom area and any highly restrictive or impervious strata or bedrock formations may not be considered in determining the effective sidewall absorption area.

Minimum diameter of pits 3 feet.

Vertical depth of pits

Minimum effective sidewalls 4 feet.

Maximum effective sidewalls 10 feet.

Calculate using only suitable soil formation.

Filled Seepage Pits.

In pits filled with coarse drain media, the perforated distribution pipe shall run across each pit. A layer of drain media shall be used for leveling the distribution pipe.

The entire pit shall be completely filled with coarse drain media to at least the top of any permeable soil formation to be calculated as effective sidewall absorption area.

Hollow-Lined Seepage Pits:

For hollow-lined pits, the inlet pipe shall extend horizontally at least 1 foot into the pit.

The annular space between the lining and excavation wall shall be filled with crushed rock or gravel ranging from ¾ through 6 inches in diameter and free of fines, sand, clay or organic material. The maximum fines in the gravel shall be 2 % by weight passing through a US Standard #10 mesh or 2.0 millimeter sieve.

Minimum width of annular space between lining and sidewall	12 inches.
Minimum thickness of reinforced perforated concrete liner	2-½ inches.
Minimum thickness of reinforced concrete top	6 inches.
Minimum depth of drain media in pit bottom	6 inches.
Minimum depth of cover over seepage pit top	6 inches.

A reinforced concrete top shall be provided.

When the cover over the seepage pit top exceeds 6 inches, risers shall conform to Subsection R317-4-6.7.F for accessibility.

6.15. Alternative Systems.

A. System Types.

1. At-Grade.

2. Mounds.

3. Packed Bed Media.

Intermittent Sand Filters.

Recirculating Sand Filters.

Recirculating Gravel Filters.

Textile Filters.

Peat Filters.

4. Sand Lined Trenches.

B. General Requirements.

1. Conformance to Applicable Requirements.
All requirements stated elsewhere in this rule for design, setbacks, construction and installation details, performance, repairs and abandonment shall apply unless stated differently for a given alternative system.

2. Sizing Criteria for Alternative Systems.
Absorption area shall be sized based on Section R317-4-13 Table 5 or 6 except as specified in this section.

3. Design Criteria for Alternative Systems.
All alternative systems shall be designed by a person certified at Level 3 in accordance with Rule R317-11.

The designer shall submit details of all system components with the necessary calculations.

The designer shall provide to the local health department and to the owner operation and maintenance instructions that include the minimum inspection levels in Section R317-4-13 Table 7 for the system.

4. Record in the Chain of Title.
When an alternative system exists on a property, notice of the existence of that system shall be recorded in the chain of title for that property.

C. Design of Alternative Systems.

1. At-Grade Systems.
Absorption trenches and absorption beds may be used in at-grade systems. At-grade systems shall conform to the requirements applicable to absorption trenches and absorption beds, except for the following:

Horizontal setbacks in Section R317-4-13 Table 2 are measured from edge of trench sidewall- ~~trench,~~ with the exception of property lines, where the toe of the final cover shall be 5 feet or greater in separation distance to a property line.

Minimum number of observations ports provided within absorption area — 2.

The ports shall be installed to the depth of the trench or bed.

Depth of absorption excavations below natural grade — 0-10 inches.

Minimum cover over the absorption area — 6 inches.

Maximum slope of natural ground surface — 4%.

The maximum side slope for above ground fill shall be four horizontal to one vertical — 25% slope.

Where final contours are above the natural ground surface, the cover shall extend from the center of the wastewater system at the same general top elevation for a minimum of 10 feet in all directions beyond the limits of the absorption area perimeter, before beginning the side slope.

2. Mound Systems.
Mound systems shall conform to the following:

The design shall generally be based on the Wisconsin Mound Soil Absorption System: Siting, Design and Construction Manual, January 2000 published by the University of Wisconsin-Madison Small-Scale Waste Management Project, with the following exceptions.

The minimum separation distance between the natural ground surface and the anticipated maximum ground water table — 12 inches.

Mound systems may be built over naturally existing soil types per Section R317-4-13 Table 5 or 6 provided the minimum depth of suitable soil is:

between the natural ground surface and bedrock formations or unsuitable soils — 36 inches; or

above soils that have a percolation rate faster than one minute per inch — 24 inches.

The minimum depth of sand media over natural soil — 12 inches.

The maximum slope of natural ground surface — 25 %.

The separation distances in Section R317-4-13 Table 2 are measured from the toe of the final cover.

The effluent loading rate at the sand media to natural soil interface shall be calculated using Section R317-4-13 Table 5 or 6.

The effluent entering a mound system shall be at levels at or below the defined parameters of non-domestic effluent.

The minimum thickness of aggregate media around the distribution pipes of the absorption system shall be the sum of 6 inches below the distribution pipe, the diameter of the distribution pipe and 2 inches above the distribution pipe or 10 inches, whichever is larger.

The cover may not be less than 6 inches in thickness and shall provide protection against erosion, frost, storm water infiltration and support vegetative growth and aeration of distribution cell.

A minimum of three observation ports shall be located within the mound at each end and the center of the distribution cell.

At least one port shall be installed at the gravel-sand interface, and one port at the sand-soil interface.

Mounds shall use pressure distribution.

The Utah Guidance for Performance, Application, Design, Operation & Maintenance: Pressure Distribution Systems document and Subsection R317-4-6.14.D.4 shall be used for design requirements.

See Section R317-4-14 Appendix B for pump and control requirements.

3. Packed Bed Media Systems.
Packed bed media systems shall conform to the following:

System Design Criteria.

Wastewater Design Flows.

For single-family dwellings the design shall be based on a minimum of 300 gallons per day for two bedrooms and 100 gallons per day for each additional bedroom.

All other flow estimates shall be based on Subsection R317-4-6.4.

Special design considerations shall be given for non-domestic effluent.

Effluent Distribution.
Effluent shall be uniformly distributed over the filter media using pressure distribution.

Absorption System Requirements.
Absorption systems shall conform to the following:

Siting Conditions.
Packed bed media absorption systems may be sited under the following conditions:

The minimum separation distance between the natural ground surface and the anticipated maximum ground water table 12 inches.

Packed bed media absorption systems may be built over naturally existing soil types per Section R317-4-13 Table 5 or 6 provided the minimum depth of suitable soils:

above soils that have a percolation rate faster than one minute per inch 24 inches; and

between the natural ground surface and bedrock formations or unsuitable soils 36 inches; or

between the natural ground surface and bedrock formations or unsuitable soils 18 inches based on an evaluation of infiltration rate and hydrogeology from a professional geologist or engineer that is certified at the appropriate level to perform onsite wastewater system design and having sufficient experience in geotechnical engineering based on:

type, extent of fractures, presence of bedding planes, angle of dip;

hydrogeology of surrounding area; and

cumulative effect of all existing and future systems within the area for any localized mounding or surfacing that may create a public health hazard or nuisance, description of methods used to determine infiltration rate and evaluations of surfacing or mounding conditions.

A non-chemical disinfection unit, capable of meeting laboratory testing parameters in Table 7.3, and a maintenance schedule consistent to Section R317-4-13 Tables 7.1 and 7.3, shall be used in excessively permeable soils.

Conformance with the minimum setback distances in Section R317-4-13 Table 2, except for the following that require a minimum of 50 feet of separation:

watercourses, lakes, ponds, reservoirs;

non-culinary springs or wells;

foundation drains, curtain drains; or

non-public culinary grouted wells, constructed as required by Title R309.

Sizing Criteria.
The minimum required effective absorption area shall be calculated using Section R317-4-13 Table 5 or 6 and may be reduced by 30%.

The use of chambered trenches with a packed bed media system may not receive additional reductions as allowed in Subsection R317-4-6.14.E.1.c.

Separation from Ground Water Table.
The bottom of the absorption system shall have a vertical separation distance of at least 12 inches from the anticipated maximum ground water table.

Observation Ports.
A minimum of two observation ports shall be provided within the absorption area.

Drip Irrigation.
Drip irrigation absorption may be used for packed bed media absorption system effluent dispersal based on type of soil and drip irrigation manufacturer's recommendations.

Materials shall be specifically designed and manufactured for onsite wastewater applications.

Non-absorption components shall be installed per Section R317-4-6 and Section R317-4-13 Table 2.

Intermittent Sand Filter Systems.

Media.
Either sand media or sand fill as described below may be used.

Minimum depth of sand media	24 inches.
Minimum depth of sand fill	24 inches.
Effective size	0.35-0.5 millimeter.
Uniformity coefficient	less than 4.0.
Maximum fines passing through #200 sieve	1%.

Maximum application rate per day per square foot of media surface area:

Sand media	1.0 gallons.

Sand fill 1.2 gallons.

Maximum dose volume through any given orifice for each dosing	2 gallons

Effluent entering an intermittent sand filter shall be at levels at or below the defined parameters of non-domestic effluent.

Recirculating Sand Filter (RSF) Systems.

Media.

Minimum depth of washed sand	24 inches.
Effective size	1.5-2.5 millimeter.
Uniformity coefficient	less than 3.0.
Maximum fines passing through #50 sieve	1%.
Maximum application rate per day per square foot of media surface area	5 gallons.

Recirculating Gravel Filter (RGF) Systems.

Media.

Minimum depth of washed gravel	36 inches.
Effective size	2.5-5.0 millimeter.
Uniformity Coefficient	less than 2.0.
Maximum fines passing through #16 sieve	1 %.
Maximum application rate per day per square foot of media surface area	15 gallons.

Textile Filter Systems.

Media shall be geotextile, AdvanTex, or an approved equal.

Maximum application rate per day per square foot of media surface area	30 gallons.

Peat Filter Systems.

Minimum depth of peat media	24 inches.
Maximum application rate per day per square foot of media surface area	5 gallons.

4. Sand Lined Trench Systems.
Sand lined trench systems shall conform to the following:

Siting Conditions.

The minimum depth of suitable soil or saprolite between the sand media in trenches and the anticipated maximum ground water table — 12 inches.

Sand lined trench systems may be built over naturally existing:

soil types 1 through 4; or

soils or saprolite with a percolation rate between 1 and 60 minutes per inch.

The minimum depth of suitable soil or saprolite is:

between the sand media in trenches and bedrock formations or unsuitable soils — 36 inches; or

above soils or saprolite that have a percolation rate faster than one minute per inch — 24 inches.

Trench Requirements.
Sand lined trenches shall conform to the requirements applicable to absorption trenches except for the following:

Trenches in Suitable Soil.
The minimum required effective absorption area shall be calculated using Section R317-4-13 Table 5 or 6.

Trenches in Saprolite.
The minimum required effective absorption area shall be based on percolation rate using Section R317-4-13 Table 5.

This rate shall be determined by conducting percolation tests. The soil shall be allowed to swell not less than 24 hours or more than 30 hours

The use of chambered trenches with a sand media system may not receive additional reductions as allowed in Subsection R317-4-6.14.E.1.c.

Width of absorption trench excavations — 36 inches.

The entire trench sidewall shall be installed in natural ground. At-Grade system designs are not allowed.

Minimum depth of sand media — 24 inches.

Sand lined trenches with drain media.

Minimum depth of drain media under the pressure lateral distribution pipe — 6 inches.

Minimum depth of drain media over pressure lateral distribution pipe — 2 inches.

Minimum depth of soil cover or saprolite over drain media — 6 inches.

Sand lined trenches with Type A chambers.

Minimum depth of soil cover or saprolite over chambers — 12 inches.

Minimum number of observation ports per trench — 1.

Effluent Distribution.
Effluent shall be uniformly distributed over the sand media using pressure distribution.

Design shall generally be based on the Utah Guidance for Performance, Application, Design, Operation & Maintenance: Pressure Distribution Systems document.

R317-4-7. Construction and Installation.

7.1. System Installation.

A. Approved Plans.
The installer may not deviate from the approved plans or conditions of the construction permit without the approval of the designer and the reviewing regulatory authority.

B. Installation Restrictions.
A regulatory authority may limit the time period or area in which a system can be installed to ensure that soil conditions, weather, groundwater, or other conditions do not adversely affect the reliability of the system.

C. General Requirements.

1. Prior to installation, all minimum setback distances shall be field verified.
2. All absorption areas shall be protected prior to and during site construction.
3. The regulatory authority may require a temporary barrier around the absorption area, including the replacement area for additional protection prior to and during any site construction. If necessary, a more permanent barrier may be required following construction.
4. All absorption excavations and piping shall be level within a tolerance of plus or minus 1 inch. The overall slope from effluent entry to terminus shall be no more than 4 inches per hundred feet.
5. Absorption system excavations shall be made such that the soil in the bottom and sides of the excavation is not compacted. Strict attention shall be given to the protection of the natural absorption properties of the soil.
6. Absorption systems may not be excavated when the soil is wet enough to smear or compact easily.
7. All smeared or compacted surfaces should be raked to a depth of 1 inch, and loose material removed before the absorption system components are placed in the excavation.
8. Open absorption system excavations shall be protected from surface runoff to prevent the entrance of silt and debris.
9. Absorption systems shall be backfilled with earth that is free from stones 10 inches or more in diameter.
10. Distribution pipes may not be crushed or misaligned during backfilling. When backfilling, the earth shall be mounded slightly above the surface of the ground to allow for settlement and prevent depressions for surface ponding of water.
11. Final grading shall prevent ponding throughout the entire system area and promote surface water runoff.
12. Heavy wheeled equipment may not be driven in or over absorption systems prior to or during construction or backfilling.

D. Building and Effluent Sewer.

1. Pipe, pipe fittings, and similar materials comprising building and effluent sewers shall conform to the applicable standards as outlined in Section R317-4-13 Table 4.
2. Each length of pipe shall be stamped or marked as required by the International Plumbing Code.
3. Where two different sizes or types of pipe are connected, a proper type of fitting or conversion adapter shall be used.
4. All sewers:

   shall have watertight, root-proof joints; and

   may not receive any ground water or surface runoff.
5. Pipes shall be installed on a foundation of undisturbed earth, or stabilized earth that is not subject to settling.

E. Tanks.
Tank installation shall conform to the following requirements:

1. All tanks shall be installed on a level, stable base that will not settle.
2. The hole to receive the tank shall be large enough to permit the proper placement of the tank and backfill.

3. Where ground water, rock or other undesirable protruding obstructions are encountered, the bottom of the hole shall be excavated an additional 6 inches, and backfilled with sand, crushed stone, or gravel to the proper grade.

4. Backfill around and over the septic tank shall be placed in such a manner as to prevent undue strain or damage to the tank or connected pipes.

F. Absorption Systems.

1. Cover shall be evenly graded over the entire absorption area.

2. Distribution and Drop Boxes.

The inlet and outlet piping shall be sealed watertight to the sidewalls of the box.

The box shall be provided with a means of access. Access shall be brought to final grade.

The lid of the riser shall be adequate to prevent entrance of water, dirt or other foreign material, but made removable for observation and maintenance of the system.

The top of the box shall be at least 6 inches below final grade.

The box shall be installed on a level, stable base to ensure against tilting or settling, and to minimize movement from frost action.

Unused knock-out holes in boxes shall be sealed watertight.

3. The solid and distribution pipes shall be bedded true to line and grade, uniformly and continuously supported by firm, stable material.

4. No cracked, weakened, modified or otherwise damaged chamber or bundled synthetic aggregate units shall be used in any installation.

G. Pressure Distribution.

1. Installation practices shall follow the approved design.

H. Alternative Systems.

1. At-Grade and Mound Systems.

The site shall be cleared of surface vegetation, without removing soil, and scarified to an approximate depth of 6 inches. Any furrows resulting from the scarification shall be perpendicular to any slope on the site.

Rotary tilling is prohibited for scarification.

The system may not be installed in wet or moist soil conditions.

No equipment shall be driven over the scarified area.

The site shall be graded such that surface water drains away from the system and adjoining area.

2. Packed Bed Media and Sand Lined Trench Systems.
Installation practices shall follow the approved design.

R317-4-8. Final Inspections.

8.1. Final Inspections.
The regulatory authority shall inspect the entire installation before backfilling to determine compliance with this rule. Some components or system types require additional testing or inspection methods as outlined in the following:

A. Tank Water Tightness Testing.
Each tank shall be tested for water tightness prior to backfill.

1. The tanks shall be filled 24 hours before the inspection to allow stabilization of the water level. Considering water absorption by the concrete, there may not be a change in the water level nor any water moving visibly into or out of the tank. Testing shall be supervised by the regulatory authority. Tanks exhibiting obvious defects or leaks may not be approved unless such deficiencies are repaired to the satisfaction of the regulatory authority.

The regulatory authority may allow two piece tanks, with the joint below the water level, to be backfilled up to 3 inches below the joint to provide adequate support to the seam of the tank.

Polyethylene or fiber glass tanks may be backfilled as per manufacturers' recommendations.

2. If ground water elevations inhibit the ability to visibly inspect the exterior of the tank, the tanks may be tested by their ability to exclude water.

B. Distribution and Drop Boxes.

1. Distribution and drop boxes should be installed level and the flow distribution lines shall be checked by filling the boxes with water up to the outlets.

C. Pressure Distribution, Effluent Pumps.

1. Verify the correct operation of the pump, controls, and alarm.

D. Deep Wall Trenches, Seepage Pits.

1. Verify the depth of the trench excavation.

E. At Grade and Mound Systems.

1. Verify the preparation of the original ground before the placement of fill.

2. Verify that the final cover meets requirements.

F. (E.)Alternative and Experimental Systems.

1. All additional inspections will be dictated by the complexity of the system and absorption system type as identified by the regulatory authority.

G. Final Approval.
Final approval shall be issued by the regulatory authority prior to operation of the system, and shall include an as-built drawing of the completed system.

R317-4-9. Experimental Systems.

9.1. Administrative Requirements.

A. Where unusual conditions exist, experimental methods of onsite wastewater treatment and dispersal may be employed provided they are acceptable to the division and to the local health department having jurisdiction.

B. When considering proposals for experimental onsite wastewater systems, the division or the local health departments may not be restricted by this rule provided that:

1. the experimental system proposed is attempting to resolve an existing pollution or public health hazard, or when the experimental system proposal is for new construction, it has been predetermined that an acceptable back-up wastewater system will be installed in event of failure of the experiment;

2. the proposal for an experimental onsite wastewater system shall be in the name of and bear the signature of the person who will own the system; and

3. the person proposing to utilize an experimental system has the responsibility to maintain, correct, or replace the system in event of failure of the experiment.

C. When sufficient, successful experience is established with experimental onsite wastewater systems, the division may designate them as approved alternative onsite wastewater systems.

D. Following this approval of alternative onsite wastewater systems, the division may initiate rulemaking.

9.2. General Requirements.

A. All experimental systems shall be designed, installed and operated under the following conditions:

1. The ground water requirements shall be determined as described in Subsection R317-4-4.1.B.3.

2. The local health department shall advise the owner of the system of the experimental status of that type of system. The advisory shall contain information concerning risk of failure, level of maintenance required, financial liability for repair, modification or replacement of a failed system and periodic monitoring requirements that are all specific to the type of system to be installed.

3. The local health department and the owner shall be provided with sufficient design, installation and operating information to produce a successful, properly operating installation.

4. The local health department is responsible for provision of, or oversight of an approved installation, inspection and maintenance and monitoring program for the systems. Such programs shall include approved procedures for complete periodic maintenance and monitoring of the systems.

5. The local health department may impose more stringent design, installation, operating and monitoring conditions than those required by the division.

6. All failures, repairs or alterations shall be reported to the local health department. All repairs or alterations shall be approved by the local health department.

B. When an experimental wastewater system exists on a property, notification of the existence of that system shall be recorded in the chain of title for that property.

R317-4-10. Wastewater Holding Tanks Administrative, Design, and Installation.

10.1. Administrative Requirements.

A. Requests for the use of wastewater holding tanks shall receive the written approval of the local health department prior to the installation of the holding tank and be administered under an annual operating permit.

B. Wastewater holding tanks are only permitted:

1. where an absorption system for an existing dwelling has failed and installation of a replacement absorption system is not practicable;

2. as a temporary, not to exceed one year, wastewater system for a new dwelling until a connection is made to an approved sewage collection system;

3. as a temporary, not to exceed one year, wastewater system that may include construction sites, labor camps, temporary mass gatherings, or emergency refuge sheltering; or

4. for other essential and unusual situations where both the division and the local health department having jurisdiction concur that the proposed holding tank will be designed, installed and maintained in a manner that provides long term protection of the waters of the state.

Requests for the use of wastewater holding tanks in this instance shall receive the written approval of both agencies prior to the installation of such devices.

C. Except on those lots recorded and approved for wastewater holding tanks prior to May 21, 1984, wastewater holding tanks are not permitted for use in new housing subdivisions, or commercial, institutional, and recreational developments except in those instances where these devices are part of a specific watershed protection program acceptable to the division and the local health department having jurisdiction.

10.2. General Requirements.
The design, site placement, installation, and maintenance of all wastewater holding tanks shall comply with the following:

A. No wastewater holding tank shall be installed and used unless plans and specifications covering its design and construction have been submitted to and approved by the appropriate regulatory authority.

B. A statement accompanying the application, that a contract with an approved pumper per Rule R317-550 will be obtained stating that the tank will be pumped out periodically at regular intervals or as needed, and contents will be disposed in an approved manner.

C. If authorization is necessary for disposal of wastewater at certain facilities, evidence of such authorization must be submitted for review.

10.3. Basic Plan Information Required.
Depending on the individual site and circumstances, or as determined by the regulatory authority, some or all of the following plan information may be required.

A. Applicant Information.

1. The name, current address, and telephone number of the applicant.

2. Complete address, legal description of the property, or both to be served by this onsite wastewater system.

B. A plot or site plan showing:

1. direction of North;

2. daily wastewater flow;

3. location and liquid capacity of wastewater holding tank;

4. source and location of water supply;

5. location of water service line and building sewer; and

6. location of streams, ditches, watercourses, ponds, etc., near property.

C. Plan detail of wastewater holding tank and high wastewater level warning device.

D. Relative elevations of:

1. building floor drain;

2. building sewer;

3. invert of inlet for tank;

4. lowest plumbing fixture or drain in building served; and

5. the maximum liquid level of the tank.

E. Statement indicating the maximum anticipated ground water table.

10.4. Construction.

A. The tank shall be constructed of sound and durable material not subject to excessive corrosion and decay and designed to withstand hydrostatic and external loads. All wastewater holding tanks shall comply with the manufacturing materials and construction requirements specified for septic tanks.

B. Construction of the tank shall be such as to assure water tightness and to prevent the entrance of rainwater, surface drainage or ground water.

C. Tanks shall be provided with a maintenance access manhole at the ground surface or above and of at least 18 inches in diameter. Access covers shall have adequate handles and shall be designed and constructed in such a manner that they cannot pass through the access opening, and when closed will be child-proof and prevent entrance of surface water, dirt, or other foreign material, and seal the odorous gases in the tank.

D. A high water warning device shall be installed on each tank to indicate when it is within 75% of being full.

1. This device shall be either an audible or a visual alarm.

If the latter, it shall be conspicuously mounted.

2. All wiring and mechanical parts of such devices shall be corrosion resistant.

3. All conduit passage ways through the tank top or walls shall be water and vapor tight.

E. No overflow, vent, or other opening shall be provided in the tank other than those described above.

F. The regulatory authority may require that wastewater holding tanks be filled with water and allowed to stand overnight to check for leaks. Tanks exhibiting obvious defects or leaks may not be approved unless such deficiencies are repaired to the satisfaction of the regulatory authority.

G. The building sewer shall comply with this rule.

H. Above ground holding tanks shall be clearly labeled as "Sewage".

10.5. Capacity.
The liquid capacity of the wastewater holding tank shall be based on wastewater flows for the type of dwelling or facility being served as identified in Section R317-4-13 Table 3 and on the desired time period between each pumping.

A. The minimum capacity of underground wastewater holding tanks shall be 1,000 gallons.

10.6. Location.
Any wastewater holding tank must be located:

A. in an area readily accessible to the pump truck in any type of weather that is likely to occur during the period of use;

B. in accordance with the requirements for septic tanks as specified in Section R317-4-13 Table 2; and

C. where it will not tend to float out of the ground due to a high ground water table or a saturated soil condition, since it will be empty or only partially full most of the time. In areas where the ground water table may be high enough to float the tank out of the ground when empty or partially full, adequate ground anchoring procedures shall be provided.

10.7. Management.

A. Wastewater holding tanks shall be pumped periodically, at regular intervals or as needed, and the wastewater contents shall be disposed of in a manner and at a facility meeting the approval of the appropriate regulatory authority.

B. Wastewater holding tanks for seasonal dwellings should be pumped out before each winter season to prevent freezing and possible rupture of the tank.

C. A record of the liquid waste hauler, pumping dates, and amounts pumped shall be maintained and made available to the appropriate regulatory authorities upon request.

D. Wastewater holding tanks shall be checked at frequent intervals by the owner or occupant and if leakage is detected it shall be immediately reported to the regulatory authority.

E. Repairs or replacements shall be conducted under the direction of the regulatory authority.

F. Improper location, construction, operation, or maintenance of a particular holding tank may result in appropriate legal action against the owner by the regulatory authority having jurisdiction.

G. Each holding tank installed under this rule, shall be inspected upon renewal of the operating permit.

R317-4-11. Operation and Maintenance of Systems.

11.1. Purpose.
The purpose of this section is to diminish the possibility of onsite wastewater system failures by informing the owners of required periodic maintenance, servicing, and monitoring. More complex systems will require a higher level of operation and maintenance.

11.2. Conventional Systems.
All conventional systems should be assessed after the first year of operation, and thereafter at the following minimum frequency.

A. Systems with daily flows between 1 and 3,000 gallons	every three years.
B. Systems with daily flows between 3,001 and 5,000 gallons	every two years.
C. Systems with non-domestic wastewater flows	yearly.

11.3. Pressure Distribution.

A. Each system utilizing pressure distribution shall be inspected as outlined in Section R317-4-13 Tables 7.1 and 7.2.

11.4. Alternative Systems.

A. Each alternative system shall be inspected as outlined in Section R317-4-13 Tables 7.1 and 7.2.

B. Each packed bed media system shall be sampled a minimum of every six months as outlined in Section R317-4-13 Table 7.3.

1. The grab sample shall be taken before discharge to an absorption system.

2. Effluent not meeting the standards of Section R317-4-13 Table 7.3 shall be followed with two successive weekly tests of the same type within a 30 day period from the first exceedance.

3. If two successive samples exceed the minimum standards, the system shall be deemed to be malfunctioning, and shall require further evaluation and a corrective action plan, see Subsection R317-4-3.11.

Effluent quality testing shall continue every two weeks until three successive samples are found to be in compliance.

11.5. Tank Servicing.
For recommended tank servicing see Section R317-4-14 Appendix E.

11.6. Distribution and Drop Box Maintenance.
Distribution and drop boxes, if provided, should be inspected and cleaned periodically.

11.7. Repair of a Malfunctioning System.
If corrective action is required see Subsection R317-4-3.11.

R317-4-12. Variance to Design Requirements.

12.1. Reasons for a Variance.
An applicant may request a variance from requirements of this rule only when a property has been deemed not feasible for the design or construction of an onsite wastewater system. A variance may not be granted for separation distances from public culinary water sources.

12.2. Conditions for a Variance.
A variance will not be approved unless the applicant demonstrates that all of the following conditions are met:

A. An onsite wastewater system consistent with this rule and local health department requirements cannot be constructed and a connection to a public or community-based sewerage system is not available or practicable. This determination will be made by the local health department.

B. Wastewater from the proposed onsite wastewater system will not:

1. contaminate ground water or surface water; and

2. surface or move off site before it is adequately treated to protect public health and the environment.

C. The proposed system will result in equal or greater protection of public health and the environment than is required by meeting the minimum standards and intent of this rule.

D. Adjacent properties, including the current and reasonably anticipated uses of adjacent properties, will not be jeopardized if the proposed system is constructed, operated, and maintained.

12.3. Procedure for Requesting a Variance.

A. A variance request shall include the information and documentation described in Subsection R317-4-12.5.

B. The local health department shall review the variance request and prepare a written determination outlining the conditions of approval or denial of the request. The review shall identify the factors considered in the process and specify the basis for the determination.

12.4. Variance Approvals.

A. A variance will not be approved unless the applicant demonstrates that all of the conditions in Subsection R317-4-12.2 are met.

B. A local health department may not issue an approval or an operating permit for an onsite wastewater system that does not comply with this rule unless a variance has been approved.

C. Notice of the conditions shall be recorded in the chain of title for the property in the office of the county recorder. The notice shall include:

1. the description of the system and variance conditions;

2. operation and maintenance requirements;

3. permission for the regulatory authority to access the property for the purpose of inspection and monitoring of the system; and

4. owner responsibilities to correct, repair, or replace the system at the direction of the regulatory agency.

12.5. Application Requirements.

The variance application shall include all information and documentation necessary to ensure that the standards in Subsection R317-4-12.2 will be met.

A. As appropriate, the information required under this section shall be submitted in a report by a professional engineer or a professional geologist that is certified at the appropriate level to perform onsite wastewater system design. An engineer or geologist who submits a report shall be licensed to practice in Utah and shall have sufficient experience and expertise to make the determinations in the report. Any such report shall include the engineer's or geologist's name and registration number, and a summary of qualifications. The report shall be imprinted with the engineer's or geologist's registration seal and signature. Information shall include at least the following.

1. Information demonstrating that connection to a public or community-based sewerage system is not available or practicable.
2. Technical justification and appropriate engineering, geotechnical, hydrogeologic, and reliability information justifying the request for a variance and how the conditions in 12.2 will be met.
3. A detailed description of the proposed system, including a detailed explanation of wastewater treatment technologies allowed by this rule that have been considered for use, and that will provide the best available treatment.
4. A statement of alternatives considered in lieu of a variance.
5. An operation, maintenance, and troubleshooting plan to keep the installed system operating as described in the application.
6. Documentation provided by the local health department that the adjoining land owners have been notified and provided opportunity for comment on the proposed variance.

R317-4-13. TABLES

TABLE 1.1 – MINIMUM LOT SIZE [(a)]

Culinary Water Source	Soil Type				
	1	2	3	4	5 (c)
Public Water Supply	12,000 sq. ft.	15,000 sq. ft.	18,000 sq. ft.	20,000 sq. ft.	20,000 sq. ft. (c)
Non-public Water Supply (b)	1 Acres	1.25 Acres	1.5 Acres	1.75 Acres	1.75 Acres (c)

TABLE 1.2 – SOIL TYPE KEY [(d)]

Soil Type	Soil Texture (e)	Soil Structure	Percolation Rate (minutes per inch)
1	Coarse Sand, Sand, Loamy Coarse Sand, Loamy Sand	Single Grain	1-10
2	Fine Sand, Very Fine Sand, Loamy Fine Sand, Loamy Very Fine Sand	Single Grain	11-20
3	Coarse Sandy Loam, Sandy Loam	Prismatic, Blocky, Granular	21-40
4	Coarse Sandy Loam, Sandy Loam	Massive, Platy	41-60
	Fine Sandy Loam, Very Fine Sandy Loam, Loam, Silt Loam	Prismatic, Blocky, Granular	
5	Fine Sandy Loam, Very Fine Sandy Loam, Loam, Silt Loam,	Massive, Platy	61-120
	Sandy Clay Loam, Clay Loam, Silty Clay Loam	Massive	
	Sandy Clay Loam, Clay Loam, Silty Clay Loam, Sandy Clay, Clay, Silty Clay, Silt	Prismatic, Blocky, Granular	
6 (f)	Sandy Clay Loam, Clay Loam, Silty Clay Loam	Platy	>120
	Sandy Clay, Clay, Silty Clay, Silt	Massive, Platy	

NOTES

(a) Excluding public streets and alleys or other public rights-of-way, lands or any portion thereof abutting on, running through or within a building lot for a single-family dwelling. These minimum lot size requirements do not apply to building lots that have received final local health department approval prior to the adoption of this rule.

Lots that are part of subdivisions that have received final local health department approval prior to the adoption of this rule are only exempt from the minimum lot size requirements if the developer has and is proceeding with reasonable diligence. Notwithstanding this grandfather provision for approved lots, the minimum lot size requirements are applicable if compelling or countervailing public health interests would necessitate application of these more stringent requirements. The shape of the lot shall also be acceptable to the regulatory authority.

(b) See the separation requirements in Section R317-4-13 Table 2.

(c) Packed bed media systems are required for this soil type.

(d) When there is a substantial discrepancy between the percolation rate and the soil classification, it shall be resolved to the satisfaction of the regulatory authority, or the soil type requiring the largest lot shall be used.

(e) See the USDA soil classification system for a more detailed description.

(f) These soils are unsuitable for any absorption system.

TABLE 2 – MINIMUM SEPARATION DISTANCES IN FEET [(A)]

Item Requiring Setback	From Building Sewers and Effluent Sewers	From Tanks (Septic, Pump and Others)	From Absorption Area and Replacement Area
Absorption and Replacement Areas	--	5	(b)
Public Culinary Water Sources (c)	(c)	100 (c)	100 (c)
Individual or Nonpublic Culinary Water Sources (d)	25	50	100(e)
Culinary Water Supply Line	(f)	10 (f)	10 (f)
Non-culinary Well or Spring	10	25	100
Lake, Pond, Reservoir (a)	10	25	100
Watercourse (live or ephemeral stream, river, subsurface drain, canal, storm water drainage systems, etc.)	--	25	100 (g)
Building Foundation Without foundation drain With foundation drain	 -- --	 5 10	 5 (h) 100 (i)
Curtain drains	10	10	100 (i)
Dry washes, gulches, and gullies	--	25	50
Swimming pool (below ground)	3	10	25
Dry wells, catch basins.		5	25
Down slopes that exceed 35 %. (This includes all natural slopes or escarpments and any manmade cuts, retaining walls, or embankments.		10	50 (j)
Property line	5	5	5

NOTES

(a) All distances are from edge to edge. Where surface waters are involved, the distance shall be measured from the high water line.

(b) See Subsection R317-4-6.14 for setback requirements.

(c) All distances shall be consistent with Rule R309-600, and 605.

(d) Compliance with separation requirements does not guarantee acceptable water quality in every instance. Where geological or other conditions warrant, greater distances may be required by the regulatory authority.

(e) For ungrouted wells and springs the distance shall be 200 feet. A private or individual well is considered to be "grouted" if it meets the construction standards required in R655-4-11, which requires a minimum 30-foot deep grout surface seal. Private or individual wells not constructed to this minimum standard are considered to be "ungrouted". Although this distance shall be generally adhered to as the minimum required separation distance, exceptions maybe approved by the regulatory authority, taking into account geology, hydrology, topography, existing land use agreements, consideration of the drinking water source protection requirements, protection of public health and potential for pollution of water source. Any person proposing to locate an absorption system closer than 200 feet to an individual or nonpublic ungrouted well or spring must submit a report to the regulatory authority that considers the above items. In no case shall the regulatory authority grant approval for an onsite wastewater system to be closer than 100 feet from an ungrouted well or a spring.

(f) If the water supply line is for a public water supply, the separation distance shall comply with the requirements of Rule R309-550. No culinary water service line shall pass through any portion of an absorption area.

g) Lining or enclosing watercourses with an acceptable impervious material may permit a reduction in the separation requirement. In situations where the bottom of a canal or watercourse is at a higher elevation than the ground in which the absorption system is to be installed, a reduction in the distance requirement may be justified, but each case shall be decided on its own merits by the regulatory authority.

(h) Horizontal setback between a deep wall trench or seepage pit and a foundation of any building is at least 20 feet.

(i) The regulatory authority may reduce the separation distance, if it can be shown that the effluent will not enter the drain, but each case must be decided on its own merits by the regulatory authority. In no case shall the regulatory authority grant approval for an absorption area to be closer than 20 feet.

(j) This setback may be reduced if a 53 foot reference line originating at the bottom of the distribution pipe, sloped at 35% below horizontal, will not daylight or intersect the ground surface.

TABLE 3 – ESTIMATED FLOW RATES OF WASTEWATER [A]

Type of Establishment	Gallons per Day
Airports a. per passenger b. per employee	 3 15
Boarding and Rooming Houses a. for each resident boarder and employee per person b. additional for each nonresident boarder	 50 per person 10 per person
Bowling Alleys (does not include food service)	85 per alley
Camps a. developed with flush toilets and showers b. developed with flush toilets c. developed with no flush toilets	 30 per person 20 per person 5 per person
Churches, per person	5
Condominiums, Multiple Family Dwellings, or Apartments	150 per bedroom
Dentist's Office a. per chair b. per staff member	 200 35
Doctor's Office a. per patient b. per staff member	 10 35
Fairgrounds	1 per person
Fire Stations a. with full-time employees and food preparation b. with no full-time employees and no food preparation	 70 per person 5 per person
Food Service Establishment (b) a. ordinary restaurants (not 24 hour service) b. 24 hour service c. single service customer utensils only d. or, per customer served (includes toilet and Kitchen wastes)	 35 per seat 50 per seat 2 per customer 10
Gyms a. participant/staff member b. spectator	 25 per person 4 per person
Hairdresser, per chair	65
Highway Rest Stops (improved, with restroom facilities)	5 per vehicle
Hospitals	250 per bed space
Hotels, Motels, and Resorts	125 per unit
Industrial Buildings (exclusive of industrial waste) a. with showers, per 8 hour shift b. with no showers, per 8 hour shift	 35 per person 15 per person
Labor or Construction Camps	50 per person
Launderette	580 per washer
Mobile Home Parks	400 per unit
Movie Theaters a. auditorium b. drive-in	 5 per seat 10 per car space

Type of Establishment	Gallons per Day
Nursing Homes	200 per bed space
Office Buildings and Business Establishments (does not include food service) per eight hour shift	15 per employee
Picnic Parks (toilet wastes only)	5 per person
Recreational Vehicle Parks a. temporary or transient with no sewer connections b temporary or transient with sewer connections	 50 per space 125 per space
Recreational Vehicle Dump Station (per self-contained vehicle)	50
Schools a. boarding b. day, without cafeteria, gymnasiums or showers c. day, with cafeteria, but no gymnasiums and showers d. day, with cafeteria, gymnasium and showers	 75 per person 15 per person 20 per person 25 per person
Service Stations (c) (per day, per pump)	250
Skating Rink, Dance Halls, Ski Areas, etc.	10 per person
Stores (Including Convenience Stores) a. per public toilet room b. per employee	 500 11
Swimming Pools and Bathhouses (Using Maximum Bather Load)	10 per person
Taverns, Bars, Cocktail lounges (No Food Service)	20 per seat
Visitor Centers	5 per visitor

NOTES

(a) When more than one use will occur, the multiple use shall be considered in determining total flow. Small industrial plants maintaining a cafeteria or showers and club houses or motels maintaining swimming pools or laundries are typical examples of multiple uses. Uses other than those listed above shall be considered in relation to established flows from known or similar installations.

(b) No commercial food waste disposal unit shall be connected to an onsite wastewater system unless first approved by the regulatory authority.

TABLE 4 – MINIMUM STANDARDS FOR BUILDING SEWER, EFFLUENT SEWER, AND DISTRIBUTION PIPE MATERIALS (A)

Acceptable Building Sewer and Effluent Sewer Materials	
Type of Pipe	**Minimum Standard**
Acrylonitrile-Butadiene Styrene (ABS) ~~Schedule 40~~	ASTM (b) D-2680 (c), D-2751, F-628
Polyvinyl Chloride (PVC) ~~Schedule 40~~	ASTM D-2665, D-3033, D-3034
Acceptable Distribution Pipe Materials	
Type of Pipe	**Minimum Standard**
ABS ~~Schedule 40~~	ASTM D-2661, D-2751
Polyethylene (PE), Smooth Wall	ASTM D-3350
PVC ~~Schedule 40~~	ASTM D-2665, D-3033, D-3034, D-2729 (d)
~~PVC~~	~~ASTM D-2729 (d)~~

NOTES

(a) Each length of building sewer, effluent sewer, and distribution pipe shall be stamped or marked.

(b) American Society for Testing and Materials.

(c) For domestic wastewater only, free from industrial wastes.

(d) Although perforated PVC, ASTM D-2729 is approved for absorption system application, the solid-wall version of this pipe is not approved for any application.

TABLE 5 – ~~MINIMUM~~ MAXIMUM HYDRAULIC LOADING RATES FOR PERCOLATION TESTING

Percolation Rate (Minutes per Inch)	Absorption Systems Hydraulic Loading Rates (a) (gal/~~day/~~ft²/day) (c)(d)(e)	Absorption Beds and Mound Systems Hydraulic Loading Rates (b) (gal ~~/day~~/ft²/day) (c)(d)(f)
0-10 (g)	0.90	0.45
11-20	0.70	0.35
21-30	0.60	0.3
31-40	0.55	0.27
41-50	0.50	0.25 (h)
51-60	0.45	0.22 (h)
61-90 (i)	0.40	(j)
91-120 (i)	0.35	(j)

NOTES

(a) The following formula may be used in place of the values in this table: q=2.35 divided by the square root of the percolation rate and then add 0.15 where q is the hydraulic loading rate. In no case shall the loading rate be greater than 1.0. ~~For percolation rates faster than 1 minute per inch, 1 minute per inch shall be used in the formula.~~

(b) The following formula may be used in place of the values in this table: q=1.2 divided by the square root of the percolation rate and then add 0.08 where q is the hydraulic loading rate. In no case shall the loading rate be greater than 0.5. ~~For percolation rates faster than 1 minute per inch, 1 minute per inch shall be used in the formula.~~

(c) Minimum absorption area is equal to the actual or estimated wastewater flow in gallons per day shown in Section R317-4-13 Table 3, divided by the hydraulic loading rate within the applicable percolation rate category.

(d) For non-residential facilities, if a garbage grinder is not used, the absorption area may be reduced by 10% (0.9 multiplier). If any automatic sequence washer is not used the absorption area may be reduced by 30% (0.7 multiplier). If both of these appliances are not used, the absorption area may be reduced by 40% (0.6 multiplier).

(e) For non-residential facilities, a minimum of 150 square feet of trench bottom or sidewall absorption area shall be provided.

(f) For non-residential facilities, a minimum of 300 square feet of absorption area shall be provided.

(g) Soils with a percolation rate faster than 1 minute per inch are only acceptable with the use of an alternative packed bed media system with a disinfection unit.

(h) Not suitable for absorption beds.

(i) Acceptable for alternative packed bed media systems only.

(j) Not suitable for absorption beds or mounds.

TABLE 6 – ~~MINIMUM~~ MAXIMUM HYDRAULIC LOADING RATES FOR SOIL CLASSIFICATION

Texture	Structure	Absorption Systems Hydraulic Loading Rate (gal/ft²/day) (a)(b)(c)	Absorption Beds and Mound Systems Hydraulic Loading Rate (gal/ft²/day) (a)(b)(d)
Coarse sand, sand, loamy coarse sand, loamy sand	Single grain	0.9 (e)	0.45 (e)
Fine sand, very fine sand, loamy fine sand, loamy very fine sand	Single grain	0.7	0.35
Coarse sandy loam, sandy loam	Massive	0.45	0.22 (f)
	Platy	0.5	0.25 (f)
	Prismatic, blocky, granular	0.65	0.32
Fine sandy loam, very fine sandy loam	Massive	0.4	(g)
	Platy	0.35	(g)
	Prismatic, blocky, granular	0.5	0.25 (f)
Loam	Massive	0.4	(g)
	Platy	(e)	(g)
	Prismatic, blocky, granular	0.5	0.25 (f)
Silt loam	Massive	(e)	(g)
	Platy	(e)	(g)
	Prismatic, blocky, granular	0.45	0.22 (f)
Sandy clay loam, clay loam, silty clay loam	Massive	(e)(h)	(g)
	Platy	(i)	(i)
	Prismatic, blocky, granular	0.4 (e)(h)	(g)
Silt, silty clay, sandy clay, clay	Massive	(i)	(i)
	Platy	(i)	(i)
	Prismatic, blocky, granular	0.35 (e)(h)	(g)

NOTES

(a) Minimum absorption area is equal to the actual or estimated wastewater flow in gallons per day, using Section R317-4-13 Table 3, divided by the hydraulic loading rate within the applicable soil texture and structure category.

(b) For non-residential facilities, if a garbage grinder is not used, the absorption area may be reduced by 10% (0.9 multiplier). If any automatic sequence washer is not used, the absorption area may be reduced by 30% (0.7 multiplier). If both of these appliances are not used, the absorption area may be reduced by 40% (0.6 multiplier).

(c) For non-residential facilities, a minimum of 150 square feet of trench bottom or sidewall absorption area shall be provided.

(d) For non-residential facilities, a minimum of 300 square feet of absorption area shall be provided.

(e) These soils are usually considered unsuitable for absorption systems, but may be suitable, depending upon the percentage and type of fines in coarse grained porous soils, and the percentage of sand and structure in fine grained soils. Percolation testing shall be used for further evaluation.

(f) Not suitable for absorption beds.

(g) Not suitable for absorption beds or mounds.

(h) These soils may be permissible for packed bed media absorption systems only.

(i) These soils are unsuitable for any absorption system.

TABLE 7 – MINIMUM INSPECTION FREQUENCY, COMPONENTS, AND EFFLUENT SAMPLING PARAMETERS

TABLE 7.1 – MINIMUM INSPECTION FREQUENCY (a)

Type of System	Annual	Semi-annual
Pressure Distribution	X	
At-Grade (first 5 years only)	X	
Mound	X	
Packed Bed Media		X
Sand Lined Trench	X	
Holding Tank	X	
Experimental System		X

NOTES
(a) Or more frequently as directed by the regulatory authority.

TABLE 7.2 – COMPONENTS (a)

Type of System	Septic Tank and Other Tanks.	Distribution or Drop Boxes (if accessible)	Pumps, Float Settings, Control Panel	Pressure Laterals, Absorption Area	Disinfection Unit (c)
Pressure Distribution	X		X	X	
At-Grade	X	X	X	X	
Mound	X		X	X	
Packed Bed Media	X	X	X	X	X
Sand Lined Trench	X		X	X	
Holding Tank (b)	X		X		
Experimental	X	X	X	X	

NOTES
(a) Inspect other components as directed by the regulatory authority.
(b) Including pumping records.
(c) Required for absorption systems installed in excessively permeable soils, or as directed by the regulatory authority.

TABLE 7.3 – EFFLUENT SAMPLING PARAMETERS

Packed Bed Media System Routine Sampling Parameters Must sample Turbidity, or BOD_5 and TSS.				
Field Testing	**Laboratory Testing**			
Turbidity	BOD_5	TSS	COD (a)	E. coli
≤20 NTUs	≤25 mg/l	≤25 mg/l	≤75 mg/l	<126/100 ml (b)

NOTES
(a) Chemical oxygen demand (COD) may be used in place of BOD_5.
(b) E. coli testing required when a disinfection unit is installed.

R317-4-14. APPENDICES

APPENDIX A. SEPTIC TANK CONSTRUCTION.

1.1. Plans for Tanks Required.

Plans for all septic tanks and underground holding tanks shall be submitted to the division for approval. Such plans shall show all dimensions, capacities, reinforcing, maximum depth of soil cover, and such other pertinent data as may be required. All tanks shall conform to the design drawing and shall be constructed under strict, controlled supervision by the manufacturer.

A. Precast Reinforced Concrete Tanks.

1. The walls and base of precast tanks shall be securely bonded together and the walls shall be of monolithic or keyed construction.
2. The sidewalls and bottom of such tanks shall be at least 3 inches in thickness.
3. The top shall have a minimum thickness of 4 inches.
4. Such tanks shall have reinforcing of at least 6 inch x 6 inch No. 6, welded wire fabric, or equivalent. Exceptions to this reinforcing requirement may be considered by the division based on an evaluation of acceptable structural engineering data submitted by the manufacturer.
5. All concrete used in precast tanks shall be Class A, at least 4,000 pounds per square inch, and shall be vibrated or well-rodded to minimize honeycombing and to assure water tightness.
6. Precast sections shall be set evenly in a full bed of sealant. If grout is used it shall consist of two parts plaster sand to one part cement with sufficient water added to make the grout flow under its own weight.
7. Excessively mortared joints should be trimmed flush.
8. The inside and outside of each mortar joint shall be sealed with a waterproof bituminous sealing compound.
9. For the purpose of early reuse of forms, the concrete may be steam cured. Other curing by means of water spraying or a membrane curing compound may be used and shall comply to best acceptable methods as outlined in Guide to Curing Concrete, ACI308R-01, by American Concrete Institute, Farmington Hills, Michigan.

B. Poured-In-Place Concrete Septic Tanks.

1. The top of poured-in-place septic tanks with a liquid capacity of 1,000 to 1,250 gallons shall be a minimum of 4 inches thick, and reinforced with 3/8 inch reinforcing rods 12 inches on center both ways, or equivalent.
2. The top of tanks with a liquid capacity of greater than 1,250 gallons shall be a minimum of 6 inches thick, and reinforced with 3/8 inch reinforcing rods 8 inches on center both ways, or equivalent.
3. The walls shall be a minimum of 6 inches thick. The walls shall be reinforced with 3/8 inch reinforcing rods 8 inches on center both ways, or equivalent. Inspections by the regulatory authority may be required of the tank reinforcing steel before any concrete is poured.
4. A 6 inch water stop shall be used at the wall-floor juncture to ensure water tightness.
5. All concrete used in poured-in-place tanks shall be Class A, at least 4,000 pounds per square inch, and shall be vibrated or well-rodded to minimize honeycombing and to ensure water tightness.
6. Curing of concrete shall comply with the requirements in Subsection R317-4-14 Appendix A.1.2.

C. Fiberglass Tanks.

1. Fiberglass tanks shall comply with one of the following criteria for acceptance.
   a. The Interim Guide Criteria for Glass-Fiber-Reinforced Polyester Septic Tanks, International Association of Plumbing and Mechanical Officials Z1000-2007. The identifying seal of the International Association of Plumbing and Mechanical Officials shall be permanently embossed in the fiberglass as evidence of compliance.
   b. Manufactured to meet the structural requirements of Underwriters Laboratories (UL) Standard 1316.

c. Professionally engineered plans demonstrating compliance to tank configuration requirements of this rule including acceptable structural calculations or other pertinent data as may be required.

2. Inlet and outlet tees shall be attached to the tank by a rubber or synthetic rubber ring seal and compression plate, or in some other manner approved by the division.

3. The tank shall be installed in accordance with the manufacturer's recommendations.

D. Polyethylene Tanks.

1. Polyethylene tanks shall comply with the criteria for acceptance established in Prefabricated Septic Tanks and Wastewater Holding Tanks, Can3-B66-10 by the Canadian Standards Association, Ontario, Canada.

2. Inlet and outlet tees shall be attached to the tank by a rubber or synthetic rubber ring seal and compression plate, or in some other manner approved by the division.

3. The tank shall be installed in accordance with the manufacturer's recommendations.

1.2. Identifying Marks.

A. All prefabricated or precast tanks that are commercially manufactured shall be plainly, legibly, and permanently marked or stamped with:

1. the manufacturer's name and address, or nationally registered trademark;

2. the liquid capacity of the tank in gallons on the exterior at the outlet end within 6 inches of the top of the wall; and

3. the inlet and outlet of all such tanks shall be plainly marked as "IN" or "OUT" respectively.

1.3. Inlets and Outlets.
Inlets and outlets of tanks or compartments thereof shall meet the minimum diameter requirements for building sewers.

A. Only one inlet or outlet is allowed, unless preauthorized by the regulatory authority.

B. Inlets and outlets shall be located on opposite ends of the tank.

1. The invert of flow line of the inlet shall be located at least 2 inches, above the invert of the outlet to allow for momentary rise in liquid level during discharge to the tank.

2. Approved tanks with offset inlets may be used when approved by the regulatory authority.

C. All inlets and outlets shall have a baffle or sanitary tee.

1. An inlet baffle or sanitary tee of wide sweep design shall be provided to divert the incoming wastewater downward. This baffle or tee is to penetrate at least 6 inches below the liquid level, but the penetration is not to be greater than that allowed for the outlet device.

2. For tanks with vertical sides, outlet baffles or sanitary tees shall extend below the liquid surface a distance equal to approximately 40 % of the liquid depth. For horizontal cylindrical tanks and tanks of other shapes, that distance shall be reduced to approximately 35 % of the liquid depth.

3. All baffles shall be constructed from sidewall to sidewall or shall be designed as a conduit.

4. All sanitary tees shall be permanently fastened in a vertical, rigid position.

D. Inlet and outlet pipe connections to the septic tank shall be sealed and adhere to the tank and pipes to form watertight connections with a bonding compound or sealing rings.

E. Inlet and outlet devices may not include any design features preventing free venting of gases generated in the tank or absorption system back through the roof vent in the building plumbing system. The top of the baffles or sanitary tees shall extend at least 6 inches above the liquid level in order to provide scum storage, but no closer than 1 inch to the inside top of the tank.

1.4. Liquid Depth of Tanks.
Liquid depth of tanks shall be at least 30 inches. Depth in excess of 72 inches may only be considered in calculating liquid volume required in Subsection R317-4-6.6 if the tank length is at least two times the liquid depth.

1.5. Burial Depth.

The maximum burial depth shall be stated on the plans submitted.

1.6. Tank Compartments.

Septic tanks may be divided into compartments provided they meet the following:

A. The volume of the first compartment shall equal or exceed two-thirds of the total required septic tank volume;

B. No compartment shall have an inside horizontal dimension less than 24 inches;

C. Inlets and outlets shall be designed as specified for tanks, except that when a partition wall is used to form a multi-compartment tank, an opening in the partition may serve for flow between compartments provided the minimum dimension of the opening is 4 inches, the cross-sectional area is not less than that of a 6 inch diameter pipe (28.3 square inches), and the mid-point is below the liquid surface a distance approximately equal to 40 % of the liquid depth of the tank.

1.7. Scum Storage.

Scum storage volume shall consist of 15 % or more of the required liquid capacity of the tank and shall be provided in the space between the liquid surface and the top of inlet and outlet devices.

1.8. Access to Tank Interior.

Adequate access to the tank shall be provided to facilitate inspection, servicing and maintenance, and shall have no structure or other obstruction placed over it and shall conform to the following requirements:

A. Access to each compartment of the tank shall be provided through properly placed manhole openings not less than 18 inches in diameter, in minimum horizontal dimension or by means of an easily removable lid section.

B. All access covers shall be designed and constructed in such a manner that they cannot pass through the access openings, and when closed will be child-proof and prevent entrance of surface water, dirt, or other foreign material, and seal the odorous gases in the tank. Concrete access covers for manhole openings shall have adequate handles.

C. Access to inlet and outlet devices shall be provided through properly spaced openings not less than 12 inches in minimum horizontal dimension or by means of an easily removable lid section.

Appendix B. Pressure Distribution, Pumps, Controls, and Alarms.

1.1. Design.

The design shall generally be based on the Utah Guidance for Performance, Application, Design, Operation & Maintenance: Pressure Distribution Systems document with the following exceptions:

A. Design and equipment shall emphasize ease of maintenance, longevity, and reliability of components and shall be proven suitable by operational experience, test, or analysis, acceptable to the regulatory authority.

B. Electrical disconnects shall be provided that are appropriate for the installation and shall have gas-tight junction boxes or splices. Electrical components used in onsite wastewater systems shall comply with applicable requirements of the State of Utah Electrical Code.

C. All components shall be constructed and installed to facilitate ease of service without having to alter any other part.

1.2. Pumps, Controls, and Alarms.

Prior to final approval for operation, all pumps, controls and related apparatus shall be field tested and found to operate as designed.

A. When duplex pump system is designed, controls shall be provided that an alarm will signal when one of the pumps malfunctions.

B. Where multiple pumps are operated in series, controls shall be installed to prevent the operation of a pump or pumps preceding a station that experiences a high level alarm event.

C. Controls shall be capable of controlling all functions incorporated or required in the design of the system.

1. The control panel for all pressure distribution systems shall include a pump run-time hour meter and a pump event counter or other acceptable flow measurement method.

2. The control panel shall be installed within sight of the access risers.

    a. Other locations may be approved by the regulatory authority.

3. Supporting hydraulic calculations and pump curve analysis shall be submitted to the regulatory authority with the design.

APPENDIX C. SOIL EXPLORATION PITS, SOIL LOGS, SOIL EVALUATIONS.

1.1. Soil Exploration Pit Construction.
Soil conditions shall be obtained from soil exploration pit(s) dug to a depth of 10 feet in the absorption area, or to the ground water table if it is shallower than 10 feet below ground surface. In the event that absorption system excavations will be deeper than 6 feet, soil exploration pits shall extend to a depth of at least 4 feet below the bottom of the proposed absorption system excavation.

A. Soil exploration pits shall be constructed in a manner to reduce potential for physical injury. One end of each pit should be sloped gently or "stair-stepped" to permit easy entry if necessary.

1.2. Soil Logs.

A. The soil log shall contain the following information.

1. A signed statement certifying that the logs were evaluated and recorded in accordance with this rule.
2. The names of all qualified individuals per Rule R317-11 conducting the tests.
3. The location of the property.
4. The location of the soil exploration pit on the property.
5. The date of the log.
6. A description and depths of the soil horizons throughout the soil exploration pit to include:
   a. soil texture and structure using the USDA system of classification;
   b. estimated volume percentage of coarse fragments defined as:
      i. "Gravel" means a rock fragment from 0.1 inches to 3 inches in diameter;
      ii. "Cobble" means rock fragment from 3 inches to 10 inches in diameter;
      iii. "Stone" means a rock fragment greater than 10 inches in diameter;
   c. the presence and abundance of mottling defined as:
      i. "Few" when less than 2 % of the exposed surface is occupied by mottles;
      ii. "Common" when from 2 % to 20 % of the exposed surface is occupied by mottles; and
      iii. "Many" when more than 20 % of the exposed surface is occupied by mottles;
   d. depth to groundwater or bedrock if encountered and maximum anticipated groundwater table; and
   e. other pertinent information.

1.3. Soil Evaluation.
Soils shall be evaluated using the USDA Soil Texture Classification method.

A. The soil horizon with the lowest loading rate shall be used in calculating the required absorption area.

Appendix D. Percolation Method.

1.1. Percolation Test Requirements.
Percolation tests shall be completed by an individual certified per Rule R317-11 and shall be conducted in accordance with the instructions in this appendix.

A. Typical Areas.
When percolation tests are conducted, such tests shall be conducted at points and elevations selected as typical of the area in which the absorption system will be located.

B. Percolation Test Certificate.
Percolation test results shall be submitted on a signed "Percolation Test Certificate". The test certificate shall contain the following:

1. A signed statement certifying that the tests were conducted in accordance with this rule.
2. The names of all individuals per Rule R317-11 conducting the tests.
3. The location of the property.
4. The location of the percolation tests on the property.
5. The depth to the bottom of the percolation test hole from the existing grade.
6. The final stabilized percolation rate of each test in minutes per inch.
7. The date of the tests.
8. Other pertinent information.

C. Specific Requirements.
Percolation tests shall be conducted at the owner's expense and in accordance with the following:

1. Conditions Prohibited for Test Holes.
Percolation tests may not be conducted in test holes that extend into ground water, bedrock, or frozen ground. Where shrink-swell clays, fissured soil formations, or saprolite is encountered, tests shall be made under the direction of the regulatory authority.

2. Soil Exploration Pit Prerequisite to Percolation Tests.
Since the appropriate percolation test depth depends on the soil conditions at a specific site, the percolation test shall be conducted only after the soil exploration pit has been dug and examined for suitable and porous strata and ground water table information. Percolation test results should be related to the soil conditions found.

3. Test Holes to Commence in Specially Prepared Excavations.
All percolation test holes should commence in specially prepared larger excavations, preferably made with a backhoe, of sufficient size that extend to a depth approximately 6 inches above the strata to be tested.

4. Type, Depth, and Dimensions of Test Holes.
Test holes shall be dug or bored, preferably with hand tools such as shovels or augers, etc., and shall have horizontal dimensions ranging from 4 to 18 inches, preferably 8 to 12 inches. The vertical sides shall be at least 12 inches deep, terminating in the soil at an elevation 6 inches below the bottom of the proposed onsite wastewater system. In testing individual soil strata for deep wall trenches and seepage pits, the percolation test hole shall be located entirely within the strata to be tested, if possible.

5. Preparation of Percolation Test Hole.
Carefully remove any smeared soil surfaces to provide an open, natural soil interface into that water may percolate. Remove all loose soil from the bottom of the hole. Add 2 to 3 inches of clean pea gravel to protect the bottom from scouring or sealing with sediment when water is added. Caving or sloughing in some test holes can be prevented by placing in the test hole a wire cylinder or perforated pipe surrounded by clean pea gravel.

6. Saturation and Swelling of the Soil.
It is important to distinguish between saturation and swelling. Saturation means that the void spaces between soil particles are full of water. This can be accomplished in a relatively short period of time. Swelling is a soil volume increase caused by intrusion of water into the individual soil particles. This is a slow process, especially in clay-type soil, and is the reason for requiring a prolonged swelling period.

7. Placing Water in Test Holes.
Water should be placed carefully into the test holes by means of a small diameter siphon hose or other suitable method to prevent washing down the side of the hole.

8. Percolation Rate Measurement, General.
Necessary equipment should consist of a tape measure with at least 1/16 inch calibration or float gauge and a time piece or other suitable equipment. All measurements shall be made from a fixed reference point near the top of the test hole to the surface of the water.

9. Percolation Test Procedure.
The hole shall be carefully filled with clear water and a minimum depth of 12 inches shall be maintained above the gravel for at least a four hour period by refilling whenever necessary. Water remaining in the hole after four hours may not be removed. Immediately following the saturation period, the soil shall be allowed to swell not less than 16 hours or more than 30 hours. Immediately following the soil swelling period, the percolation rate measurements shall be made as follows:

a. Any soil that has sloughed into the hole shall be removed and water shall be adjusted to 6 inches over the gravel.

b. Thereupon, from the fixed reference point, the water level shall be measured and recorded at approximately 30 minute intervals for a period of four hours. ~~, unless two successive water level drops do not vary more than 1/16 of an inch and indicate that an approximate stabilized rate has been obtained.~~

i. If 6 inches of water seeps away in less than ~~15~~ 30 minutes, a shorter time interval of 15 minutes between measurements may be used.

ii. If 6 inches of water seeps away in less than ~~30~~15 minutes, a shorter time interval of ~~1~~5 minutes between measurements may be used.

iii. Eight consecutive time intervals shall be recorded unless two successive water level drops do not vary more than 1/16 of an inch and indicate that an approximate stabilized rate has been obtained.

c. The hole shall be filled with 6 inches of clear water above the gravel after each time interval.

d. In no case shall the water depth exceed 6 inches above the gravel.

e. The final water level drop shall be used to calculate the percolation rate.

i. If no stabilized rate is achieved, the smallest drop shall be used to make this calculation.

f. Precautions shall be taken to prohibit water or soil from freezing during the test procedure.

10. Test Procedure for Type 1 and Type 2 Soils.
The hole shall be carefully filled with clear water to a minimum depth of 12 inches over the gravel and the time for this amount of water to seep away shall be determined. The procedure shall be repeated and if the water from the second filling of the hole at least 12 inches above the gravel seeps away in 10 minutes or less, the test may proceed immediately as follows:

a. Water shall be added to a point not more than 6 inches above the gravel.

b. Thereupon, from the fixed reference point, water levels shall be measured at 10 minute intervals for a period of one hour.

i. If 6 inches of water seeps away in less than 10 minutes, a shorter time interval of 5 minutes between measurements may be used.

ii. Six consecutive time intervals shall be recorded unless two successive water level drops do not vary more than 1/16 of an inch and indicate that an approximate stabilized rate has been obtained.

c. The hole shall be filled with 6 inches of clear water above the gravel after each time interval.

d. In no case shall the water depth exceed 6 inches above the gravel.

e. The final water level drop shall be used to calculate the percolation rate.

i. If no stabilized rate is achieved, the smallest drop shall be used to make this calculation.

11. Calculation of Percolation Rate.
The percolation rate is equal to the time elapsed in minutes for the water column to drop, divided by the distance the water dropped in inches and fractions thereof.

12. Using Percolation Rate to Determine Absorption Area.
The minimum or slowest percolation rate shall be used in calculating the required absorption area.

APPENDIX E. TANK OPERATION AND MAINTENANCE.

1.1. Maintenance of Septic Tanks.

A. Septic tanks shall be emptied before too much sludge or scum is allowed to accumulate and seriously reduce the tank volume settling depth. If either the settled solids or floating scum layer accumulate too close to the bottom of the outlet baffle or bottom of the sanitary tee pipe in the tank, solid particles will overflow into the absorption system and eventually clog the soil and ruin its absorption capacity.

B. A septic tank that receives normal loading should be inspected as indicated in Section R317-4-11 to determine if it needs emptying. Although there are wide differences in the rate that sludge and scum accumulate in tanks, a septic tank for a private residence will generally require emptying every three to five years. Actual measurement of scum and sludge accumulation is the only sure way to determine when a tank needs to be emptied. Experience for a particular system may indicate the desirability of longer or shorter intervals between inspections.

C. The tank should be completely emptied if either the bottom of the floating scum mat is within 3 inches of the bottom of the outlet baffle or tee or the sludge level has built up to approximately 12 inches from the bottom of the outlet baffle or tee, or the scum and sludge layers together equal 40% or more of the tank volume. All scum and solids should be washed out and removed from the tank.

D. If multiple tanks or tanks with multiple compartments are provided, care should be taken to ensure that each tank or compartment is inspected and emptied.

E. Septic tank wastes contain disease causing organisms and shall be disposed of only in areas and in a manner that is acceptable to local health authorities and consistent with State rules.

F. Immediate replacement of damaged inlet or outlet fittings in the septic tank is essential for effective operation of the system.

G. Effluent screens or filters.
Remove the filter in a manner that prevents solids from passing to the absorption system. Wash the filter over the inlet side of septic tank. Replace the cleaned filter back into the outlet tee.

H. When the tank is empty, the interior surfaces of the tank should be inspected for leaks or cracks using a strong light.

I. A written record of all maintenance of the septic tank and absorption system should be kept by the owner of that system.

J. The functional operation of septic tanks is not improved by the addition of yeasts, disinfectants, additives or other chemicals; therefore, use of these materials is not recommended.

K. The advice of your regulatory authority should be sought before chemicals arising from a hobby or home industry or other unusual activities are discharged into a septic tank system.

L. Economy in the use of water helps prevent overloading of a septic tank system that could shorten its life and necessitate expensive repairs. The plumbing fixtures in the building should be checked regularly to repair any leaks that can add substantial amounts of water to the system. Industrial wastes and other liquids that may adversely affect the operation of the onsite wastewater system should not be discharged into such a system. Paper towels, facial tissue, disinfectant wipes, newspaper, wrapping paper, disposable diapers, sanitary napkins, coffee grounds, rags, sticks, and similar materials should also be excluded from the septic tank since they do not readily decompose and can lead to clogging of both the plumbing and the absorption system.

1.2. Maintenance of Other Tanks.

A. Other Tanks.
Any measurable amount of sludge or scum present in other tanks should be removed.

B. If a screen is present, it should be rinsed and cleaned over the opening of the septic tank.

Key: waste water, onsite wastewater systems, alternative wastewater systems, septic tanks

Date of Enactment or Last Substantive Amendment: September 1, 2013

Notice of Continuation: February 10, 2010

Authorizing, Implemented or Interpreted Law: 19-5-104

State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

TO: Water Quality Board Members

THROUGH: Walter L. Baker, P.E.

FROM: Chris Bittner, Standards Coordinator

DATE: September 2, 2015

SUBJECT: Request to the Water Quality Board for a Change in Proposed Rule and Adoption with an effective date of November 30, 2015 for R317-2 Standards of Quality for Waters of the State.

As approved by the Board at the April 2015 meeting, staff initiated rulemaking for revisions to Utah's water quality standards. The revisions were noticed in the May 15, 2015 Utah Bulletin, a public hearing was held June 29, 2015, and the public comment period ended on July 6, 2015. No one commented at the public hearing but comments were submitted by USEPA Region 8 on the proposed revisions. The comments resulted in additional revisions as shown in green highlighting in Attachment 1 to this memorandum. The USEPA comments are presented in Attachment 2 and staff responses are presented in Attachment 3.

Staff requests that the Board approve the change in proposed rule and adopt all of the changes with an effective date of November 30, 2015. In accordance with Utah's administrative procedures, a Change in Proposed Rule will be public noticed for at least 30 days prior to being made effective.

Utah's water quality standards are set at concentrations that will protect the use. For total dissolved solids (salt), the standard is 1,200 mg/l to protect the yield for crops that are sensitive to the salt content of the irrigation water. Many streams and rivers in Utah exceed 1,200 mg/l because of natural conditions. In these situations, Utah's water quality standards and the federal Clean Water Act allow for the standard to be set at the natural background concentrations. However, USEPA has not issued any guidance on how standards based on natural background conditions should be derived.

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USEPA Region 8 advocates for standards based on natural background conditions to be set at concentrations where there is no question that the standard is not higher than the natural conditions. This results in Region 8 primarily focusing on the potential for the standard being too high because this is the simplest way for the standard to be defensible for USEPA. Staff supports that these standards must be representative of natural conditions but the standards should be neither too high nor too low. If the standard is too high, the agricultural uses could be harmed. If the standard is too low, permittees may be forced to do unnecessary treatment and Blue Creek could erroneously be classified as water quality impaired.

As documented in the response to comments presented in Attachment 3, philosophical disagreements remain between staff and USEPA regarding the most appropriate statistical parameters to represent natural conditions. For the Blue Creek site-specific standard, staff is recommending a compromise by reducing the maximum criteria. The revised maximum criteria are statistical estimates of the 90^{th} percentile (90% of measured TDS concentrations will be lower). Utah's standards allow for up to 10 percent of the measurements to exceed the TDS standard, so the 90^{th} percentile maximum is technically and legally defensible. The lower maximums are unlikely to adversely affect the existing permitted discharge to Blue Creek. While false positive water quality impairment decisions are expected to be infrequent, if they do occur, additional sampling should be adequate to address them.

USEPA Region 8 is expected to approve the revised maximum criteria but if they do not, the revised standards cannot be implemented into UPDES discharge permits. One permit is currently affected by the site-specific total dissolved solids standard and this permit has been administratively extended for many years beyond its normal expiration date while the total dissolved solids standards issues were resolved. Staff recommends that the Board approve the Change in Proposed Rule and adopt the changes.

A summary of the changes in proposed rule are summarized in Table 1 below and the revisions unchanged because of comments are shown in Table 2. All changes will be effective on the implementation date specified by the Board Order shown as Attachment 3.

Staff will continue to work with USEPA and the Water Quality Standards Workgroup to resolve the issues with standards based on natural conditions because over the next 5 years, staff anticipates that revised standards for total dissolved solids will be necessary for several streams and rivers. Some of these other locations, for instance, the Jordan River, affect many more discharge permits and are considered a higher priority for resolution than Blue Creek.

Table 1

Summary of Changes in Proposed Rules to R317-2 Standards of Quality for Waters of the State

Rule Number	Description of Change
R317-2-7.1	The new explicit condition that was added was deleted for when background concentration of a pollutant is higher than the applicable water quality criterion, the criterion will be the background concentration. Staff will return to the Water Quality Standards Workgroup to develop a definition of "natural conditions" and staff anticipates returning to the Board in the future for this revision.
Table 2.14.1 Footnote 4	The site-specific TDS criteria for Blue Creek were revised as a result of comments received by USEPA. The daily maximum total dissolved standards were changed from 7,200 to 4,900 mg/l and 7,500 to 6,300 mg/l for the summer and winter seasons, respectively. The comparison values for assessing the average criteria were deleted because the comparison values proposed are sensitive to the number of assessment samples available. This change is also consistent with how most of Utah's standards are already assessed using methods specified in the *Intgegrated Reports*.
Table 2.14.1 Footnote 4	The site-specific TDS criteria for Blue Creek reservoir was revised from a maximum of 2,200 mg/l to a daily maximum of 2,100 mg/l by using the same methodology applied to Blue Creek.

Table 2 **Summary of Changes to R317-2 Standards of Quality for Waters of the State Not Changed by Response to Public Comments**	
Rule Number	Description of Change
Table 2.14.2	The aquatic life criteria for gross alpha were changed to indicators. Footnote 10 that applies to the other pollutant indicators also previously applied to gross alpha. Gross alpha is a non-specific measurement and the source of the radioactivity should be determined if the gross alpha (or beta) indicators are exceeded. Criteria for gross alpha and beta remain for Class 1C and Class 4 waters. USEPA does not have aquatic life use criteria for gross alpha or beta.
Table 2.14.2	Footnote 13 was deleted because the formula for calculating hydrogen sulfide could not be verified in either USEPA or Standard Methods and produces erroneous results at low pH. Absent the footnote, hydrogen sulfide concentrations will be determined in accordance with approved analytical methods.
Table 2.14.3b	Missing parentheses were added to correct formulas for the calculating acute aquatic life criteria for nickel, silver, and zinc.

ATTACHMENT 1

Mark-Up of PROPOSED REVISIONS TO R317-2
STANDARDS OF QUALITY FOR WATERS OF THE STATE

Un-revised changes proposed from April 2015 are shown in yellow highlighting with strikeout and underlining.

September 2015 Revisions to proposed changes are shown in green highlighting with strikeout and underlining.

R317. Environmental Quality, Water Quality.
R317-2. Standards of Quality for Waters of the State.

-----BREAK----

R317-2-7. Water Quality Standards.

7.1 Application of Standards

a. The numeric criteria listed in R317-2-14 shall apply to each of the classes assigned to waters of the State as specified in R317-2-6. It shall be unlawful and a violation of these rules for any person to discharge or place any wastes or other substances in such manner as may interfere with designated uses protected by assigned classes or to cause any of the applicable standards to be violated, except as provided in R317-1-3.1.

b. At a minimum, assessment of the beneficial use support for waters of the state will be conducted biennially and available for a 30-day period of public comment and review. Monitoring locations and target indicators of water quality standards shall be prioritized and published yearly. For water quality assessment purposes, up to 10 percent of the representative samples may exceed the minimum or maximum criteria for dissolved oxygen, pH, E. coli, total dissolved solids, and temperature, including situations where such criteria have been adopted on a site-specific basis.

c. Site-specific standards may be adopted by rulemaking where biomonitoring data, bioassays, or other scientific analyses indicate that the statewide criterion is over or under protective of the designated uses or where natural or un-alterable conditions or other factors as defined in 40 CFR 131.10(g) prevent the attainment of the statewide criteria as prescribed in Subsections R317-2-7.2, and R317-2-7.3, and Section R317-2-14.~~When it is~~

~~determined that natural background level of a pollutant is less stringent than the otherwise applicable criterion, the water quality criterion will be equal to the natural background concentration.~~

7.2 Narrative Standards

It shall be unlawful, and a violation of these rules, for any person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste; or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by bioassay or other tests performed in accordance with standard procedures; or determined by biological assessments in Subsection R317-2-7.3.

7.3 Biological Water Quality Assessment and Criteria

Waters of the State shall be free from human-induced stressors which will degrade the beneficial uses as prescribed by the biological assessment processes and biological criteria set forth below:

a. Quantitative biological assessments may be used to assess whether the purposes and designated uses identified in R317-2-6 are supported.

b. The results of the quantitative biological assessments may be used for purposes of water quality assessment, including, but not limited to, those assessments required by 303(d) and 305(b) of the federal Clean Water Act (33 U.S.C. 1313(d) and 1315(b)).

c. Quantitative biological assessments shall use documented methods that have been subject to technical review and produce consistent, objective and repeatable results that account for methodological uncertainty and natural environmental variability.

d. If biological assessments reveal a biologically degraded water body, specific pollutants responsible for the degradation will not be formally published (i.e., Biennial Integrated Report, TMDL) until a thorough evaluation of potential causes, including nonchemical stressors (e.g., habitat degradation or hydrological modification or criteria described in 40 CFR 131.10 (g)(1 - 6) as defined by the Use Attainability Analysis process), has been conducted.

-----BREAK----

R317-2-14. Numeric Criteria.

TABLE 2.14.1
NUMERIC CRITERIA FOR DOMESTIC,
RECREATION, AND AGRICULTURAL USES

Parameter	Domestic Source	Recreation and Aesthetics		Agri-culture
	1C	2A	2B	4
BACTERIOLOGICAL (30-DAY GEOMETRIC MEAN) (NO.)/100 ML) (7)				
E. coli	206	126	206	
MAXIMUM (NO.)/100 ML) (7)				
E. coli	668	409	668	
PHYSICAL				
pH (RANGE)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
Turbidity Increase (NTU)		10	10	
METALS (DISSOLVED, MAXIMUM MG/L) (2)				
Arsenic	0.01			0.1
Barium	1.0			
Beryllium	<0.004			
Cadmium	0.01			0.01
Chromium	0.05			0.10
Copper				0.2
Lead	0.015			0.1
Mercury	0.002			
Selenium	0.05			0.05
Silver	0.05			
INORGANICS (MAXIMUM MG/L)				
Bromate	0.01			
Boron				0.75

Chlorite	<1.0			
Fluoride (3)	1.4-2.4			
Nitrates as N	10			
Total Dissolved Solids (4)				1200
	RADIOLOGICAL			
(MAXIMUM pCi/L)				
Gross Alpha	15			15
Gross Beta	4 mrem/yr		Radium 226, 228	
(Combined)	5			
Strontium 90	8			
Tritium	20000			
Uranium	30			
ORGANICS (MAXIMUM UG/L)				
Chlorophenoxy Herbicides				
2,4-D	70			
2,4,5-TP	10	Methoxychlor		40
POLLUTION INDICATORS (5)				
BOD (MG/L)		5	5	5
Nitrate as N (MG/L)		4	4	
Total Phosphorus as P (MG/L)(6)		0.05	0.05	

FOOTNOTES:

(1) Reserved

(2) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by approved laboratory methods for the required detection levels.

(3) Maximum concentration varies according to the daily maximum mean air temperature.

TEMP (C)	MG/L
12.0	2.4
12.1-14.6	2.2
14.7-17.6	2.0
17.7-21.4	1.8

21.5-26.2	1.6
26.3-32.5	1.4

(4) SITE SPECIFIC STANDARDS FOR TOTAL DISSOLVED SOLIDS (TDS)

Blue Creek and tributaries, Box Elder County, from ~~Gunnison~~ Bear River Bay. Great Salt Lake to Blue Creek Reservoir: ~~maximum 6,300 mg/l and an average of 3,900 mg/l~~March through October daily maximum 4,900 ~~7,200~~ mg/l and an average of 3,800 mg/l; November through February daily maximum 6,300 ~~7,500~~ mg/l and an average of 4,700 mg/l. Assessments will be based on TDS concentrations measured at the location of STORET 4960740. ~~At least 10 samples are required to assess compliance with the average criterion. If the sample average for samples collected from March through October is equal to or less than 4,100 mg/l and the sample average for samples collected from November through February is equal to or less than 5,300 mg/l, the average criteria are met. Alternative scientifically defensible assessment methods may be applied for assessing the average criteria.~~

Blue Creek Reservoir and tributaries, Box Elder County, daily maximum 2,100 ~~2,200~~ mg/l

Castle Creek from confluence with the Colorado River to Seventh Day Adventist Diversion: 1,800 mg/l;

Cottonwood Creek from the confluence with Huntington Creek to I-57: 3,500 mg/l;

Ferron Creek from the confluence with San Rafael River to Highway 10: 3,500 mg/l;

Huntington Creek and tributaries from the confluence with Cottonwood Creek to U-10: 4,800 mg/l;

Ivie Creek and its tributaries from the confluence with Muddy Creek to the confluence with Quitchupah Creek: 3,800 mg/l provided that total sulfate not exceed 2,000 mg/l to protect the livestock watering agricultural existing use;

Ivie Creek and its tributaries from the confluence with Quitchupah Creek to U10: 2,600 mg/l;

Lost Creek from the confluence with Sevier River to U.S. Forest Service Boundary: 4,600 mg/l;

Muddy Creek and tributaries from the confluence with Ivie Creek toU-10: 2,600 mg/l;

Muddy Creek from confluence with Fremont River to confluence with Ivie Creek: 5,800 mg/l;

North Creek from the confluence with Virgin River to headwaters: 2,035 mg/l;

Onion Creek from the confluence with Colorado River to road crossing above Stinking Springs: 3000 mg/l;

Brine Creek-Petersen Creek, from the confluence with the Sevier River to U-119 Crossing: 9,700 mg/l;

Price River and tributaries from confluence with Green River to confluence with Soldier Creek: 3,000 mg/l;

Price River and tributaries from the confluence with Soldier Creek to Carbon Canal Diversion: 1,700 mg/l

Quitchupah Creek from the confluence with Ivie Creek to U-10: 3,800 mg/l provided that total sulfate not exceed 2,000 mg/l to protect the livestock watering agricultural existing use;
Rock Canyon Creek from the confluence with Cottonwood Creek to headwaters: 3,500 mg/l;

San Pitch River from below Gunnison Reservoir to the Sevier River: 2,400 mg/l;

San Rafael River from the confluence with the Green River to Buckhorn Crossing: 4,100 mg/l;

San Rafael River from the Buckhorn Crossing to the confluence with Huntington Creek and Cottonwood Creek: 3,500 mg/l;

Sevier River between Gunnison Bend Reservoir and DMAD Reservoir: 1,725 mg/l;

Sevier River from Gunnison Bend Reservoir to Clear Lake: 3,370 mg/l;

South Fork Spring Creek from confluence with Pelican Pond Slough Stream to US 89 1,450 mg/l (Apr.-Sept.)
1,950 mg/l (Oct.-March)

Virgin River from the Utah/Arizona border to Pah Tempe Springs: 2,360 mg/l

(5) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(6) Total Phosphorus as P (mg/l) indicator for lakes and reservoirs shall be 0.025.

(7) Where the criteria are exceeded and there is a reasonable basis for concluding that the indicator bacteria E. coli are primarily from natural sources (wildlife), e.g., in National Wildlife Refuges and State Waterfowl Management Areas, the criteria may be considered attained provided the density attributable to non-wildlife sources is less than the criteria. Exceedences of E. coli from nonhuman nonpoint sources will generally be addressed through appropriate Federal, State, and local nonpoint source programs.

Measurement of E. coli using the "Quanti-Tray 2000" procedure is approved as a field analysis. Other EPA approved methods may also be used.

For water quality assessment purposes, up to 10% of representative samples may exceed the 668 per 100 ml criterion(for 1C and 2B waters) and 409 per 100 ml (for 2A waters). For small datasets, where exceedences of these criteria are observed, follow-up ambient monitoring should be conducted to better characterize water quality.

TABLE 2.14.2
NUMERIC CRITERIA FOR AQUATIC WILDLIFE(8)

Parameter	Aquatic Wildlife				
	3A	3B	3C	3D	5
PHYSICAL					
Total Dissolved Gases	(1)	(1)			

Minimum Dissolved Oxygen (MG/L) (2)(2a)				
30 Day Average	6.5	5.5	5.0	5.0
7 Day Average	9.5/5.0	6.0/4.0		
Minimum	8.0/4.0	5.0/3.0	3.0	3.0
Max. Temperature(C)(3)	20	27	27	
Max. Temperature Change (C)(3)	2	4	4	
pH (Range)(2a)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
Turbidity Increase (NTU)	10	10	15	15
METALS (4) (DISSOLVED, UG/L)(5)				
Aluminum				
4 Day Average (6)	87	87	87	87
1 Hour Average	750	750	750	750
Arsenic (Trivalent)				
4 Day Average	150	150	150	150
1 Hour Average	340	340	340	340
Cadmium (7)				
4 Day Average	0.25	0.25	0.25	0.25
1 Hour Average	2.0	2.0	2.0	2.0
Chromium (Hexavalent)				
4 Day Average	11	11	11	11
1 Hour Average	16	16	16	16
Chromium (Trivalent) (7)				
4 Day Average	74	74	74	74
1 Hour Average	570	570	570	570
Copper (7)				
4 Day Average	9	9	9	9
1 Hour Average	13	13	13	13
Cyanide (Free)				
4 Day Average	5.2	5.2	5.2	

1 Hour Average	22	22	22	22	
Iron (Maximum)	1000	1000	1000	1000	
Lead (7)					
4 Day Average	2.5	2.5	2.5	2.5	
1 Hour Average	65	65	65	65	
Mercury					
4 Day Average	0.012	0.012	0.012	0.012	
Nickel (7)					
4 Day Average	52	52	52	52	
1 Hour Average	468	468	468	468	
Selenium					
4 Day Average	4.6	4.6	4.6	4.6	
1 Hour Average	18.4	18.4	18.4	18.4	
Selenium (14) Gilbert Bay (Class 5A) Great Salt Lake Geometric Mean over Nesting Season (mg/kg dry wt)					12.5
Silver					
1 Hour Average (7)	1.6	1.6	1.6	1.6	
Tributyltin					
4 Day Average	0.072	0.072	0.072	0.072	
1 Hour Average	0.46	0.46	0.46	0.46	
Zinc (7)					
4 Day Average	120	120	120	120	
1 Hour Average	120	120	120	120	
INORGANICS (MG/L) (4)					
Total Ammonia as N (9)					
30 Day Average	(9a)	(9a)	(9a)	(9a)	
1 Hour Average	(9b)	(9b)	(9b)	(9b)	
Chlorine (Total Residual)					
4 Day Average	0.011	0.011	0.011	0.011	
1 Hour Average	0.019	0.019	0.019	0.019	

Hydrogen Sulfide ~~(13)~~				
(Undissociated,				
Max. UG/L)	2.0	2.0	2.0	2.0
Phenol(Maximum)	0.01	0.01	0.01	0.01
RADIOLOGICAL	(MAXIMUM pCi/L)			
~~Gross Alpha (10)~~	~~15~~	~~15~~	~~15~~	~~15~~
ORGANICS (UG/L) (4)				
Acrolein				
4 Day Average	3.0	3.0	3.0	3.0
1 Hour Average	3.0	3.0	3.0	3.0
Aldrin				
1 Hour Average	1.5	1.5	1.5	1.5
Chlordane				
4 Day Average	0.0043	0.0043	0.0043	0.0043
1 Hour Average	1.2	1.2	1.2	1.2
Chlorpyrifos				
4 Day Average	0.041	0.041	0.041	0.041
1 Hour Average	0.083	0.083	0.083	0.083
4,4' -DDT				
4 Day Average	0.0010	0.0010	0.0010	0.0010
1 Hour Average	0.55	0.55	0.55	0.55
Diazinon				
4 Day Average	0.17	0.17	0.17	0.17
1 Hour Average	0.17	0.17	0.17	0.17
Dieldrin				
4 Day Average	0.056	0.056	0.056	0.056
1 Hour Average	0.24	0.24	0.24	0.24
Alpha-Endosulfan				
4 Day Average	0.056	0.056	0.056	0.056
1 Hour Average	0.11	0.11	0.11	0.11
beta-Endosulfan				
4 Day Average	0.056	0.056	0.056	0.056
1 Day Average	0.11	0.11	0.11	0.11
Endrin				
4 Day Average	0.036	0.036	0.036	0.036

1 Hour Average	0.086	0.086	0.086	0.086
Heptachlor				
4 Day Average	0.0038	0.0038	0.0038	0.0038
1 Hour Average	0.26	0.26	0.26	0.26
Heptachlor epoxide				
4 Day Average	0.0038	0.0038	0.0038	0.0038
1 Hour Average	0.26	0.26	0.26	0.26
Hexachlorocyclohexane (Lindane)				
4 Day Average	0.08	0.08	0.08	0.08
1 Hour Average	1.0	1.0	1.0	1.0
Methoxychlor (Maximum)	0.03	0.03	0.03	0.03
Mirex (Maximum)	0.001	0.001	0.001	0.001
Nonylphenol				
4 Day Average	6.6	6.6	6.6	6.6
1 Hour Average	28.0	28.0	28.0	28.0
Parathion				
4 Day Average	0.013	0.013	0.013	0.013
1 Hour Average	0.066	0.066	0.066	0.066
PCB's				
4 Day Average	0.014	0.014	0.014	0.014
Pentachlorophenol (11)				
4 Day Average	15	15	15	15
1 Hour Average	19	19	19	19
Toxaphene				
4 Day Average	0.0002	0.0002	0.0002	0.0002
1 Hour Average	0.73	0.73	0.73	0.73
POLLUTION INDICATORS (~~11~~10)				
Gross Alpha (pCi/L)	15	15	15	15
Gross Beta (pCi/L)	50	50	50	50
BOD (MG/L)	5	5	5	5
Nitrate as N (MG/L)	4	4	4	

Total Phosphorus as P(MG/L) (12)	0.05	0.05

FOOTNOTES:

(1) Not to exceed 110% of saturation.

(2) These limits are not applicable to lower water levels in deep impoundments. First number in column is for when early life stages are present, second number is for when all other life stages present.

(2a) These criteria are not applicable to Great Salt Lake impounded wetlands. Surface water in these wetlands shall be protected from changes in pH and dissolved oxygen that create significant adverse impacts to the existing beneficial uses. To ensure protection of uses, the Director shall develop reasonable protocols and guidelines that quantify the physical, chemical, and biological integrity of these waters. These protocols and guidelines will include input from local governments, the regulated community, and the general public. The Director will inform the Water Quality Board of any protocols or guidelines that are developed.

(3) Site Specific Standards for Temperature
Ken's Lake: From June 1st - September 20th, 27 degrees C.

(4) Where criteria are listed as 4-day average and 1-hour average concentrations, these concentrations should not be exceeded more often than once every three years on the average.

(5) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels.

(6) The criterion for aluminum will be implemented as follows:

Where the pH is equal to or greater than 7.0 and the hardness is equal to or greater than 50 ppm as CaC03 in the receiving water after mixing, the 87 ug/1 chronic criterion (expressed as total recoverable) will not apply, and aluminum will be regulated based on compliance with the 750 ug/1 acute aluminum criterion (expressed as total recoverable).

(7) Hardness dependent criteria. 100 mg/l used. Conversion factors for ratio of total recoverable metals to dissolved metals must also be applied. In waters with a hardness greater than 400 mg/l as CaC03, calculations will assume a hardness of 400 mg/l as CaC03. See Table 2.14.3 for complete equations for hardness and conversion factors.

(8) Reserved

(9) The following equations are used to calculate Ammonia criteria concentrations:

(9a) The thirty-day average concentration of total ammonia nitrogen (in mg/l as N) does not exceed, more than once every three years on the average, the chronic criterion calculated using the following equations.

Fish Early Life Stages are Present:

mg/l as N (Chronic) = $((0.0577/(1+10^{7.688-pH})) + (2.487/(1+10^{pH-7.688}))) * MIN (2.85, 1.45*10^{0.028*(25-T)})$

Fish Early Life Stages are Absent:

mg/1 as N (Chronic) = $((0.0577/(1+10^{7.688-pH})) + (2.487/(1+10^{pH-7.688}))) * 1.45*10^{0.028* (25-MAX(T,7))})$

(9b) The one-hour average concentration of total ammonia nitrogen (in mg/l as N) does not exceed, more than once every three years on the average the acute criterion calculated using the following equations.

Class 3A:

mg/l as N (Acute) = $(0.275/(1+10^{7.204-pH})) + (39.0/1+10^{pH-7.204}))$

Class 3B, 3C, 3D:

mg/l as N (Acute) = $0.411/(1+10^{7.204-pH})) + (58.4/(1+10^{pH-7.204}))$

In addition, the highest four-day average within the 30-day period should not exceed 2.5 times the chronic criterion. The "Fish Early Life Stages are Present" 30-day average total ammonia criterion will be applied by default unless it is determined by the Director, on a site-specific basis, that it is appropriate to apply the "Fish Early Life Stages are Absent" 30-day average criterion for all or some portion of the year. At a minimum, the "Fish Early Life Stages are Present" criterion will apply from the beginning of spawning through the end of the early life stages. Early life stages include the pre-hatch embryonic stage, the post-hatch free embryo or yolk-sac fry stage, and the larval stage for the species of fish expected to occur at the site. The Director will consult with the Division of Wildlife Resources in making such determinations. The Division will maintain information regarding the waterbodies and time periods where application of the "Early Life Stages are Absent" criterion is determined to be appropriate.

(10) Investigation should be conducted to develop more information where these levels are exceeded.

(11) pH dependent criteria. pH 7.8 used in table. See Table 2.14.4 for equation.

(12) Total Phosphorus as P (mg/l) as a pollution indicator

for lakes and reservoirs shall be 0.025.

(13) ~~Formula to convert dissolved sulfide to un-disassociated hydrogen sulfide is: H_2S = Dissolved Sulfide * $e^{((-1.92 + pH) + 12.05)}$~~Reserved

(14) The selenium water quality standard of 12.5 (mg/kg dry weight) for Gilbert Bay is a tissue based standard using the complete egg/embryo of aquatic dependent birds using Gilbert Bay based upon a minimum of five samples over the nesting season. Assessment procedures are incorporated as a part of this standard as follows:

Egg Concentration Triggers: DWQ Responses

Below 5.0 mg/kg: Routine monitoring with sufficient intensity to determine if selenium concentrations within the Great Salt Lake ecosystem are increasing.

5.0 mg/kg: Increased monitoring to address data gaps, loadings, and areas of uncertainty identified from initial Great Salt Lake selenium studies.

6.4 mg/kg: Initiation of a Level II Antidegradation review by the State for all discharge permit renewals or new discharge permits to Great Salt Lake. The Level II Antidegradation review may include an analysis of loading reductions.

9.8 mg/kg: Initiation of preliminary TMDL studies to evaluate selenium loading sources.

12.5 mg/kg and above: Declare impairment. Formalize and implement TMDL.

Antidegradation
Level II Review procedures associated with this standard are referenced at R317-2-3.5.C.

TABLE
1-HOUR AVERAGE (ACUTE) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/L)

pH	Class 3A	Class 3B, 3C, 3D
6.5	32.6	48.8
6.6	31.3	46.8
6.7	29.8	44.6

6.8	28.1	42.0
6.9	26.2	39.1
7.0	24.1	36.1
7.1	22.0	32.8
7.2	19.7	29.5
7.3	17.5	26.2
7.4	15.4	23.0
7.5	13.3	19.9
7.6	11.4	17.0
7.7	9.65	14.4
7.8	8.11	12.1
7.9	6.77	10.1
8.0	5.62	8.40
8.1	4.64	6.95
8.2	3.83	5.72
8.3	3.15	4.71
8.4	2.59	3.88
8.5	2.14	3.20
8.6	1.77	2.65
8.7	1.47	2.20
8.8	1.23	1.84
8.9	1.04	1.56
9.0	0.89	1.32

TABLE
30-DAY AVERAGE (CHRONIC) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/l)

Fish Early Life Stages Present
Temperature, C

pH	0	14	16	18	20	22	24	26	28	30
6.5	6.67	6.67	6.06	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	6.57	6.57	5.97	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	6.44	6.44	5.86	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	6.29	6.29	5.72	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	6.12	6.12	5.56	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	5.91	5.91	5.37	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	5.67	5.67	5.15	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	5.39	5.39	4.90	4.31	3.78	3.33	2.92	2.57	2.26	1.99
7.3	5.08	5.08	4.61	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	4.73	4.73	4.30	3.78	3.32	2.92	2.57	2.26	1.98	1.74
7.5	4.36	4.36	3.97	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.98	3.98	3.61	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	3.58	3.58	3.25	2.86	2.51	2.21	1.94	1.71	1.50	1.32

7.8	3.18	3.18	2.89	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.80	2.80	2.54	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	2.43	2.43	2.21	1.94	1.71	1.50	1.32	1.16	1.02	0.90
8.1	2.10	2.10	1.91	1.68	1.47	1.29	1.14	1.00	0.88	0.77
8.2	1.79	1.79	1.63	1.43	1.26	1.11	0.97	0.86	0.75	0.66
8.3	1.52	1.52	1.39	1.22	1.07	0.94	0.83	0.73	0.64	0.56
8.4	1.29	1.29	1.17	1.03	0.91	0.80	0.70	0.62	0.54	0.48
8.5	1.09	1.09	0.99	0.87	0.76	0.67	0.59	0.52	0.46	0.40
8.6	0.92	0.92	0.84	0.73	0.65	0.57	0.50	0.44	0.39	0.34
8.7	0.78	0.78	0.71	0.62	0.55	0.48	0.42	0.37	0.33	0.29
8.8	0.66	0.66	0.60	0.53	0.46	0.41	0.36	0.32	0.28	0.24
8.9	0.56	0.56	0.51	0.45	0.40	0.35	0.31	0.27	0.24	0.21
9.0	0.49	0.49	0.44	0.39	0.34	0.30	0.26	0.23	0.20	0.18

TABLE
30-DAY AVERAGE (CHRONIC) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/l)

Fish Early Life Stages Absent

pH	Temperature, C								
	0-7	8	9	10	11	12	13	14	16
6.5	10.8	10.1	9.51	8.92	8.36	7.84	7.36	6.89	6.06
6.6	10.7	10.1	9.37	9.37	8.79	8.24	7.72	7.24	6.36
6.7	10.5	9.99	9.20	8.62	8.08	7.58	7.11	6.66	5.86
6.8	10.2	9.81	8.98	8.42	7.90	7.40	6.94	6.51	5.72
6.9	9.93	9.31	8.73	8.19	7.68	7.20	6.75	6.33	5.56
7.0	9.60	9.00	8.43	7.91	7.41	6.95	6.52	6.11	5.37
7.1	9.20	8.63	8.09	7.58	7.11	6.67	6.25	5.86	5.15
7.2	8.75	8.20	7.69	7.21	6.76	6.34	5.94	5.57	4.90
7.3	8.24	7.73	7.25	6.79	6.37	5.97	5.60	5.25	4.61
7.4	7.69	7.21	6.76	6.33	5.94	5.57	5.22	4.89	4.30
7.5	7.09	6.64	6.23	5.84	5.48	5.13	4.81	4.51	3.97
7.6	6.46	6.05	5.67	5.32	4.99	4.68	4.38	4.11	3.61
7.7	5.81	5.45	5.11	4.79	4.49	4.21	3.95	3.70	3.25
7.8	5.17	4.84	4.54	4.26	3.99	3.74	3.51	3.29	2.89
7.9	4.54	4.26	3.99	3.74	3.51	3.29	3.09	2.89	2.54
8.0	3.95	3.70	3.47	3.26	3.05	2.86	2.68	2.52	2.21
8.1	3.41	3.19	2.99	2.81	2.63	2.47	2.31	2.17	1.91
8.2	2.91	2.73	2.56	2.40	2.25	2.11	1.98	1.85	1.63
8.3	2.47	2.32	2.18	2.04	1.91	1.79	1.68	1.58	1.39
8.4	2.09	1.96	1.84	1.73	1.62	1.52	1.42	1.33	1.17
8.5	1.77	1.66	1.55	1.46	1.37	1.28	1.20	1.13	0.990
8.6	1.49	1.40	1.31	1.23	1.15	1.08	1.01	0.951	0.836
8.7	1.26	1.18	1.11	1.04	0.976	0.915	0.858	0.805	0.707

8.8	1.07	1.01	0.944	0.885	0.829	0.778	0.729	0.684	0.601
8.9	0.917	0.860	0.806	0.758	0.709	0.664	0.623	0.584	0.513
9.0	0.790	0.740	0.694	0.651	0.610	0.572	0.536	0.503	0.442

pH	18	20	22	24	26	28	30
6.5	5.33	4.68	4.12	3.62	3.18	2.80	2.46
6.6	5.25	4.61	4.05	3.56	3.13	2.75	2.42
6.7	5.15	4.52	3.98	3.50	3.07	2.70	2.37
6.8	5.03	4.42	3.89	3.42	3.00	2.64	2.32
6.9	4.89	4.30	3.78	3.32	2.92	2.57	2.25
7.0	4.72	4.15	3.65	3.21	2.82	2.48	2.18
7.1	4.53	3.98	3.50	3.08	2.70	2.38	2.09
7.2	4.41	3.78	3.33	2.92	2.57	2.26	1.99
7.3	4.06	3.57	3.13	2.76	2.42	2.13	1.87
7.4	3.78	3.32	2.92	2.57	2.26	1.98	1.74
7.5	3.49	3.06	2.69	2.37	2.08	1.83	1.61
7.6	3.18	2.79	2.45	2.16	1.90	1.67	1.47
7.7	2.86	2.51	2.21	1.94	1.71	1.50	1.32
7.8	2.54	2.23	1.96	1.73	1.52	1.33	1.17
7.9	2.24	1.96	1.73	1.52	1.33	1.17	1.03
8.0	0.94	1.71	1.50	1.32	1.16	1.02	0.897
8.1	0.68	1.47	1.29	1.14	1.00	0.879	0.733
8.2	0.43	1.26	1.11	0.073	0.855	0.752	0.661
8.3	0.22	1.07	0.941	0.827	0.727	0.639	0.562
8.4	0.03	0.906	0.796	0.700	0.615	0.541	0.475
8.5	0.870	0.765	0.672	0.591	0.520	0.457	0.401
8.6	0.735	0.646	0.568	0.499	0.439	0.396	0.339
8.7	0.622	0.547	0.480	0.422	0.371	0.326	0.287
8.8	0.528	0.464	0.408	0.359	0.315	0.277	0.244
8.9	0.451	0.397	0.349	0.306	0.269	0.237	0.208
9.0	0.389	0.342	0.300	0.264	0.232	0.204	0.179

TABLE 2.14.3a

EQUATIONS TO CONVERT TOTAL RECOVERABLE METALS STANDARD
WITH HARDNESS (1) DEPENDENCE TO DISSOLVED METALS STANDARD
BY APPLICATION OF A CONVERSION FACTOR (CF).

Parameter	4-Day Average (Chronic) Concentration (UG/L)
CADMIUM	$CF * e^{(0.7409 (\ln(hardness)) -4.719}$ CF = 1.101672 - ln(hardness) (0.041838)

CHROMIUM III

$CF * e^{(0.8190(\ln(hardness)) + 0.6848}$

CF = 0.860

COPPER $CF * e^{(0.8545(\ln(hardness)) -1.702)}$

CF = 0.960

LEAD $CF * e^{(1.273(\ln(hardness))-4.705)}$

CF = 1.46203 - ln(hardness)(0.145712)

NICKEL $CF * e^{(0.8460(\ln(hardness))+0.0584)}$

CF = 0.997

SILVER N/A

ZINC $Cf * e^{(0.8473(\ln(hardness))+0.884)}$ CF = 0.986

TABLE 2.14.3b

EQUATIONS TO CONVERT TOTAL RECOVERABLE METALS STANDARD WITH HARDNESS (1) DEPENDENCE TO DISSOLVED METALS STANDARD BY APPLICATION OF A CONVERSION FACTOR (CF).

Parameter	1-Hour Average (Acute) Concentration (UG/L)
CADMIUM	$CF * e^{(1.0166(\ln(hardness))-3.924)}$ CF = 1.136672 - ln(hardness)(0.041838)
CHROMIUM (III)	$CF * e^{(0.8190(\ln(hardness)) +3.7256)}$ CF = 0.316
COPPER	$CF * e^{(0.9422(\ln(hardness))- 1.700)}$ CF = 0.960
LEAD	$CF * e^{(1.273(\ln(hardness))-1.460)}$ CF = 1.46203 - ln(hardness)(0.145712)
NICKEL	$CF * e^{(0.8460(\ln(hardness)) +2.255)}$ CF= 0.998
SILVER	$CF * e^{(1.72(\ln(hardness))- 6.59)}$ CF = 0.85

ZINC	CF * $e^{(0.8473(\ln(hardness)) +0.884)}$	
	CF = 0.978	

FOOTNOTE:

(1) Hardness as mg/l $CaCO_3$.

TABLE 2.14.4
EQUATIONS FOR PENTACHLOROPHENOL
(pH DEPENDENT)

4-Day Average (Chronic) Concentration (UG/L)	1-Hour Average (Acute) Concentration (UG/L)
$e^{(1.005(pH))-5.134}$	$e^{(1.005(pH))-4.869}$

TABLE 2.14.5
SITE SPECIFIC CRITERIA FOR
DISSOLVED OXYGEN FOR JORDAN RIVER, SURPLUS CANAL, AND STATE CANAL
(SEE SECTION 2.13)

DISSOLVED OXYGEN:	
May-July	
7-day average	5.5 mg/l
30-day average	5.5 mg/l
Instantaneous minimum	4.5 mg/l
August-April	
30-day average	5.5 mg/l
Instantaneous minimum	4.0 mg/l

TABLE 2.14.6
LIST OF HUMAN HEALTH CRITERIA (CONSUMPTION)

Chemical Parameter	Water and Organism (ug/L) Class 1C	Organism Only (ug/L) Class 3A,3B,3C,3D
Antimony	5.6	640
Arsenic	A	A
Beryllium	C	C
Cadmium	C	C
Chromium III	C	C
Chromium VI	C	C
Copper	1,300	

Lead	C	C
Mercury	A	A
Nickel	100 MCL	4,600
Selenium	A	4,200
Thallium	0.24	0.47
Zinc	7,400	26,000
Cyanide	140	140
Asbestos	7 million Fibers/L	
2,3,7,8-TCDD Dioxin	5.0 E -9 B	5.1 E-9 B
Acrolein	6.0	9.0
Acrylonitrile	0.051 B	0.25 B
Alachlor	2.0	
Atrazine	3.0	
Benzene	2.2 B	51 B
Bromoform	4.3 B	140 B
Carbofuran	40	
Carbon Tetrachloride	0.23 B	1.6 B
Chlorobenzene	100 MCL	1,600
Chlorodibromomethane	0.40 B	13 B
Chloroethane		
2-Chloroethylvinyl Ether		
Chloroform	5.7 B	470 B
Dalapon	200	
Di(2ethylhexl)adipate	400	
Dibromochloropropane	0.2	
Dichlorobromomethane	0.55 B	17 B
1,1-Dichloroethane		
1,2-Dichloroethane	0.38 B	37 B
1,1-Dichloroethylene	7 MCL	7,100
Dichloroethylene (cis-1,2)	70	
Dinoseb	7.0	
Diquat	20	
1,2-Dichloropropane	0.50 B	15 B
1,3-Dichloropropene	0.34	21
Endothall	100	
Ethylbenzene	530	2,100
Ethylene Dibromide	0.05	
Glyphosate	700	
Haloacetic acids	60 E	
Methyl Bromide	47	1,500
Methyl Chloride	F	F
Methylene Chloride	4.6 B	590 B
Ocamyl (vidate)	200	
Picloram	500	

Simazine	4	
Styrene	100	
1,1,2,2-Tetrachloroethane	0.17 B	4.0 B
Tetrachloroethylene	0.69 B	3.3 B
Toluene	1,000	15,000
1,2 -Trans-Dichloroethylene	100 MCL	10,000
1,1,1-Trichloroethane	200 MCL	F
1,1,2-Trichloroethane	0.59 B	16 B
Trichloroethylene	2.5 B	30 B
Vinyl Chloride	0.025	2.4
Xylenes	10,000	
2-Chlorophenol	81	150
2,4-Dichlorophenol	77	290
2,4-Dimethylphenol	380	850
2-Methyl-4,6-Dinitrophenol	13.0	280
2,4-Dinitrophenol	69	5,300
2-Nitrophenol		
4-Nitrophenol		
3-Methyl-4-Chlorophenol		
Penetachlorophenol	0.27 B	3.0 B
Phenol	10,000	860,000
2,4,6-Trichlorophenol	1.4 B	2.4 B
Acenaphthene	670	990
Acenaphthylene		
Anthracene	8,300	40,000
Benzidine	0.000086 B	0.00020 B
BenzoaAnthracene	0.0038 B	0.018 B
BenzoaPyrene	0.0038 B	0.018 B
BenzobFluoranthene	0.0038 B	0.018 B
BenzoghiPerylene		
BenzokFluoranthene	0.0038 B	0.018 B
Bis2-ChloroethoxyMethane		
Bis2-ChloroethylEther	0.030 B	0.53 B
Bis2-Chloroisopropy1Ether	1,400	65,000
Bis2-EthylhexylPhthalate	1.2 B	2.2 B
4-Bromophenyl Phenyl Ether		
Butylbenzyl Phthalate	1,500	1,900
2-Chloronaphthalene	1,000	1,600
4-Chlorophenyl Phenyl Ether		
Chrysene	0.0038 B	0.018 B
Dibenzoa,hAnthracene	0.0038 B	0.018 B
1,2-Dichlorobenzene	420	1,300
1,3-Dichlorobenzene	320	960
1,4-Dichlorobenzene	63	190
3,3-Dichlorobenzidine	0.021 B	0.028 B

Diethyl Phthalate	17,000	44,000
Dimethyl Phthalate	270,000	1,100,000
Di-n-Butyl Phthalate	2,000	4,500
2,4-Dinitrotoluene	0.11 B	3.4 B
2,6-Dinitrotoluene		
Di-n-Octyl Phthalate		
1,2-Diphenylhydrazine	0.036 B	0.20 B
Fluoranthene	130	140
Fluorene	1,100	5,300
Hexachlorobenzene	0.00028 B	0.00029 B
Hexachlorobutedine	0.44 B	18 B
Hexachloroethane	1.4 B	3.3 B
Hexachlorocyclopentadiene	40	1,100
Ideno 1,2,3-cdPyrene	0.0038 B	0.018 B
Isophorone	35 B	960 B
Naphthalene		
Nitrobenzene	17	690
N-Nitrosodimethylamine	0.00069 B	3.0 B
N-Nitrosodi-n-Propylamine	0.005 B	0.51 B
N-Nitrosodiphenylamine	3.3 B	6.0 B
PhenanthrenePyrene	830	4,000
1,2,4-Trichlorobenzene	35	70
Aldrin	0.000049 B	0.000050 B
alpha-BHC	0.0026 B	0.0049 B
beta-BHC	0.0091 B	0.017 B
gamma-BHC (Lindane)	0.2 MCL	1.8
delta-BHC		
Chlordane	0.00080 B	0.00081 B
4,4-DDT	0.00022 B	0.00022 B
4,4-DDE	0.00022 B	0.00022 B
4,4-DDD	0.00031 B	0.00031 B
Dieldrin	0.000052 B	0.000054 B
alpha-Endosulfan	62	89
beta-Endosulfan	62	89
Endosulfan Sulfate	62	89
Endrin	0.059	0.060
Endrin Aldehyde	0.29	0.30
Heptachlor	0.000079 B	0.000079 B
Heptachlor Epoxide	0.000039 B	0.000039 B
Polychlorinated Biphenyls PCB's	0.000064 B,D	0.000064 B,D
Toxaphene	0.00028 B	0.00028 B

Footnotes:

A. See Table 2.14.2

B. Based on carcinogenicity of 10-6 risk.

C. EPA has not calculated a human criterion for this contaminant. However, permit authorities should address this contaminant in NPDES permit actions using the State's existing narrative criteria for toxics

D. This standard applies to total PCBs.

KEY: water pollution, water quality standards
Date of Enactment or Last Substantive Amendment: July 2, 2014
Notice of Continuation: October 2, 2012
Authorizing, and Implemented or Interpreted Law: 19-5

ATTACHMENT 2

Comments received for proposed amendments to R317-2 published in the June 1, 2015 *Utah Bulletin* No. 39397. Only written comments were received. No comments were received at the Public Hearing July 6, 2015

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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July 1, 2015

Ref:

Mr. Christopher Bittner
Division of Water Quality
Utah Department of Environmental Quality
P.O. Box 144870
Salt Lake City, Utah
84114-4870

Re: Proposed revisions to R317-2

Dear Mr. Bittner:

This letter provides the comments of the U.S. EPA Region 8 Water Quality Unit (WQU) on the proposed revisions to R317-2 that were published for public comment on June 1, 2015 in the Utah State Bulletin (Volume 2015, No. 11). The Utah Department of Environmental Quality (UDEQ), Division of Water Quality (Division) proposes the following water quality standards (WQS) revisions:

- a natural background provision;
- revised site-specific total dissolved solids (TDS) criteria for Blue Creek, Box Elder County, Utah;
- changing the gross alpha aquatic life criterion to a pollution indicator;
- deletion of the hydrogen sulfide aquatic life criteria footnote; and
- typographical corrections to the hardness-based metals criteria.

The WQU reviewed the proposal and supporting information that was provided at the water quality standards workgroup on March 23, 2015.[1] The WQU has substantial concerns with the proposed natural background provision and the methods that were used to derive the maximum criterion for Blue Creek. We generally do not oppose adoption of the remaining WQS revisions in the proposal.

Please note that the positions described in our comments, regarding both existing and proposed water quality standards, are preliminary in nature and should not be interpreted as final decisions under the Clean Water Act § 303(c). The EPA approval/disapproval decisions will be made after adoption of water quality standards revisions and submittal to the EPA, and will consider all pertinent evidence including information submitted during the rulemaking process.

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[1] http://www.deq.utah.gov/ProgramsServices/programs/water/wqmanagement/standards/workgroup.htm

Natural Background

The Division's proposal includes the addition of the following sentence to the existing site-specific standards provision (R317-2-7.1):

> *c. Site-specific standards may be adopted by rulemaking where biomonitoring data, bioassays, or other scientific analyses indicate that the statewide criterion is over or under protective of the designated uses or where natural or un-alterable conditions or other factors as defined in 40 CFR 131.10(g) prevent the attainment of the statewide criteria as prescribed in Subsections R317-2-7.2, and R317-2-7.3, and Section R317-2-14. When it is determined that natural background level of a pollutant is less stringent than the otherwise applicable criterion, the water quality criterion will be equal to the natural background concentration.*

The Division further explains in the summary of the proposed rule that the change is "per USEPA Guidance and is intended to allow Utah to delist or not list water where the exceedance of criteria is determined to be caused by natural conditions." The proposed language would allow UT to disregard the numeric criteria when making assessment decisions, and since the language does not limit the application to assessment decision, it could also be used to supplant the numeric criteria with a value that reflects the natural background when issuing UPDES permits.

The WQU agrees that it may be appropriate to consider naturally occurring pollutant concentrations when establishing water quality criteria for a specific waterbody; however, the WQU disagrees with the Division that the proposed approach for considering natural background concentrations is consistent with EPA guidance. The1997 EPA memorandum *Establishing Site Specific Aquatic Life Criteria Equal to Natural Background* provides the national policy that natural background maybe taken into consideration when deriving site-specific numeric aquatic life criteria.[2] The memo also states that policy does not apply to human health uses. In 2015, the EPA issued additional guidance on natural background in *A Framework for Defining and Documenting Natural Conditions for Development of Site-specific Natural Background Aquatic Life Criteria for Temperature, Dissolved Oxygen, and pH: Interim Document.* [3] The interim framework is provided to assist states and tribes in developing a consistent, transparent, and scientifically-defensible approach for identifying natural conditions for temperature, dissolved oxygen, and pH, which can support the development of site-specific aquatic life criteria.

The 1997 memorandum recommends that the state WQS should include the following when adopting site-specific standards set to natural background:

1) A definition of natural background that only includes non-anthropogenic sources;
2) A provision that site-specific criteria may be set equal to natural background; and
3) A procedure for determining natural background, or alternatively, a reference in their WQS to another document describing the binding procedure that will be used.

[2] http://water.epa.gov/scitech/swguidance/standards/upload/2009_01_29_criteria_naturalback.pdf
[3] http://water.epa.gov/scitech/swguidance/standards/library/upload/natural_conditions_framework.pdf

Utah's proposal only addresses one of the three recommendations. Regulations R317-1 and R317-2 do not provide a definition of natural background and UDEQ does not have an existing procedure for identifying natural conditions to support the proposed narrative approach. Without including provisions to address these recommendations, it is not clear how the proposed natural background provision will be implemented by the state. Additionally, since the provision is written so broadly, it could be used in situations beyond its original intent (e.g., to establish permit limits that exceed criteria to protect designated uses, include sources that are not truly natural, applied to parameters with human health concern, etc.). Considering natural sources of pollutants for the purposes of WQS at the time of assessment or when issuing permits would remove the public comment process and public hearing that is required by the CWA and the EPA's implementing regulations at 40 CFR Parts 25 and 131. Furthermore, the Division's proposed narrative approach to allow the background level of a pollutant to become the applicable water quality criterion if the background level is less stringent than the otherwise applicable water quality criterion constitutes a revision to the WQS and as such, the state is required to submit the new/revised WQS to EPA for review and action consistent with CWA 303(c)(2)(A).

It is possible that Division misinterpreted the EPA's integrated report (IR) guidance, which addresses CWA 303(d), 305(b) and 314 requirements as recommendations for state WQS. Several states requested that EPA clarify how to make a 303(d) listing decision for waterbody segments with natural background levels of a pollutant. The EPA responded by adding a discussion of natural background in the IR guidance, which states that applicable water quality standards are the basis for determining whether a waterbody must be included on a State's Section 303(d) list. For some states, this includes an EPA-approved natural conditions provision. In the absence of an EPA-approved natural background provision in state WQS, or site-specific criteria based on natural background, the otherwise applicable criteria would be the basis for determining whether a waterbody is impaired. [4] The clarification on natural conditions in the IR guidance is not an EPA recommendation that states should adopt a natural conditions provision into state water quality standards.

For these reasons, the WQU would recommend disapproval of the natural background provision if it is adopted by the Water Quality Board. Moving forward, we recommend UDEQ remove the revised language and instead include language that explicitly states that all site-specific criteria based on natural background shall be noticed for public comment and subjected to other applicable public participation requirements prior to being adopted by the state and submitted to EPA for review and action. We also recommend UDEQ include a definition for natural background due *only* to non-anthropogenic sources and a procedure for determining natural background consistent with the 1997 EPA memorandum.

<u>Blue Creek Site-specific TDS Criteria</u>

Background

The Water Quality Board adopted new site-specific criteria for Blue Creek and Blue Creek Reservoir in 2014. The EPA provided public comments on the Division's proposed approach in a letter dated 4/4/14. In these comments, the WQU generally supported the adoption of site-specific criteria for Blue Creek and Blue Creek Reservoir; yet had several questions and concerns with the criteria derivation

[4] http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/2014-memo.cfm#recommendations

methodology and implementation, including the following.

- The methods used to derive the upper bound criteria combined with UT's default 10% exceedance frequency for assessment decisions may not protect the existing water quality and allow for substantial degradation prior to making an impairment decision.
- The WQU expressed concerns with data requirements to implement the 30-day average criterion and that expressing the criterion as a 30-day average could result in unnecessary listing since the criterion was set to the average of a two year dataset.
- We suggested that the Division use of a more robust dataset to characterize the annual variability of mean TDS concentrations and true range of expected TDS concentrations in Blue Creek.

In the response to comments, the Division acknowledged that the proposed duration restricted the state's ability to assess the criteria and deleted the 1-hour and 30-day requirements from the proposal. Our other concerns with the maximum criteria and the limited dataset used to derive the criteria were not addressed in the final WQS that were adopted by the Board in 2014. The site-specific criteria were submitted to Region 8 for review in a letter dated 8/18/2014. The Region has not acted on the submission knowing that the Division was considering additional revisions to the site-specific criteria.

Summary of proposed revisions

In this notice, UDEQ proposes the following revisions the site-specific TDS criteria for Blue Creek that were adopted in 2014:

> *Blue Creek and tributaries, Box Elder County, from ~~Gunnison~~ Bear River Bay, Great Salt Lake to Blue Creek Reservoir: ~~maximum 6,300 mg/l and an average of 3,900~~*
> *March through October daily maximum 7,200 and an average of 3,800 mg/l; November through February daily maximum 7,500 mg/l and an average of 4,700 mg/l. Assessments will be based on TDS concentrations measured at the location of STORET 4960740. At least 10 samples are required to assess compliance with the mean criteria. If the sample mean for samples collected in March through October is equal to or less than 4,100 mg/l and the sample mean for samples collected November through February is equal to or less than 5,300 mg/l, the average criteria are being met. Alternative scientifically defensible assessment methods may be applied for assessing the average criteria.*

The proposed criteria were derived from a robust dataset (1989-2010; N=349) and protect the conditions when TDS is generally lower (i.e., summer). The revisions also include implementation details for criteria that are expressed as an average. The summer and winter average criteria are set to the mean seasonal concentration (summer N = 235; winter N = 113). The maximum criteria are set to a statistical upper limit that is greater than the maximum concentration observed in that season. For summer the maximum criterion is set to the 95% upper simultaneous limit (USL95). For winter the maximum criterion is set to the 95% upper tolerance limit with 99% coverage (UTL95-99). All calculations were conducted with the EPA ProUCL software Version 5.0.

The WQU has the following comments on the proposed revisions to the Blue Creek site-specific criteria:

1. We thank UDEQ for using a more robust dataset and support the proposed seasonal approach.

2. We continue to support the Division's intent to adopt site-specific criteria that will protect both the average and maximum concentrations when the parameter of concern exhibits high seasonal variability. This tiered approach in an improvement over previous approaches to set site-specific standards since it protects the high quality conditions with an average, in addition to limiting the maximum concentrations that will be allowed.

3. We continue to have significant concerns with the methods used to derive the maximum criterion when R317-2-7.1 allows for a 10% exceedance of maximum TDS criteria when making assessment decisions. The Division's approach to deriving site-specific maximum criteria is to evaluate a wide range of upper percentile values that are intended to approximate the maximum. The Division has set maximum criteria to three different upper limit statistics. The criteria adopted in 2014 (Blue Creek and Blue Creek Reservoir) were set to the 95 % upper prediction limits (UPL95) for the next 5 observations. The revised seasonal maximum criteria for Blue Creek are set to the USL95 and UTL95-99 for summer and winter, respectively. The ProUCL 5.0 Technical Guide provides the following descriptions of these statistics (emphasis added): [5]

   Upper Prediction Limit (UPL): The upper boundary of a prediction interval for an independently obtained observation (or an independent future observation). Based upon an established background data set, a 95% UPL (UPL95) represents that statistic such that an independently collected new/future observation from the target population (e.g., background, comparable to background) will be less than or equal to the UPL95 with CC of 0.95. **We are 95% sure that a *single future value* from the background population will be less than the UPL95** with CC= 0.95. A parametric UPL takes data variability into account.

   Upper Tolerance Limit (UTL): A confidence limit on a percentile of the population rather than a confidence limit on the mean. For example, a 95 % one-sided UTL for 95 % coverage represents the value below which 95 % of the population values are expected to fall with 95 % confidence. In other words, **a 95% UTL with coverage coefficient 95% represents a 95% UCL for the 95th percentile.**

   Upper Simultaneous Limit (USL): The upper boundary of the largest value. Based upon an established background data set free of outliers and representing a single statistical population, a USL95 represents that statistic such that all observations from the "established" background data set are less than or equal to the USL95 with a CC of 0.95. A parametric USL takes the data variability into account. It is expected that **all current or future observations coming from the background population (comparable to background population, unimpacted site locations) will be less than or equal to the USL95** with CC, 0.95.

[5] http://www2.epa.gov/sites/production/files/2015-03/documents/proucl_v5.0_tech.pdf

These statistics either provide high confidence that future samples will be less than the limit (i.e., UPLs and UTL – both with a low false positive rate) or are statistics that are typically used to estimate the true maximum of a given distribution (i.e., USL). Figure 7 from the Division's support document clearly shows that the proposed maximum criteria are greater than what has been observed in Blue Creek over the last 20+ years. We question why the Division is interested in setting the criterion to an estimate of the true maximum, rather than a percentile of the distribution? Estimating a true maximum is a challenging task that inflates the limit and results in less protective criteria. It is also worthy to note the statistical outlier in the dataset (7,180 mg/L, not presented in these figures) is less than the proposed maximum criteria. Use of the proposed maximum criteria to establish permit limit or when making assessment decisions, which allows for a 10% exceedance, will not protect the existing water quality conditions in Blue Creek.

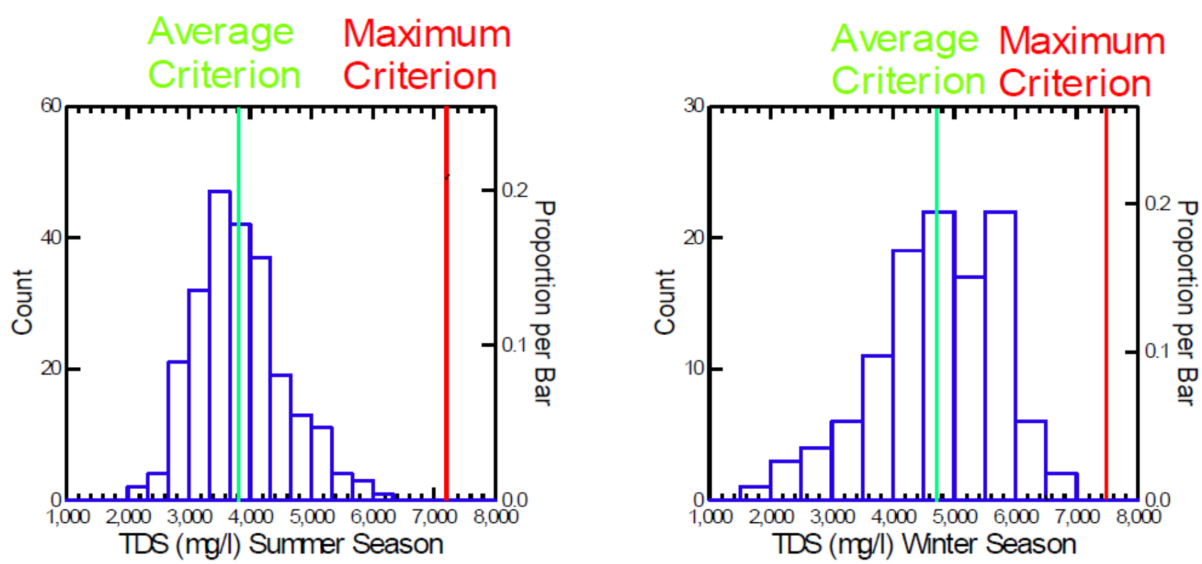


Figure 7. Histograms of Blue Creek summer and winter seasons total dissolved solids concentrations with proposed average and maximum criteria

To resolve our concerns with the proposed approach, we suggest that the Division consider adding an additional statement to the site-specific standard that when making assessment decisions, the 10% exceedance frequency in R317-2-7.1 does not apply to the maximum criteria. This approach would only address the concerns with assessment decisions and does not address the implementation in UPDES permits; however, it is likely that permit limits derived using the average criteria will control effluent concentrations such that the maximum criterion will never be observed.

Alternatively, the Division could consider an approach similar to what is proposed for the average criteria where the statistical uncertainty with the dataset is taken into consideration in the assessment thresholds, rather than the water quality criterion. The UPL/UTL/USL limits are more akin to the assessment thresholds than values that are expected to protect the existing water quality of Blue Creek. The maximum criterion could then be set to a more protective limit that is compatible with R317-2-7.1 (e.g., 90^{th} percentile or potentially maximum observed, depending on the robustness of the dataset).

We recommend that the Division address our concerns with the proposed natural conditions provision and the maximum TDS criteria for Blue Creek prior to presenting the proposal to the Water Quality Board for adoption. We appreciate the efforts of the Division to coordinate with the WQU when developing proposed revisions to state WQS. If there are questions concerning our comment, please contact me at (303) 312-6947 or Lareina Guenzel at (303) 312-6610.

Sincerely,

Sandra Spence, Chief
Water Quality Unit

ATTACHMENT 3

Comments and responses for proposed amendments to R317-2 published in the June 1, 2015 *Utah Bulletin* No. 39397. Only written comments were received. No comments were received at the Public Hearing July 6, 2015.

1. **Comment:** A comment raises a concern regarding the proposed revision to R317-2-7.1 regarding not listing lakes and streams as impaired when the water quality exceedance was due to background conditions. USEPA Region 8 (USEPA8) notes that the language does not limit the determination that a criterion exceedance is due to background to assessments but would also be applicable to other programs such as permitting.

   DWQ Response: DWQ agrees with the comment and is proposing to withdraw the provision as shown below to develop wording that will limit the implementation of this provision to assessments.

   > R317-2-7......Site-specific standards may be adopted by rulemaking where biomonitoring data, bioassays, or other scientific analyses indicate that the statewide criterion is over or under protective of the designated uses or where natural or un-alterable conditions or other factors as defined in 40 CFR 131.10(g) prevent the attainment of the statewide criteria as prescribed in Subsections R317-2-7.2, and R317-2-7.3, and Section R317-2-14. ~~When it is determined that natural background level of a pollutant is less stringent than the otherwise applicable criterion, the water quality criterion will be equal to the natural background concentration.~~

2. **Comment**: A comment raises a concern regarding the proposed revision to R317-2-7.1 regarding not listing lakes and streams as impaired when the water quality exceedance was due to background conditions. USEPA specifically identifies 2 components (out of 3) that are recommended in USEPA guidance as missing in Utah's standards:

   1. A definition of natural background that only includes non-anthropogenic sources;
   2. A procedure for determining natural background, or alternatively, a reference in their WQS to another document describing the binding procedure that will be used.

   DWQ Response: DWQ agrees that a definition for natural background is necessary. DWQ proposes to withdraw the revisions to R317-2-7 regarding background conditions at this time. DWQ will develop a definition for background conditions with the Water Quality Standards Workgroup. With regards to the binding procedures, further discussion with USEPA8 and the Water Quality Standards Workgroup are necessary because of the lack of similar USEPA guidance or specific regulations.

3. **Comment:** "*We continue to have significant concerns with the methods used to derive the maximum criterion when R317-2-7.1 allows for a 10% exceedance of maximum TDS criteria when making assessment decisions. The Division's approach to deriving site-*

specific maximum criteria is to evaluate a wide range of upper percentile values that are intended to approximate the maximum. The Division has set maximum criteria to three different upper limit statistics. The criteria adopted in 2014 (Blue Creek and Blue Creek Reservoir) were set to the 95 % upper prediction limits (UPL95) for the next 5 observations. The revised seasonal maximum criteria for Blue Creek are set to the USL95 and UTL95-99 for summer and winter, respectively. The ProUCL 5.0 Technical Guide provides the following descriptions of these statistics…

…These statistics either provide high confidence that future samples will be less than the limit (i.e.,UPLs and UTL – both with a low false positive rate) or are statistics that are typically used to estimate the true maximum of a given distribution (i.e., USL). Figure 7 from the Division's support document clearly shows that the proposed maximum criteria are greater than what has been observed in Blue Creek over the last 20+ years. We question why the Division is interested in setting the criterion to an estimate of the true maximum, rather than a percentile of the distribution? Estimating a true maximum is a challenging task that inflates the limit and results in less protective criteria. It is also worthy to note the statistical outlier in the dataset (7,180 mg/L, not presented in these figures) is less than the proposed maximum criteria. Use of the proposed maximum criteria to establish permit limit or when making assessment decisions, which allows for a 10% exceedance, will not protect the existing water quality conditions in Blue Creek."

DWQ Response 3a. USEPA8 comments that: "*Use of the proposed maximum criteria to establish permit limit or when making assessment decisions, which allows for a 10% exceedance, will not protect the existing water quality conditions in Blue Creek.*"

DWQ disagrees with this conclusion. The Blue Creek TDS seasonal criteria include both an average and a maximum which provides much more rigorous protection than just the maximums currently applied everywhere else in Utah for TDS criteria. The promulgation of the average criteria alone are sufficient to address all of the concerns regarding protectiveness in USEPA8's comments because hypothetically even if the proposed maximum criteria were too high, the average criteria would protect the water quality of Blue Creek.

However, USEPA8 comments indicate that disapproval would be likely, so DWQ evaluated the impacts of lowering the maximum criteria to decrease the probability of a USEPA8 disapproval. The potential impacts of lower maximum criteria to permits as well as water quality assessments were evaluated and DWQ concluded that impacts of reducing the maximum criteria are acceptable.

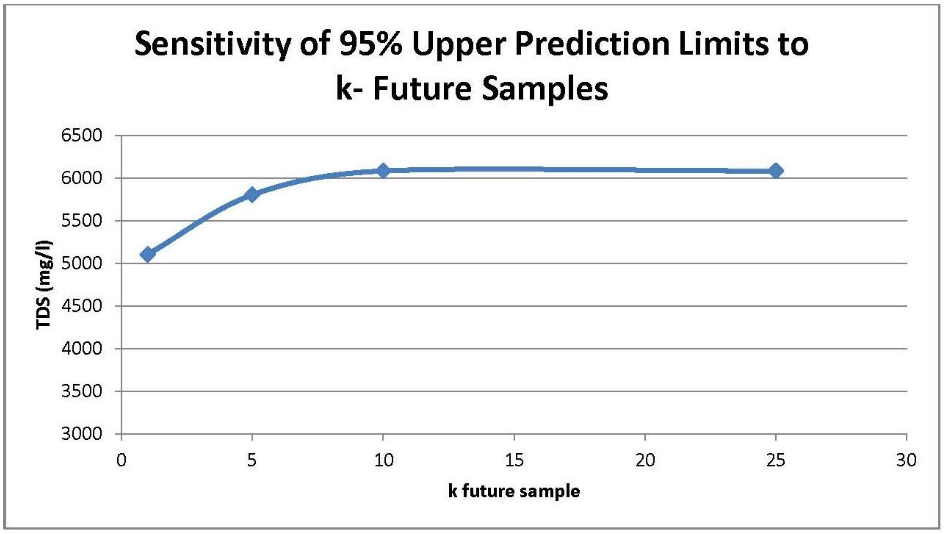
As shown in the following text, the maximum seasonal criteria for both Blue Creek and Blue Creek Reservoir were reduced by basing them on the 95% upper tolerance limits of the 90^{th} percentiles. For Blue Creek Reservoir, the revised maximum criterion is 2,100 mg/l (previously 2,200 mg/l). The revised maximum criteria for Blue Creek are 4,900 mg/l (previously 7,200 mg/l) for the summer season summer and 6,700 mg/l (previously 7,500 mg/l) for the winter season.

For permits, the average criteria are expected to remain the primary criteria for protecting water quality. The maximum criteria are more stringent than the previously proposed maximums but based on discussions with the permittee, the impacts are expected to be minimal.

For assessments, the primary concerns with the reduced maximum criteria are false-positive water quality impairments. In simulations, additional sampling, although an undesirable expenditure of resources, appears to be sufficient to address false positive water quality impairments if they occur in the future.

Upper prediction limits were also considered but rejected for the revised maximum criteria. Staff evaluated the effects of the k-number of future comparison samples (e.g., samples collected for assessment) on the upper prediction limits. As shown on the following figure, the prediction limits change depending on the number of future samples. Based on these observations, upper prediction limits were not considered optimal for the maximum criteria. For the same reason, the upper prediction limits included in the average criteria for assessment were deleted. The *Site-Specific Standard for Total Dissolved Solids Blue Creek Reservoir and Blue Creek, September 3, 2015* (2015 criteria support document) was revised to provide information and data for statistically rigorous future assessments of the average criteria. This approach will allow assessment methods to be optimized based on the number of samples of available. The assessment methods will be documented in *Integrated Reports*.

> Blue Creek and tributaries, Box Elder County, from ~~Gunnison~~ <u>Bear River</u> Bay, Great Salt Lake to Blue Creek Reservoir: maximum ~~6,300~~ ~~mg/l and an average of 3,900 mg/l,~~ <u>March through October daily maximum 4,900</u> ~~7,200~~ mg/l <u>and an average of 3,800 mg/l</u>; <u>November through February daily maximum 6,300</u> ~~7,500~~ mg/l and an average of 4,700 mg/l. Assessments will be based on TDS concentrations measured at the location of STORET 4960740. ~~At least 10 samples are required to assess compliance with the average criterion. If the sample average for samples collected from March through October is equal to or less than 4,100 mg/l and the sample average for samples collected from November through February is equal to or less than 5,300 mg/l, the average criteria are met. Alternative scientifically defensible assessment methods may be applied for assessing the average criteria.~~
>
> Blue Creek Reservoir and tributaries, Box Elder County, <u>daily</u> maximum <u>2,100</u> ~~2,200~~ mg/l



DWQ Response 3b. EPA comments that "*These statistics either provide high confidence that future samples will be less than the limit (i.e.,UPLs and UTL – both with a low false positive rate) or are statistics that are typically used to estimate the true maximum of a given distribution (i.e., USL).*" And "*We question why the Division is interested in setting the criterion to an estimate of the true maximum, rather than a percentile of the distribution? Figure 7 from the Division's support document clearly shows that the proposed maximum criteria are greater than what has been observed in Blue Creek over the last 20+ years.*"

USEPA8 appears to have misinterpreted the statistical parameters proposed. The ProUCL statistical program was developed to be used primarily by the Superfund Program for cleaning up abandoned hazardous waste sites. At these sites, background concentrations of highly toxic metals and metalloids (for instance, arsenic) often need to be characterized to limit any clean up to contamination. In these situations, false negative decision errors (concluding that an area is not contaminated when it is) are highly undesirable and the methods recommended by ProUCL balance the potential for both false positive and negative decisions. This is apparent from the following statements in the USEPA (2013) ProUCL guidance:

> "Caution: To provide a proper balance between false positives and false negatives, the upper limits described above, especially a 95% USL (USL95) should be used only when the background data set represents a single environmental population without outliers (observations not belonging to background). Inclusion of multiple populations and/or outliers tends to yield elevated values of USLs (and also of UPLs and UTLs) which can result in a high number (and not necessarily high percentage) of undesirable false negatives, especially for data sets of larger sizes (e.g., $n > 30$)."[p. 86]

> "Notes: The user specifies the allowable false positive error rate, α (=1-CC), and the false negative error rate (declaring a location clean when in fact it is contaminated) is controlled by making sure that one is dealing with a defensible/established background data set representing a single background population and the data set is free of outliers. "[p. 87]

As documented in the revised 2015 criteria support document, the analyses for Blue Creek adhered to these recommendations. DWQ acknowledges that the maximum, or any criterion, are more protective the lower they are set. The minimum requirement for this site-specific standard is to be as protective of the natural conditions as modified by irreversible conditions. By meeting this requirement, the criteria will not allow water quality to be degraded and hence will be protective. Setting the criteria more stringent will provide additional protection but also may result in undesirable outcomes such as false-positive impairment decisions that result in resources being unnecessarily diverted to address the "impairment". Setting the criteria too low could also result in unnecessarily stringent permits resulting in permittees incurring unnecessary treatment costs. Therefore, and as documented in the 2015 criteria support document, DWQ has applied methods that balance both false positive and negative decision errors.

All of the potential parameters considered by DWQ were percentile estimates and no estimates of the maximum were proposed by DWQ, nor are methods for estimating the maximum provided in the ProUCL guidance (USEPA, 2013). The 2015 criteria support document does indicate that the true maximum would be appropriate for the maximum criterion. The 2015 criteria support document was revised to indicate that estimates of the corresponding duration and frequency are desirable parameters along with the true maximum. Because a maximum could not be determined, DWQ proposed statistical estimates of the 95th percentile or higher. USEPA8 appears to believe that because the proposed maximum criteria are higher than any of the existing observations that the proposed maximums are too high. DWQ disagrees because it is statistically improbable that the maximum was sampled and is therefore included in the existing data.

Consider the following simplified example. There would only be a 4% chance that a sample was collected on the day with the maximum TDS concentration if samples are collected on 349 days out of 8,740 possible days (sampled days and possible sample days for Blue Creek data). Therefore, it is highly unlikely that the sample data set includes the daily true maximum.

4. **Comment:** "To resolve our concerns with the proposed approach, we suggest that the Division consider adding an additional statement to the site-specific standard that when making assessment decisions, the 10% exceedance frequency in R317-2-7.1 does not apply to the maximum criteria. This approach would only address the concerns with assessment decisions and does not address the implementation in UPDES permits; however, it is likely that permit limits derived using the average criteria will control effluent concentrations such that the maximum criterion will never be observed. Alternatively, the Division could consider an approach similar to what is proposed for the average criteria where the statistical uncertainty with the dataset is taken into consideration in the assessment thresholds, rather than the water quality criterion. The UPL/UTL/USL limits are more akin to the assessment thresholds than values that are expected to protect the existing water quality of Blue Creek. The maximum criterion could then be set to a more protective limit that is compatible with R317-2-7.1 (e.g., 90th percentile or potentially maximum observed, depending on the robustness of the dataset)."

DWQ Response. DWQ has elected not to exclude the Blue Creek site-specific standards from the 10% allowance in R317-2-1 because this provision is clearly intended to apply to site-specific TDS standards:

> "For water quality assessment purposes, up to 10 percent of the representative samples may exceed the minimum or maximum criteria for dissolved oxygen, pH, E. coli, total dissolved solids, and temperature, including situations where such criteria have been adopted on a site-specific basis."

Instead, DWQ has set the maximum criteria at the 90th percentile (95% upper tolerance limit of the 90th percentile). For the reasons discussed in response to comment 3, the upper prediction limit assessment thresholds have been deleted from the average criteria for Blue Creek. Specific assessment methods will be consistent with how the average criteria were derived and based on the assessment sampling design.

ATTACHMENT 4

Example of Board Order

BEFORE THE

UTAH WATER QUALITY BOARD

IN THE MATTER OF REVISING STANDARDS OF QUALITY FOR WATERS OF THE STATE (R317-2, UTAH ADMINISTRATIVE CODE	ORDER

This matter came for hearing before the Utah Water Quality Board pursuant to notice given under the provisions of *Sections 19-5-110, Utah Code Annotated,* 1953, as amended, on the 23rd day of September, 2015 in the Coalville Council Chambers, Coalville, Utah for the purpose of considering revisions to *R317-2, Utah Administrative Code,* "Standards of Quality for Waters of the State."

The Board having taken cognizance of the oral and written statements received, and having fully considered all of the facts in the is matter, it is therefore ORDERED that the revised "Standards of Quality for Waters of the State" (*R317-2, UAC*) be reissued effective November 30, 2015 with the changes as adopted by the Board on September 23, 2015.

Dated this 23rd day of September, 2015

____

Myron E. Bateman, Chairperson

Utah Water Quality Board

ATK

Launch Systems Group

Work Plan
For the Development of a New Site-Specific TDS Criterion For Blue Creek

June 2011

1.0 Introduction

ATK Launch Systems Inc. is submitting this work plan for use in the development of a site-specific criterion for Total Dissolved Solids (TDS) in a stream segment of Blue Creek. The stream segment of Blue Creek begins at 41°43'20.40" N, 112°26'33.58" W a location on the northern boundary of ATK's facility along Highway 83 that ATK identifies as Blue Creek Upper with the stream segment ending at the Great Salt Lake. ATK currently has two wastewater treatment discharges along this stream segment under UPDES Permit #UT0024805. (See Figure 1 & 2, Goggle Earth image)

2.0 Background

Blue Creek originates approximately 8 miles north of the ATK Facility from Blue Springs. Blue Springs is a warm springs that has a TDS concentration of 2000 mg/L. The water that flows from Blue Springs is then stored in the Blue Creek Reservoir Dam.

The Blue Creek Reservoir Dam was constructed in 1904. The Blue Creek Dam was modified, enlarged and repaired in 1949, 1967 and 1986. The current capacity of the reservoir is about 2,185 acre-feet (UDWR, 2001). Water from Blue Springs is stored in the reservoir during the winter months and used for agricultural irrigation during the spring through fall season. The water in the reservoir is distributed by canals owned by the Blue Creek Irrigation Company. The two main canals, the East Canal and the West Canal, are used to irrigate a portion of the valley north of ATK's facility (Bolke and Price, 1972).

Several saline springs feed the main channel of Blue Creek once it leaves the Blue Creek Reservoir. These springs are the major source of flow in Blue Creek during most of the year as it passes through the ATK facility.

Prior to 1975, the stream segment of Blue Creek from the irrigation dam flowing southward was an intermittent stream only flowing significantly after rainfall events and snow melts. As a result of an earthquake in March 1975, Blue Creek became a perennial stream with year round flow resulting from the springs located below the Blue Creek Reservoir Dam.

In May 2010, four irrigation wells used for pivot irrigation that are located west and south within ½ mile of the Blue Creek Reservoir were sampled, reporting TDS concentrations of 2910 mg/L, 2600 mg/L, 2450 mg/L and 2270 mg/L. Some

- Mercury Method 245.1;
- Total Dissolved Solids (TDS), Method 160.1; and
- Anions, Method 300 IC to include, Fluoride, Chloride, Nitrite-N, Bromide, Nitrate-N, Orthophosphate-P, Sulfate.

During each sampling event, a visual investigation will be conducted to verify if water is flowing from the Blue Creek Reservoir Dam into either the west or east irrigation canal. This will assist in validating when the irrigation season is occurring and allow the opportunity to coincide possible irrigation return flows with changing TDS levels at the two most southern monitoring sites (Blue Creek at crossing 14400 N, and Blue Creek Upper (north boundary of ATK property, Hwy 83).

A second visual investigation will be done each sampling event to verify if water is being released from the Blue Creek Reservoir Dam into the main Blue Creek channel. This will observation will be used to verify when lower TDS water that is being released from the reservoir dam is mixing with the higher TDS water below the dam, and thereby lowering the TDS levels at the two most southern monitoring sites (Blue Creek at crossing 14400 N, and Blue Creek Upper (north boundary of ATK property, Hwy 83).
Sampling these sites and conducting the visual investigations will allow the development of three datasets:

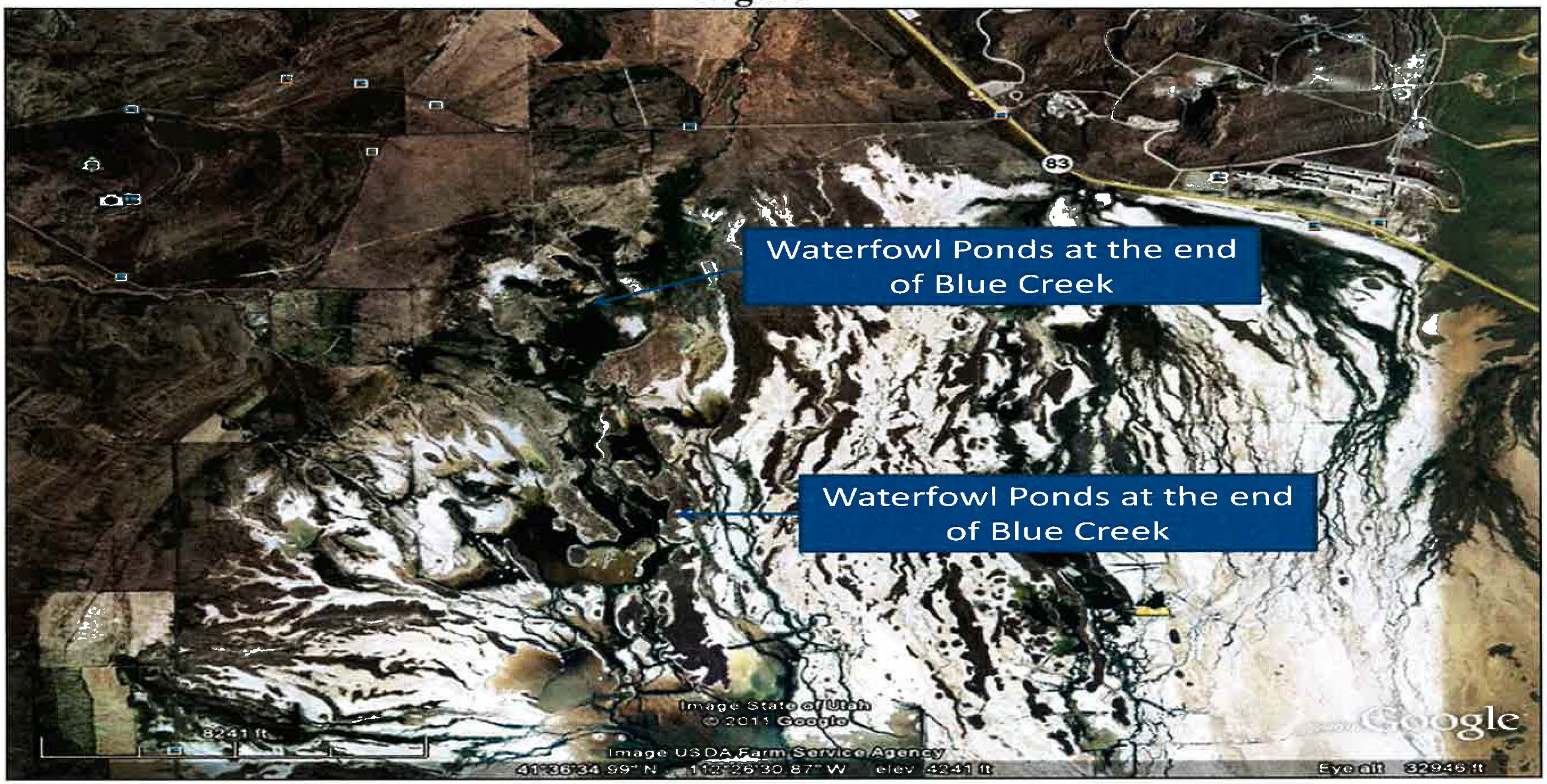
- The existing disturbed conditions, when irrigation is occurring and irrigation return flows are possible;
- When water is being discharged from the Blue Creek Reservoir Dam into the main channel of Blue Creek thereby, lowering the TDS level of Blue Creek by dilution; and
- A dataset for the periods when no irrigation is occurring and no water is being discharged from the Blue Creek Reservoir Dam, which is intended to represent natural conditions that predominate most of the year. This would represent the flow and TDS level in the main channel of Blue Creek that result from springs or seeps that occur below the reservoir dam southward.

The development of these three datasets will help characterize the three different flow conditions, as well as allowing the coordination of the sampling and analytical results with the flow conditions.

Figure 1


Blue Springs, (Source of Blue Creek Reservoir)
Sep 12, 2003
Blue Creek Reservoir
Blue Creek
Highway 83
Point of proposed Site Specific Standard (Highway 83 north boundary of ATK) following Blue Creek south to the Great Salt Lake
84
15
Image USDA Farm Service Agency
© 2009 Tele Atlas
©2009 Google
Imagery Date: Aug 19, 2003
41°43'34.79" N 112°21'43.06" W elev 5182 ft
Eye alt 24.49 mi

Figure 3

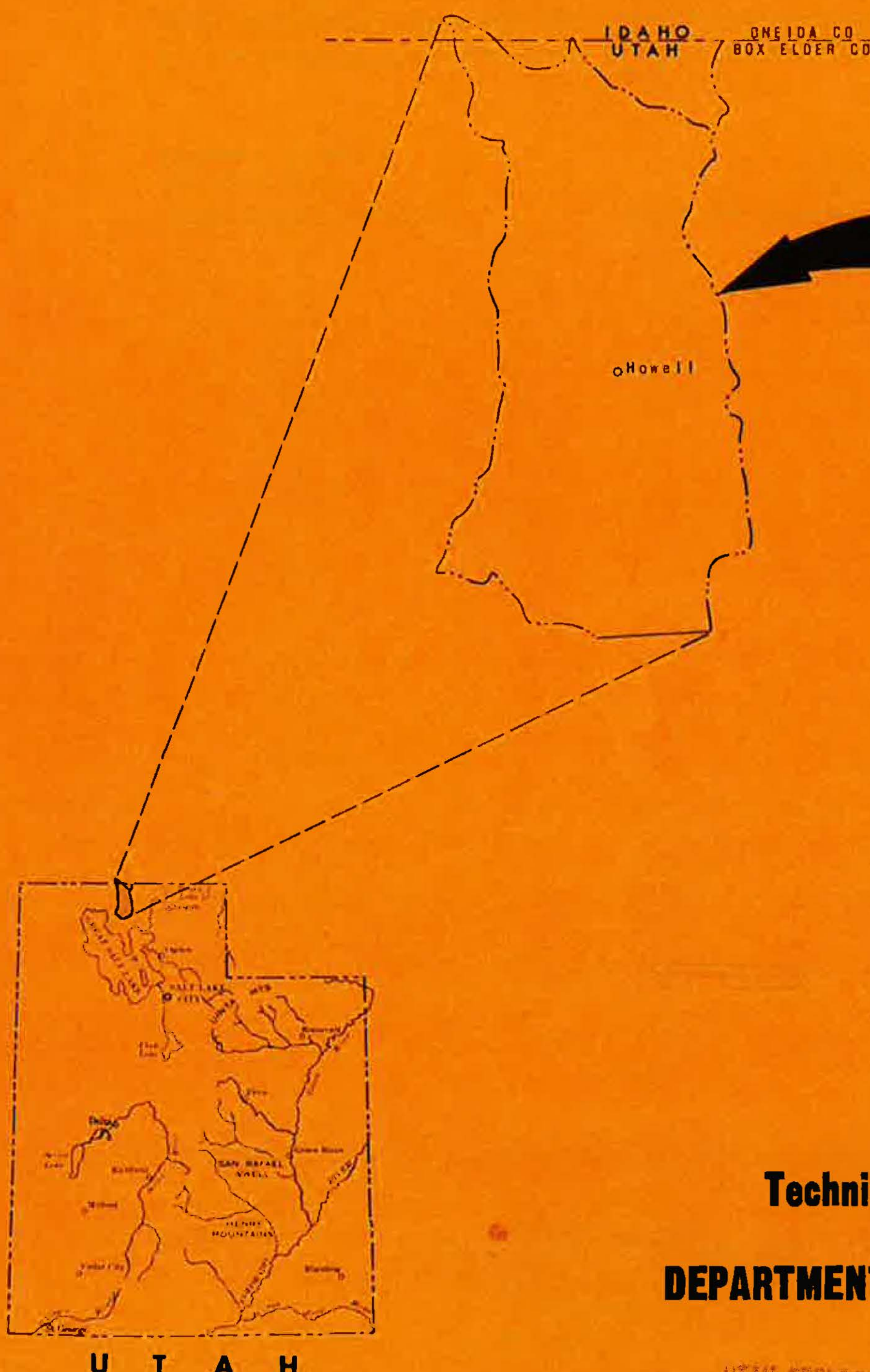

Waterfowl Ponds at the end of Blue Creek
Waterfowl Ponds at the end of Blue Creek
83
Image State of Utah
© 2011 Google
Image USDA Farm Service Agency
8241 ft
Google
41°36'34.99" N 112°26'30.87" W elev 4241 ft
Eye alt 32946 ft

References

Bolke, E.L. and Price D. 1972. Hydrologic Reconnaissance of the Blue Creek Valley Area, Box Elder County, Utah. Utah Department of Natural Resources Technical Publication No. 37.

UDWR (Utah Division of Water Resources). 2001. Utah State Water Plan, West Desert Basin, Salt Lake City, Utah. 3-17p.

HYDROLOGIC RECONNAISSANCE OF THE BLUE CREEK VALLEY AREA, BOX ELDER COUNTY, UTAH



BLUE CREEK VALLEY AREA

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State of Utah
DEPARTMENT OF NATURAL RESOURCES
1972

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES

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HYDROLOGIC RECONNAISSANCE OF THE BLUE CREEK VALLEY AREA, BOX ELDER COUNTY, UTAH

by

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Prepared by the U. S. Geological Survey
in cooperation with the
Utah Department of Natural Resources
Division of Water Rights

1972

ILLUSTRATIONS

TABLES

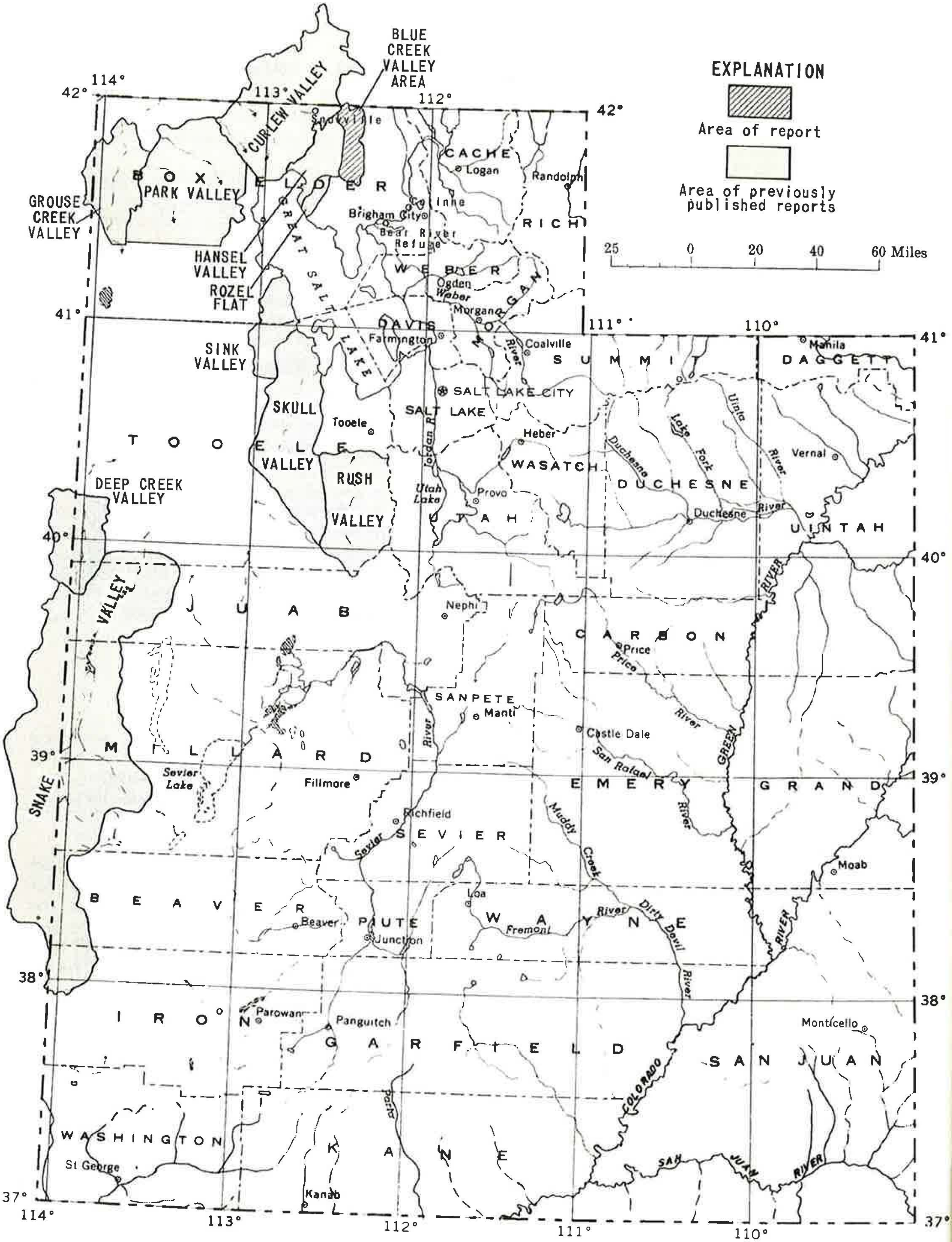

Figure 1.—Location of the Blue Creek Valley area and of other areas described in previously published reports in this reconnaissance series. (See list of technical publications at end of report.)

GEOLOGY

The general geology of the Blue Creek Valley area is shown on plate 1. The age, general lithology, and general hydrologic properties of the principal units are summarized in table 1.

Blue Creek Valley is a structural trough formed by the deformation of rocks of Paleozoic and Tertiary age. The mountain ranges, which consist of rocks of Paleozoic age, were elevated in relation to rocks of the same age that underlie the valley fill by basin- and range-type faulting. Complex folding and faulting accompanied the major structural displacements. The Salt Lake Formation of Tertiary age, which overlies the Paleozoic rocks, was also involved in this structural deformation.

Rocks of Paleozoic and Tertiary age have considerable local relief beneath the valley fill, as indicated by outliers of those rocks (as in Andersons Hill) that protrude above the valley floor. The relief in the consolidated rock is attributed at least in part to faults concealed beneath the valley fill. Such faults are also inferred from (1) the presence of Blue Springs, a thermal spring area that discharges from highly fractured Paleozoic rocks (B. L. Bridges, Geologist, U. S. Soil Conserv. Service, oral commun., 1969) near the north end of Andersons Hill, (2) an apparent "subsurface dam" of upfaulted Paleozoic rocks near the lower end of the valley that impedes drainage from the valley, and (3) local anomalies in the chemical character of the ground water (p. 15). However, subsurface data are not adequate to accurately map any of these inferred faults.

Volcanic activity, which was widespread in adjacent parts of southern Idaho and northern Utah during the Tertiary Epoch, is evidenced in Blue Creek Valley by tuffaceous rocks of the Salt Lake Formation and by layered basaltic lava flows and associated deposits of tuff near the northwest margin of the valley. Lava is reported in logs of several wells drilled in that general area.

The valley fill, which forms the most permeable part of the valley ground-water reservoir, consists largely of detritus eroded from the mountains. Some of the fill was deposited in ancient Lake Bonneville and other pre-existing lakes and reworked by wave action. Shoreline features and deposits of Lake Bonneville are clearly visible at many places along the margins of the valley, especially near the highest level (about 5,200 feet) reached by that lake. Because of the high relief on the underlying rocks, the thickness of the valley fill varies considerably over short distances.

WATER RESOURCES

The quantitative estimates given in this section pertain only to the area within the Blue Creek Valley drainage basin above the narrows in sec. 17, T. 11 N., R. 5 W.

Volume of precipitation

The normal annual (1931-60) precipitation in the Blue Creek Valley drainage basin is shown by isohyets (lines of equal precipitation) on plate 1. The total volume of precipitation was estimated by determining the areas between isohyets, multiplying those areas by the mean value of precipitation between the isohyets and accumulating the total (table 2). The average annual volume of precipitation is about 184,000 acre-feet. Most of this precipitation is returned directly to the atmosphere by evapotranspiration at or near the point of fall; the remaining precipitation becomes runoff or ground-water recharge.

Age	Lithologic unit	General character of material	General hydrologic properties
Mississippian to Permian	Sedimentary and metasedimentary rocks undivided	These rocks form Andersons Hill and the bulk of the mountains that bound Blue Creek Valley. The Oquirrh Formation (Pennsylvanian-Permian age), which consists chiefly of limestone and orthoquartzite with some sandstone, comprises more than 90 percent of the exposures. Manning Canyon Shale (mostly shale and sandstone of Mississippian and Pennsylvanian age) and Great Blue Limestone (mostly massive limestone of Mississippian age) are exposed only locally in Andersons Hill, along the lower slopes of Blue Spring Hills, and in the hills that protrude into the valley from the south. The oldest formation penetrated by oil test (B-11-5)18ddc-1 is reported to be the Laketown Dolomite of Silurian age. All the Paleozoic rocks have undergone considerable deformation and possible local metamorphism. Exposures display intense fracturing, and large solution cavities are evident in several places.	Water-bearing properties are highly variable. The unit as a whole has low permeability, but interconnected fracture zones and solution cavities are capable of transmitting water readily; the possibility of drilling a successful well at any given site is highly unpredictable. The rocks yield less than 10 gpm to most springs in the area; yields to wells range from about 10 to 450 gpm. These rocks probably are the source rocks for most of the flow of Blue Springs and several springs near the south end of Blue Spring Hills.

Table 2.—Estimated average annual volume of precipitation and ground-water recharge from precipitation in the Blue Creek Valley drainage basin

Average annual precipitation: Precipitation zone (inches)	Average annual precipitation: Weighted mean (feet)	Area over which precipitation occurs (acres)	Volume of precipitation (acre-feet)	Precentage of precipitation as recharge	Recharge (acre-feet)
Area where Quaternary and Tertiary sedimentary rocks are exposed					
12-16	1.25	95,770	119,710	5	5,990
16-20	1.50	5,710	8,560	10	860
Subtotals (rounded)		101,500	128,300		6,800
Area where Tertiary igneous rocks and Paleozoic rocks are exposed					
12-16	1.25	21,270	26,590	10	2,660
16-20	1.50	18,950	28,420	15	4,260
More than 20	1.90	440	840	20	170
Subtotals (rounded)		40,700	55,800		7,100
Totals (rounded)		142,000	184,000		14,000

M, Measured by U.S. Geological Survey; F, flowing, but unmeasured (observed by Thiokol Chemical Corp.); E, estimated by U.S. Geological Survey.

Discharge (cfs)	Date
5.0M	Sept. 30, 1959
3.1M	Apr. 19, 1960
4.2M	Oct. 16, 1963
10E	Mar. 19, 1964
11.0M	Apr. 10, 1964
9.0M	Apr. 24, 1964
17.8M	May 7, 1964
2.5M	June 11, 1964
.1E	Sept. 15, 1964
F	Jan. 17, 1969- May 19, 1969
Dry	June 17, 1969
Dry	July 29, 1969
Dry	Aug. 15, 1969
Dry	Sept. 25, 1969
F	Oct. 21, 1969- Dec. 19, 1969
6.8M	Feb. 19, 1970
1.1M	Mar. 18, 1970
1.7M	Apr. 14, 1970
2.4M	May 14, 1970
.5E	July 15, 1970
.3E	Sept. 1, 1970
Dry	Sept. 21, 1970

Ground water

Recharge

The principal source of recharge to the ground-water reservoir in Blue Creek Valley is precipitation that falls on the drainage basin. The volume of recharge was estimated by a method described by Hood and Waddell (1968, p. 22). The estimated recharge is about 14,000 acre-feet annually (table 2) or about 8 percent of the estimated average annual volume of precipitation.

Thiokol Chemical Corp. imports about 150 acre-feet of water per year. About 90 percent of that water is either consumed or percolates into the ground-water reservoir; the remainder is discharged to Blue Creek as treated sewage effluent.

Shallow aquifers in the irrigated segment of the valley below Blue Springs receive some recharge from leaky canals and ditches and from flooded fields; this recharge is regarded as "recycled" ground water and does not add to the total recharge figure. Some additional ground water may enter the Blue Creek Valley area from outside the drainage basin along fault zones and solution cavities. However, data collected for this study were not adequate to confirm this means of recharge or to estimate its magnitude.

Occurence and movement

Ground water in the Blue Creek Valley area occurs under both confined (artesian) and unconfined (water table) conditions. In most of the ground-water reservoir beneath the valley, artesian conditions apparently exist in permeable water-bearing strata that underlie thick beds of clay or other material of poor permeability. Water-table conditions exist in shallow aquifers beneath the valley flat south of Blue Springs. Perched water-table conditions exist locally, especially near the margins of the valley where permeable lakeshore deposits overlie rocks of relatively low permeability. However, the perched aquifers probably are of limited extent and may not be a reliable perennial source of water.

Artesian conditions also exist in the consolidated rocks. These conditions are indicated by Blue Springs and Engineer Spring, which apparently rise along faults in the Paleozoic rocks; and also by the water level in well (B-11-5)5acd-1 (table 3), which taps Paleozoic rocks. Water-table conditions exist in some deep bedrock aquifers such as those tapped by wells (B-11-5)28bba-1 and (B-12-5)27bac-1.

The general direction of ground-water movement in the ground-water reservoir beneath the valley is shown by water-level contours and arrows on plate 1. Ground water moves generally from principal areas of natural recharge on the sides and upper reaches of the valley toward the axis of the valley; movement is then downvalley through the narrow gap near the south boundary of the project area to Great Salt Lake. The overall gradient along the main axis of the valley is slightly more than 500 feet in 25 miles or about 20 feet per mile. The flattening of the gradient near the center of the valley may be due in part to discharge of ground water by evapotranspiration and in part to a subsurface constriction in T. 11 N., R. 5 W., which impedes ground-water movement.

Movement of ground water in the consolidated rocks is controlled largely by geologic structures, such as fault and fracture zones, bedding planes, and solution cavities. Movement is from areas of natural recharge toward the valley fill or toward springs and seeps near the edge of the valley.

Evapotranspiration

Phreatophytes, chiefly greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnum greenei (?)*), sedges (*Carex* sp.), other marsh grasses, and alfalfa (*Medicago sativa*) discharge ground water by evapotranspiration. Ground water probably was transpired by native vegetation in most of the area presently cultivated; when the land was cleared of native vegetation, evapotranspiration probably was reduced. Excluding the irrigated alfalfa fields, about 200 acres of land below Blue Creek Reservoir contain various amounts of phreatophytes (plant density about 50 percent). In this area the water table is less than 20 feet below land surface. Adjusting the plant density to 100 percent yields about 100 acres covered by phreatophytes. The rate of evapotranspiration is about 2 acre-feet per acre per year (Mower and Nace, 1957, p. 17-21), hence the total evapotranspiration by native phreatophytes is about 200 acre-feet per year.

There are at least 1,000 acres of well-established alfalfa under irrigation in the valley. This alfalfa probably consumes some ground water to supplement the water applied by irrigation. Assuming a ground-water consumption of 0.5 acre-foot per acre per year (J.W. Hood, U.S. Geol. Survey, oral commun., 1971), the evapotranspiration by alfalfa is about 500 acre-feet per year. Thus the total discharge of ground water by evapotranspiration is about 700 acre-feet per year.

Pumpage

Only two large-diameter (more than 6 inches) irrigation wells exist in Blue Creek Valley. In 1969, 256 acre-feet of water was discharged from well (B-13-6)1dbb-1 (estimated from power-consumption records), and about 50 acre-feet was discharged from well (B-13-5)31daa-1. About 30 small-diameter (6 inches or less) domestic and stock wells (pumped at the rate of 1-10 gpm) discharge about 200 acre-feet annually. The total pumpage is about 500 acre-feet annually.

Ground-water outflow

A direct determination of ground-water outflow was not made. The detailed study of the water-bearing properties of the aquifers needed for such a determination is beyond the scope of this investigation. Therefore, the ground-water outflow was estimated as the difference between the total annual recharge (14,000 acre-feet) and the annual discharge by springs, seeps, wells, and evapotranspiration (8,500 acre-feet). The difference is 5,500 acre-feet, which is assumed to be the ground-water outflow from Blue Creek Valley. Ground-water inflow to Blue Creek, unknown but probably small, is included in that amount.

Water-level fluctuations

Changes in ground-water storage resulting from changes in ground-water recharge and discharge are reflected by changes of water levels in wells. Under natural conditions, ground-water recharge and discharge are equal over the long term, and ground-water levels fluctuate in response to changes in precipitation. (See fig. 3.)

A considerable amount of water is stored in the valley fill and in the consolidated rocks that surround and underlie the valley, but no estimate was made of the total amount. Much of this water is probably saline.

Budget

The estimated annual volumes of ground-water recharge and discharge in the Blue Creek Valley drainage basin are given in the following table:

	Acre-feet
Recharge:	
Precipitation (p. 4)	14,000
Total	14,000
Discharge:	
Springs and seeps (p. 11)	7,300
Withdrawal by wells (p. 12)	500
Evapotranspiration (p. 12)	700
Ground-water outflow (p.12)	5,500
Total	14,000

Of the 8,500 acre-feet of water discharged by wells, springs, and evapotranspiration, about 8,000 acre-feet is used beneficially and about 500 acre-feet is regarded as salvageable.

Perennial yield

The perennial yield of a ground-water system is the maximum amount of water that can be withdrawn from the system each year indefinitely without causing a permanent and continuing depletion of ground water in storage or a deterioration of chemical quality of the ground water. The perennial yield is limited to the amount of natural discharge of water of suitable chemical quality that can economically be salvaged for beneficial use.

Assuming (1) that subsurface outflow is of suitable chemical quality and could be economically intercepted by wells and (2) that the evapotranspiration loss by nonbeneficial phreatophytes could be salvaged, then the perennial yield of the basin would approximate the discharge from the ground-water reservoir or about 14,000 acre-feet.

Chemical quality of water

Chemical analyses of selected water samples from the Blue Creek Valley area are given in table 6. Plate 1 shows diagrams of chemical quality of water. For some analyses, sulfate ion was not determined, and the sulfate values for the diagrams have been estimated by taking the difference (in milliequivalents per liter) of total cations and anions and assuming the difference to be sulfate ion. These estimated values do not appear in table 6.

Most of the water in Blue Creek Valley exceeds these standards in one or more of the categories listed; exceptions are wells (B-13-6)1dbb-1, (B-14-6)3aaa-2, and (B-15-6)35bdb-1 and some mountain springs.

Little information is available concerning the rating of water for stock supplies. The State of Montana (McKee and Wolf, 1963, p. 113) rates water containing less than 2,500 mg/l of dissolved solids as good, 2,500-3,500 mg/l as fair, 3,500-4,000 mg/l as poor, and more than 4,500 mg/l as unfit for stock. Using these criteria, most of the ground-water sampled in Blue Creek Valley is rated as good for stock use.

The principal chemical quality characteristics that affect the usefulness of water for irrigation are: (1) total concentration of soluble salts, (2) relative proportion of sodium to other cations, (3) concentration of boron or other constituents that may be toxic to some plants, and (4) bicarbonate concentration in excess of the concentration of calcium plus magnesium. The U. S. Salinity Laboratory Staff (1954, p. 79-81) has devised a method for classifying water for irrigation use by plotting data on specific conductance (conductivity) versus sodium-absorption ratio (SAR) on a diagram (fig. 4). This method of classification is based on "average conditions" with respect to soil texture, infiltration rate, drainage, quantity of water used, climate, and salt tolerance of crops. Most of the water sampled in Blue Creek Valley has a low- sodium hazard and a high- to very high-salinity hazard (compare table 6 and fig. 4). Well (B-13-6)1dbb-1 (point 7 in fig. 4) is a large-diameter irrigation well; Blue Springs (point 5 in fig. 4) is the largest source of irrigation water in the valley. Crops are raised using water from Blue Springs, which has both a high SAR and a high mineral content.

SUMMARY OF WATER USE

Past and present development

Development of water in the Blue Creek Valley area began prior to 1900 when the first wells were constructed for domestic and stock supplies. The first recorded well in the area was constructed in 1898. However, most of the domestic and stock wells were constructed during the years 1910-20 and 1930-40. Many of those wells are now used only seasonally by the dryland grain farmers.

The water system for the town of Howell began operating in 1947 with the development and diversion of Hillside Spring (table 4). The system was enlarged about 1965 when well (B-12-6)24add-1 was drilled and put into operation. In 1970 the system served about 150 people.

The Thiokol Chemical Corp. plant was constructed about 1957. About that time, Railroad Springs (table 4), which were formerly used for watering of livestock and for wildlife, were developed and diverted to the plant, chiefly for culinary use.

Irrigation in Blue Creek Valley began in 1904 using water from Blue Springs. In 1960 about 2,800 acres of land in the area was irrigated (U. S. Dept. Agriculture, Soil Conserv. Service, 1960, p. 4). Until 1962, Blue Springs was the only major source of irrigation water. An irrigation well was drilled in 1962 and another in 1968; about 300 acres of land is irrigated with water from these two wells.

Future Development

Because most of the land in Blue Creek Valley is cultivated, future development depends chiefly on additional water supplies to provide for increased irrigation. Blue Springs is fully appropriated for irrigation, and surface runoff in the valley is too meager or of too poor quality for irrigation; therefore, any additional irrigation supplies must be obtained from wells. Theoretically, the annual volume of ground water available for additional development is about 6,000 acre-feet—that is, the assumed perennial yield (about 14,000 acre-feet) less the quantity currently used beneficially (about 8,000 acre-feet). However, full development of the 6,000 acre-feet is not feasible because (1) some of the water is chemically unsuitable for irrigation, (2) the valley ground-water reservoir generally has low permeability and in most places yields water too slowly for large-scale irrigation, and (3) pumping may be too costly for irrigation in the upper part of the valley because water levels are several hundred feet below land surface. Therefore, the volume of ground water economically available probably is considerably less than 6,000 acre-feet a year.

PROPOSALS FOR FUTURE STUDIES

As the need for development of ground water in Blue Creek Valley arises, problems resulting from that development will also arise. Problems resulting from increased pumping might be declining water levels, well interference, decrease in flow of Blue Springs, and deterioration of the chemical quality of water. A detailed study of the basin and adjacent areas would help to better understand these problems and bring about a possible solution. Such a study should include:

1. Establishment of streamflow stations, particularly below Blue Springs and on Blue Creek near site (B-10-5)5bab.

2. Test drilling and gravity surveys to determine the subsurface geology and to delineate major aquifers.

3. Inventory of all wells and water sources, expansion of the observation-well network, and monitoring chemical quality of water at selected sites.

4. Aquifer performance tests to determine the water-bearing properties of the aquifers.

5. Collection of climatic records and detailed geologic mapping to more accurately estimate runoff and ground-water recharge.

6. Detailed mapping of phreatophytes.

APPENDIX

TEMPERATURE-CONVERSION TABLE

Temperatures in °C are rounded to nearest 0.5 degree. Underscored temperatures are exact equivalents. To convert from °F to °C where two lines have the same value for °F, use the line marked with an asterisk (*) to obtain equivalent °C.

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-20.0	-4	-10.0	14	0.0	32	10.0	50	20.0	68	30.0	86	40.0	104
-19.5	-3	-9.5	15	+0.5	33	10.5	51	20.5	69	30.5	87	40.5	105
-19.0	-2	-9.0	16	1.0	34	11.0	52	21.0	70	31.0	88	41.0	106
-18.5	-1	-8.5	17	1.5	35	11.5	53	21.5	71	31.5	89	41.5	107
-18.0 *	0	-8.0 *	18	2.0 *	36	12.0 *	54	22.0 *	72	32.0 *	90	42.0 *	108
-17.5	0	-7.5	18	2.5	36	12.5	54	22.5	72	32.5	90	42.5	108
-17.0	1	-7.0	19	3.0	37	13.0	55	23.0	73	33.0	91	43.0	109
-16.5	2	-6.5	20	3.5	38	13.5	56	23.5	74	33.5	92	43.5	110
-16.0	3	-6.0	21	4.0	39	14.0	57	24.0	75	34.0	93	44.0	111
-15.5	4	-5.5	22	4.5	40	14.5	58	24.5	76	34.5	94	44.5	112
-15.0	5	-5.0	23	5.0	41	15.0	59	25.0	77	35.0	95	45.0	113
-14.5	6	-4.5	24	5.5	42	15.5	60	25.5	78	35.5	96	45.5	114
-14.0	7	-4.0	25	6.0	43	16.0	61	26.0	79	36.0	97	46.0	115
-13.5	8	-3.5	26	6.5	44	16.5	62	26.5	80	36.5	98	46.5	116
-13.0	9	-3.0	27	7.0	45	17.0	63	27.0	81	37.0	99	47.0	117
-12.5	10	-2.5	28	7.5	46	17.5	64	27.5	82	37.5	100	47.5	118
-12.0 *	10	-2.0 *	28	8.0 *	46	18.0 *	64	28.0 *	82	38.0 *	100	48.0 *	118
-11.5	11	-1.5	29	8.5	47	18.5	65	28.5	83	38.5	101	48.5	119
-11.0	12	-1.0	30	9.0	48	19.0	66	29.0	84	39.0	102	49.0	120
-10.5	13	-0.5	31	9.5	49	19.5	67	29.5	85	39.5	103	49.5	121

For temperature conversions beyond the limits of the table, use the equations C = 0.5556 (F - 32) and F = 1.8°C + 32. The formulae say, in effect, that from the freezing point of water (0°C, 32°F) the temperature in °C rises (or falls) 5° for every rise (or fall) of 9°F.

BASIC DATA

Table 3.—Records of selected wells—continued

Well number	Owner	Priority date	Well depth (ft)	Casing Diameter (in.)	Casing Depth (ft)	Casing Finish	Altitude of LSD (ft)	Water level (ft)	Date of water-level measurement	Use of water	Log	Other data available
6/(B-13-5)31daa-1	L. D. Nessen	1962C	405	16	20	P	4,610	27A	7-70	I	D	P
33acc-1	Lawrence Hawkes	1900	180	2	-	O	4,780	170G	3-40	H	-	P
(B-13-6)1bdb-1	R. W. Henrie	1904	195	6	-	-	4,870	175G	3-36	S	-	P
1bdb-2	J. E. Deakin	1929	200	4	-	-	4,875	175G	3-40	H	-	-
1cac-1	M. J. Hyde	1929C	200	4	-	-	4,845	150A	10-49	U	-	P
7/1dbb-1	R. W. Henrie	1968C	704	16	482	P	4,835	121A	9-70	I	D	P
2cab-1	D. B. Bradshaw	1941C	275	6	-	-	4,970	237A	7-70	U	-	-
2dab-1	J. E. Deakin	1906	175	6	-	-	4,885	150G	3-36	U	-	-
10dda-1	H. J. Anderson	1926	364	6	-	O	5,075	311A	7-70	U	-	-
12aba-1	R. W. Henrie	1958C	-	8	-	-	4,900	-	-	S	-	P
14bbc-1	O. P. Canfield	1949C	-	-	-	-	5,070	-	-	S	-	-
24add-1	C. H. Miller	1911	250	6	-	-	4,795	-	-	H	-	-
24dcd-1	W. T. Miller	1911	250	6	-	-	4,825	-	-	H	-	P
36acc-1	Alfred Manning	1911	300	6	-	-	4,800	200G	3-36	S	-	P
(B-14-5)4bab-1	Gerald Jessop	1914	185	6	-	O	5,070	160A	7-70	U	-	-
5aaa-1	L. G. Whitney	1922	150	6	-	-	5,065	130G	4-40	H	-	-
5aba-1	Gerald Jessop	1898	430	3	100	-	5,060	125G	8-36	U	-	-
5bab-1	L. G. Whitney	1932	190	4	-	O	5,070	50G	3-40	U	-	-
8dbc-1	Edward Jessop	1917	180	6	-	O	5,160	31A	7-70	S	-	-
8ddd-1	M. S. Jessop	1918	105	6	-	O	5,175	62A	7-70	H	-	P
17aaa-1	Seth Hammond	1915	125	6	113	P	5,175	70A	7-70	U	-	-
19ccc-1	H. M. Schumann	1934	-	-	-	-	4,920	174A	7-70	U	-	-
28cca-1	William Roberts	1935C	610	-	-	X	5,120	Dry	11-35	U	D	-
29abb-1	H. and L. Schumann	1917	340	42	-	W	5,040	297A	7-70	H	-	P
30cbd-1	James Roberts	1924	200	6	191	-	4,960	166G	3-40	U	-	-
31cdd-1	Edward Doutre	1912	160	4	-	-	4,820	96A	7-70	U	-	-
(B-14-6)3aaa-2	W. R. Bishop	1969C	390	6	348	O	5,115	340D	9-69	H	D	P
9aab-1	Deloris Stokes	1967C	409	6	-	-	5,150	390D	8-67	H	D	P
12add-1	W. E. Fridal	1934	462	6	455	O	5,045	287D	-	U	D	-
12caa-1	Coop Security	1933C	480	8	445	P	5,150	406A	7-70	H	-	P
23add-1	Ray Holdaway	1941C	336	4	-	-	5,050	309A	7-70	U	-	-
23ddd-1	Hyer and Turley	1915C	350	6	348	P	5,030	300G	3-40	H	-	K
24cbc-1	R. B. Hyer	1920	330	6	-	-	5,035	304A	7-70	H	-	P
36cba-1	A. H. Rock	1900	200	2	-	O	4,920	149A	7-70	U	-	-
(B-15-5)32cdd-1	L. G. Whitney	1915	200	8	-	-	5,055	50G	8-44	H	-	P
(B-15-6)34ccc-1	R. W. Tolman	1968C	555	6	-	O	5,230	461D	7-68	H	D	P
35bdb-1	Deloris Stokes	1920	-	-	-	-	5,085	-	-	S	-	P

1/ Reported yield and drawdown: 450 gpm and 20 feet, October, 1962.

2/ Reported yield and drawdown: 90 gpm and 32 feet, July, 1956.

3/ Reported yield and drawdown: 80 gpm and 50 feet, June, 1962.

4/ Well destroyed.

5/ Reported yield and drawdown: 290 gpm and 140 feet, April, 1958.

6/ Reported yield and drawdown: 350 gpm and 200 feet, December, 1962.

7/ Reported yield and drawdown: 580 gpm and 192 feet, October, 1968.

Table 5.—Selected drillers' logs of wells.

Altitudes are in feet above sea level for land surface at well, interpolated from U.S. Geological Survey 7.5-minute topographic maps (20-foot contour interval).
Thickness in feet.
Depth in feet below land surface.

Material	Thickness	Depth
(B-11-5)5acd-1. Log by J. Hy Petersen and Sons. Alt. 4,445 ft.		
Topsoil	3	3
Clay, yellow	61	64
Clay, yellow, and gravel	31	95
Clay, sand, and gravel	49	144
Clay, yellow, and streaks of sandstone	20	164
Gravel, sand, and clay	32	196
Clay, sandy, yellow, and gravel	69	265
Gravel, sand, and hard clay	23	288
Gravel, cemented, hard, and sticky and sandy clay	81	369
Clay, yellow, and fine sandy gravel	29	398
Gravel, cemented	7	405
Gravel, hard, and clay	33	438
Gravel, hard, clay, and broken limestone boulders	7	445
Limestone, solid	94	539
Limestone, soft, black	13	552
Limestone, hard, broken	3	555
Limestone, soft, gray	10	565
Limestone, soft, broken	4	569
Limestone, hard, black	41	610
(B-11-5)28bba-1. Log by Melvin Church Drilling Co. Alt. 4,540 ft.		
Soil, rocky	2	2
Clay	3	5
Conglomerate	6	11
Rocks, large, and clay	183	194
Unlogged	1	195
Silt, yellow	5	200
Silt, red, and rocks	10	210
Silt and rocks; water seep	8	218
Limestone, broken	14	232
Shale, black	86	318
Rock; water seepage	6	324
Shale and limestone, lenticular	41	365
(B-11-5)29abb-1. Log by Melvin Church Drilling Co. Alt. 4,410 ft.		
Soil, rocky	4	4
Clay, gumbo	6	10
Conglomerate	26	36
Clay, gumbo	10	46
Conglomerate	37	83
Boulders and clay	4	87
Conglomerate	48	135
Clay, gumbo	6	141
Conglomerate	9	150
Gravel; water bearing	2	152
Clay	7	159
Gravel; water bearing	13	172
Clay	22	194
Gravel	2	196
Clay	4	200
Gravel; water bearing	14	214
Clay	2	216
(B-11-5)29cbd-1. Log by T. J. Burkhart. Alt. 4,340 ft.		
Soil	2	2
Clay, sandy	21	23
Gravel	7	30
Gravel and clay	15	45
Clay, sandy	15	60
Gravel	2	62
Clay, sandy	9	71
Gravel and clay	17	88
Sand, dirty	11	99
Gravel	8	107
Sand	8	115
Gravel	5	120
Clay	6	126
Sand and gravel	20	146
Clay	9	155
Gravel or sand	3	158
Gravel, dirty	26	184
Clay	8	192
Gravel with some clay	40	232
Gravel, loose	19	251
Gravel and boulders, dirty	53	304
Gravel and sand	6	310
(B-11-6)16bcc-1. Log by D. G. Musselman. Alt. 5,040 ft.		
Topsoil	3	3
Sandstone	17	20
Clay, blue	33	53
Clay, white	73	126
Clay, yellow, and gravel	10	136
Sandrock	156	292
(B-12-5)22dbd-1. Log by Robinson Drilling Co. Alt. 4,750 ft.		
Clay, silt, and cobbles	3	3
Sand and gravel	5	8
Clay, yellow, and boulders	7	15
Clay, red	5	20
Clay and boulders	10	30
Boulders	13	43
(B-12-5)22dbd-1 - Continued		
Limestone	18	61
Clay, red and yellow	4	65
Clay and rock	5	70
Limestone	10	80
Clay and rock	7	87
Boulders	6	93
Clay and rock	27	120
Shale, black	26	146
Limestone	53	199
Shale, black	52	251
Limestone, hard	32	283
Limestone, fractured	17	300
Limestone, hard	13	313
Shale, black	20	333
Limestone, hard	9	342
(B-12-6)24add-1. Log by Waymon Yarbrough. Alt. 4,620 ft.		
Clay	6	6
Clay and boulders	17	23
Clay and sand	22	45
Gravel	50	95
Clay and sand	23	118
Limestone	1	119
Limestone and clay	26	145
Clay and sand	10	155
Sand, soft, tight	5	160
Limestone, hard	117	277
Sand, soft	2	279
Sand	12	291
Limestone, hard	2	293
Sand and clay	7	300
(B-12-6)34acd-1. Log by David Musselman. Alt. 5,170 ft.		
Clay, red	10	10
Rocks	4	14
Clay, red	236	250
"Hardpan"	10	260
Clay, red, and gravel	28	288
Clay, white, sandy	10	298
Clay, red, and gravel	54	352
"Hardpan"	10	362
Clay, red, and gravel	10	372
"Hardpan"	12	384
Clay, soft, red	8	392
Sand	46	438
Gravel and clay	20	458
Sand	8	466
Clay	4	470
(B-13-5)5bcb-2. Log by T. J. Burkhart. Alt. 4,820 ft.		
Soil	2	2
Clay, yellow	38	40
Clay, soft, sandy, yellow	12	52
Clay, hard, sandy, light gray	53	105
Clay, yellow, and gravel	82	187
Clay, dense, gray	45	232
Shale, sandy, hard and soft streaks, light gray	28	260
(B-13-5)6aaa-2. Log by R. J. Howell Drilling Co. Alt. 4,840 ft.		
Clay, brown	5	5
Clay, yellow, and sand	30	35
Gravel, dry	2	37
Clay, yellow	33	70
Clay, brown, and conglomerate	12	82
Clay, brown, and lava rock	4	86
Clay, brown, and sand	10	96
Clay, brown, and lava rock	4	100
Clay and gravel	15	115
Clay and boulders	15	130
Sandstone	20	150
Limestone	25	175
Clay, red	10	185
Limestone, hard	3	188
Sand, red, and gravel; water bearing	10	198
Sand and gravel	32	230
Limestone	5	235
(B-13-5)7acc-1. Log by Davis and Davis. Alt. 4,800 ft.		
Sand and shale	±120	±120
Sandstone, sand, and shale	278	398
Sand; water bearing	14	412
(B-13-5)28bab-1. Alt. 4,665 ft.		
Soil, black	1	1
Clay	110	111
Gravel	1	112
(B-13-5)29aaa-1. Log by T. J. Burkhart. Alt. 4,640.		
Soil	2	2
Clay, light gray	21	23
Clay, light brown, and gravel	15	38
Clay, light gray	16	54
(B-13-5)29aaa-1 - Continued		
Gravel and boulders	3	57
Clay, light brown, and gravel	63	120
Clay, sandy, light brown	31	151
Gravel and light brown clay	40	191
Gravel and boulders; some clay	5	196
Gravel and light brown clay	19	215
Boulders, gravel, and light brown clay	88	303
Sand, clay, and gravel	21	324
Gravel and clay	4	328
(B-13-5)31daa-1. Log by Waymon Yarbrough. Alt. 4,610 ft.		
Soil	7	7
Clay	35	42
Unlogged; water bearing	13	55
Clay, gray	23	78
Gravel, coarse, boulders, and sand	12	90
Clay, white	22	112
Shale, hard	3	115
Clay, blue	30	145
Shale, hard	5	150
Clay, white	50	200
Clay, blue green	20	220
Clay, green	50	270
Sandy (sandy streak)	5	275
Shale	5	280
Clay, white	25	305
Clay, soft, blue	10	315
Sandstone, hard	10	325
Sandy (sandy streak)	1	326
Sandstone	4	330
Sandy (sandy streak)	1	331
Shale	4	335
Clay, hard	10	345
Limestone	25	370
Sand, black	10	380
Clay	20	400
Clay, hard	5	405
(B-13-6)1dbb-1. Log by Robinson Drilling Co. Alt. 4,835 ft.		
Soil	9	9
Clay	28	37
Clay and gravel	77	114
Clay	29	143
Clay with lime seams	57	200
Clay	6	206
Clay with limestone seams	6	212
Clay and gravel	69	281
Clay	13	294
Gravel	2	296
Clay	53	349
Gravel	2	351
Clay and sand	23	374
Gravel	11	385
Clay	14	399
Gravel	4	403
Clay and gravel	78	481
Clay	3	484
Gravel	12	496
Clay	16	512
Gravel	7	519
Clay	13	532
Gravel	2	534
Clay and gravel	39	573
Gravel	61	634
Clay and gravel	6	640
Gravel	31	671
Clay	8	679
Gravel	18	697
Clay and gravel	7	704
(B-14-5)28cca-1. Log by Adam Inthurn and F. H. Hughes. Alt. 5,120 ft.		
Conglomerate	140	140
Clay	35	175
Rock	65	240
Conglomerate	80	320
Rock	35	355
Shale	39	394
Rock, black	12	406
Sand and sandstone	77	483
Rock, black	50	533
Conglomerate	10	543
Rock, black	25	568
Conglomerate	15	583
Rock, black	27	610
(B-14-6)3aaa-2. Log by R. H. Howell Drilling Co. (0-320 ft) and R. O. Denton (328-390 ft). Alt. 5,115 ft.		
Lime(stone), white	12	12
Sandstone, red, hard	10	22
Clay, red	28	50
Sandstone, red	18	68
Red rock or hardpan	4	72
Clay, red	15	87
Cobbles	5	92

Table 6.—Chemical analyses of selected water samples.

Sodium and potassium: An entry of C for potassium indicates that sodium and potassium are calculated and reported as sodium.
Agency making analysis: GS, U.S. Geological Survey; IN, Thiokol Chemical Corp.; SU, Utah State University.

Location	Date of collection	Temperature (°C)	Milligrams per liter															Dissolved solids		Specific conductance (micromhos/cm at 25°C)	Sodium-adsorption ratio	pH	Agency making analysis
			Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Hardness as $CaCO_3$	Noncarbonate hardness	Determined	Calculated				
Wells																							
(B-11-6)2bdc-1	7-14-70	11.5	-	-	122	28	37	-	171	0	-	240	-	-	-	418	278	765	-	1,080	0.8	8.0	GS
14bbb-1	8-10-70	14.0	-	-	184	54	42	-	143	0	-	218	-	-	-	680	563	-	-	1,460	-	7.9	GS
(B-12-5)5cdb-1	7-14-70	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,690	-	-	GS
5d	1913	-	-	-	1/80	-	160	C	310	0	40	155	-	-	-	205	-	570	-	-	4.9	-	GS
7ccc-1	7-13-70	12.0	-	-	131	98	69	-	192	0	-	460	-	-	-	732	575	1,020	-	1,830	1.1	7.8	GS
7ddc-1	7-13-70	9.5	-	-	418	180	1,520	-	539	0	-	2,580	-	-	-	1,780	1,340	6,080	-	9,280	16	7.8	GS
10bca-1	7-14-70	15.5	-	-	66	37	129	-	254	3	-	226	-	-	-	317	104	708	-	1,220	3.2	8.5	GS
19ba	1913	-	-	-	1/80	-	200	C	215	0	40	275	-	-	-	205	-	690	-	-	6.1	-	GS
20bbb-2	7-14-70	9.5	32	-	97	59	1,020	20	525	25	129	1,470	1.2	4.0	0.45	486	14	3,260	3,120	5,270	20	8.7	GS
20bbb-3	7-14-70	10.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7,320	-	-	GS
(B-12-6)13ddd-1	7-13-70	12.5	44	-	61	47	38	3.0	179	0	33	173	.9	5.4	.01	347	200	526	493	885	.9	8.2	GS
36ada-1	7-14-70	16.5	42	-	77	49	67	7.7	183	0	54	230	.7	2.9	.05	391	241	644	620	1,100	1.5	8.2	GS
(B-13-5)5bcb-2	7- 8-70	14.5	53	-	98	40	61	6.9	173	0	20	267	.5	4.2	.03	410	268	717	636	1,140	1.3	8.1	GS
6aaa-2	7- 8-70	19.0	-	-	185	70	108	-	144	0	-	591	-	-	-	750	632	1,230	-	2,120	1.7	7.9	GS
8d	1913	-	-	-	1/80	-	180	C	220	0	40	275	-	-	-	205	-	700	-	-	5.5	-	GS
16ccc-1	7- 7-70	18.5	-	-	572	245	547	-	142	0	-	2,380	-	-	-	2,430	2,320	4,860	-	7,190	4.8	7.8	GS
18adb-1	7-13-70	-	-	-	152	226	176	-	224	0	-	520	-	-	-	1,310	1,130	1,980	-	2,980	2.1	8.0	GS
18c	1913	-	-	-	1/80	-	110	C	215	0	100	105	-	-	-	205	-	480	-	-	3.3	-	GS
22ccc-1	7- 8-70	16.5	-	-	65	24	78	-	269	0	-	128	-	-	-	260	40	501	-	860	2.1	8.2	GS
28b	1913	-	-	-	1/95	-	180	C	240	0	30	405	-	-	-	240	-	900	-	-	5.1	-	GS
28bab-1	7- 8-70	13.0	-	-	233	94	146	-	163	0	-	751	-	-	-	968	834	1,600	-	2,660	2.0	7.8	GS
31daa-1	7-13-70	20.5	-	-	89	41	153	-	343	4	-	274	-	-	-	391	103	1,010	-	1,440	3.4	8.4	GS
33acc-1	7-14-70	19.0	-	-	52	23	101	-	274	3	-	136	-	-	-	224	0	509	-	901	2.9	8.6	GS
(B-13-6)1bdb-1	7- 6-70	16.5	-	-	149	32	41	-	144	0	-	331	-	-	-	506	388	818	-	1,340	.8	7.8	GS
1cac-1	10-17-57	-	53	-	204	44	49	C	140	0	102	395	-	20	-	688	573	-	936	1,650	.8	7.5	GS
1dbb-1	7- 6-70	19.0	47	-	71	19	31	10	160	0	16	127	.4	6.1	.04	260	124	405	407	701	.8	8.2	GS
12aba-1	7- 7-70	16.5	-	-	325	77	62	-	150	0	-	551	-	-	-	1,130	1,000	1,700	-	2,470	.8	7.9	GS
24dcd-1	7-13-70	14.5	-	-	113	75	48	-	204	0	-	325	-	-	-	597	430	936	-	1,450	.9	7.9	GS
36acc-1	7-13-70	17.5	-	-	447	153	143	-	162	0	-	1,340	-	-	-	1,740	1,610	3,450	-	4,270	1.5	8.0	GS
(B-14-5)8ddd-1	7- 7-70	10.5	29	-	91	19	72	1.7	321	0	69	55	.2	7.6	.06	304	41	600	474	878	1.8	8.2	GS
29abb-1	7- 6-70	13.0	40	-	216	56	48	7.6	138	0	49	490	.3	3.9	.00	770	657	1,330	979	1,850	.8	8.1	GS
(B-14-6)3aaa-2	7- 7-70	12.0	29	-	56	22	59	4.5	187	0	26	131	.5	1.9	.05	231	78	440	422	739	1.7	7.6	GS
9aab-1	7- 7-70	20.5	-	-	67	25	213	-	2/258	0	-	341	-	-	-	270	58	870	-	1,530	5.6	8.3	GS
12caa-1	7- 7-70	12.0	26	-	87	17	41	10	143	0	44	176	.3	.0	.06	285	168	517	471	823	1.1	8.2	GS
23ddd-1	7- 8-70	10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,270	-	-	GS
24cbc-1	7- 8-70	10.0	-	-	121	30	33	-	183	-	-	230	-	-	-	428	278	773	-	1,080	.7	7.8	GS
(B-15-5)32cdd-1	7- 7-70	12.5	-	-	199	23	119	-	2/249	0	-	234	-	-	-	340	135	772	-	1,230	2.8	8.4	GS
(B-15-6)34ccc-1	7- 7-70	20.5	41	-	60	25	247	5.7	259	0	40	375	1.0	.3	.06	252	40	938	922	1,610	6.8	7.9	GS
35bdb-1	7- 7-70	18.5	-	-	88	16	16	-	258	0	-	64	-	-	-	284	73	417	-	634	.4	8.2	GS
Springs																							
(B-11-5)3cac-S1	7-14-70	17.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	765	-	-	GS
12cca-S1	7-14-70	17.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	631	-	-	GS
21-23-S3/	10- -62	-	13	-	36	5	47	-	-	-	22	75	-	-	0.06	112	-	382	-	-	1.9	8.1	IN
21-23-S3/	11- -62	-	17	-	53	11	73	-	-	-	42	119	-	-	.19	176	-	526	-	-	2.4	8.3	IN
(B-11-6)24ddb-S1	8-11-70	-	-	-	101	19	71	-	187	0	-	190	-	-	-	330	177	-		1,010	-	8.0	GS
(B-12-5)11cdd-S1	7-14-70	11.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	858	-	-	GS
14baa-S1	7-14-70	17.0	-	-	79	15	90	-	243	4	-	140	-	-	-	257	51	543	-	909	2.5	8.5	GS
14ccc-S1	7-14-70	18.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	798	-	-	GS
22dac-S1	7-14-70	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	889	-	-	GS
(B-12-6)33dba-S1	7-14-70	20.5	-	-	81	12	54	-	250	0	-	100	-	-	-	252	46	477	-	751	1.5	8.2	GS
(B-13-5)29-S	1913	-	-	-	1/75	-	630	C	240	0	40	840	-	-	-	185	-	1,600	-	-	20	-	GS
29-S	9-10-64	26.5	-	-	83	24	540	32	268	-	68	886	-	-	.2	306	-	-	1,923	3,580	13	8.0	SU
29-S	7- 7-70	28.0	19	-	56	24	636	22	329	0	84	895	0.4	1.0	.22	238	0	2,010	1,900	3,410	18	7.9	GS
Blue Creek [at location (B-10-5)5bab]																							
Discharge (cfs)																							
-	6-29-59	17.5	19	-	112	68	1,810	C	538	20	426	2,530	-	10	8.1	560	86	-	5,270	8,640	33	8.4	GS
5.0	9-30-59	12.0	26	0.04	98	36	941	34	350	16	202	1,380	2.0	1.7	.40	392	79	-	2,910	5,130	21	8.5	GS
3.1	4-19-60	12.0	26	.04	128	72	1,430	41	397	24	372	2,150	-	1.7	.55	615	250	-	4,440	7,710	25	8.5	GS
-	4- 6-61	6.0	21	.03	184	126	2,540	65	552	0	716	3,740	-	12	-	978	526	-	7,700	12,400	35	8.0	GS
4.2	10-16-63	15.0	-	-	-	-	-	-	-	-	350	2,200	-	-	-	510	-	4,220	-	7,170	-	-	GS
4/10	3-19-64	-	-	-	-	-	-	-	-	-	434	2,200	-	-	-	595	-	4,670	-	7,430	-	-	GS
11.0	4-10-64	7.0	-	-	-	-	-	-	-	-	354	1,950	-	-	-	510	-	3,850	-	6,400	-	-	GS
9.0	4-24-64	7.0	-	-	-	-	-	-	-	-	400	2,300	-	-	-	600	-	4,670	-	7,550	-	-	GS
17.8	5- 7-64	7.0	-	-	-	-	-	-	-	-	362	1,900	-	-	-	430	-	3,820	-	6,400	-	-	GS
2.5	6-11-64	13.5	26	-	136	96	2,330	-	628	-	612	3,290	-	4.7	-	735	220	6,740	-	10,800	-	8.1	GS
4/.1	9-15-64	-	-	-	-	-	-	-	-	-	395	2,440	-	-	-	454	-	4,920	-	8,140	-	-	GS
6.8	2-19-70	-	22	-	160	107	2,110	C	592	0	570	3,080	-	.6	-	840	355	6,540	6,340	10,100	32	7.8	GS
1.1	3-18-70	2.5	23	-	140	95	2,080	-	579	0	626	3,080	-	.2	-	740	265	6,560	6,330	10,100	33	8.1	GS
1.7	4-14-70	7.0	23	-	124	75	1,640	-	498	0	392	2,480	-	.0	-	620	212	5,140	4,980	8,330	29	8.1	GS
7.0	5-14-70	18.0	-	-	-	-	-	-	-	-	-	3,280	-	-	-	-	-	-	-	10,500	-	-	GS
4/.3	9- 1-70	18.5	-	-	-	-	-	-	-	-	-	2,350	-	-	-	-	-	-	-	7,980	-	-	GS

1/ Calcium plus magnesium. 2/ Some CO_3 included as HCO_3. 3/ Composite sample from 12 springs (Railroad Springs). 4/ Estimated.

PUBLICATIONS OF THE UTAH DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER RIGHTS

(*)–Out of Print

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No. 1. Underground leakage from artesian wells in the Flowell area, near Fillmore, Utah, by Penn Livingston and G. B. Maxey, U. S. Geological Survey, 1944.

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*No. 3. Ground water in Pavant Valley, Millard County, Utah, by P. E. Dennis, G. B. Maxey, and H. E. Thomas, U. S. Geological Survey, 1946.

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*No. 8. Consumptive use of water and irrigation requirements of crops in Utah, by C. O. Roskelly and Wayne D. Criddle, 1952.

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*No. 13. Ground-water resources of selected basins in southwestern Utah, by G. W. Sandberg, U. S. Geological Survey, 1966.

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No. 34. Summary of water resources of Salt Lake County, Utah, by Allen G. Hely, R.W. Mower, and C. Albert Harr, U.S. Geological Survey, 1971.

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No. 2. Ground water in Tooele Valley, Utah, by J. S. Gates and O. A. Keller, U. S. Geological Survey, 1970.

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*No. 3. Ground water data, central Sevier Valley, parts of Sanpete, Sevier, and Piute Counties, Utah, by C. H. Carpenter and R. A. Young, U. S. Geological Survey, 1963.

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*No. 15. Ground-water conditions and related water-administration problems in Cedar City Valley, Iron County, Utah, February, 1966, by Jack A. Barnett and Francis T. Mayo, Utah State Engineer's Office.

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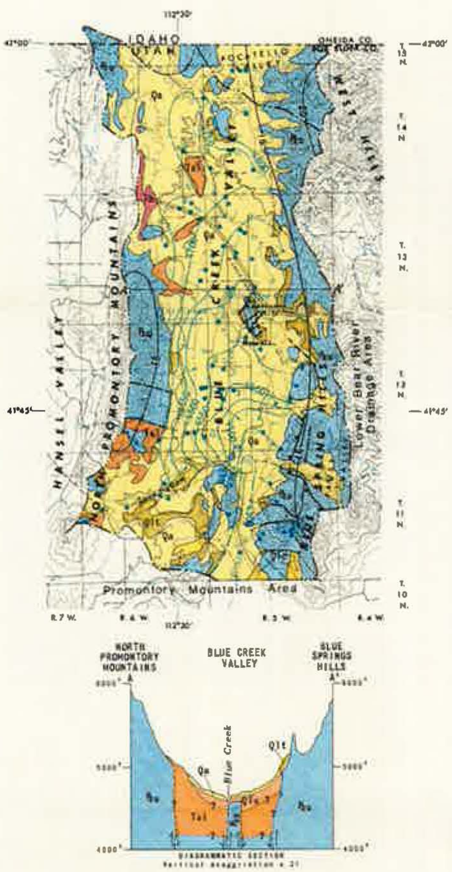


Generalized hydrogeology

EXPLANATION

GEOLOGY
(See table 1)

Cenozoic

QUATERNARY

Qa — Surficial alluvial deposits
Mostly clay and silt, some gravel and scattered boulders; generally transmit water slowly

Qlb — Lake-bottom deposits
Mostly clay and silt; some very fine sand; transmit water slowly

Qlt — Lakeshore deposits
Sand and gravel in spits, bars, and on terraces; transmit water readily

TERTIARY and QUATERNARY

Valley-fill deposits
Not exposed, but underlie mapped Quaternary units in much of the area. Mostly clay or clay mixed with sand and gravel strata which yield water readily

TERTIARY

Extrusive igneous rocks
Layered basaltic lava flows with some local associated tuff deposits; interflow zones transmit water readily

Salt Lake Formation
Mostly tuffaceous sandstone, some limestone, conglomerate, and volcanic debris; generally transmits water slowly, but some loosely cemented zones transmit water readily

Paleozoic

MISSISSIPPIAN to PERMIAN

Ru — Sedimentary and metasedimentary rocks undivided
Mostly limestone; some sandstone, quartzite, and shale; generally transmit water slowly, but interconnected fracture zones and solution cavities transmit water readily

Approximate contact
Dashed where inferred

Fault
Dashed where concealed, dotted where inferred

Thrust fault
Barbs on side of thrust sheet

A——A'
Line of diagrammatic section

HYDROLOGY

—20—
Line of equal normal annual precipitation
Interval 4 inches

—4300—
Water-level contour
Shows altitude of water level; dashed where approximately located; contour interval 50 feet; datum is mean sea level; arrows denote direction of ground-water movement

Spring
Number by spring symbol indicates number of springs shown in the same location

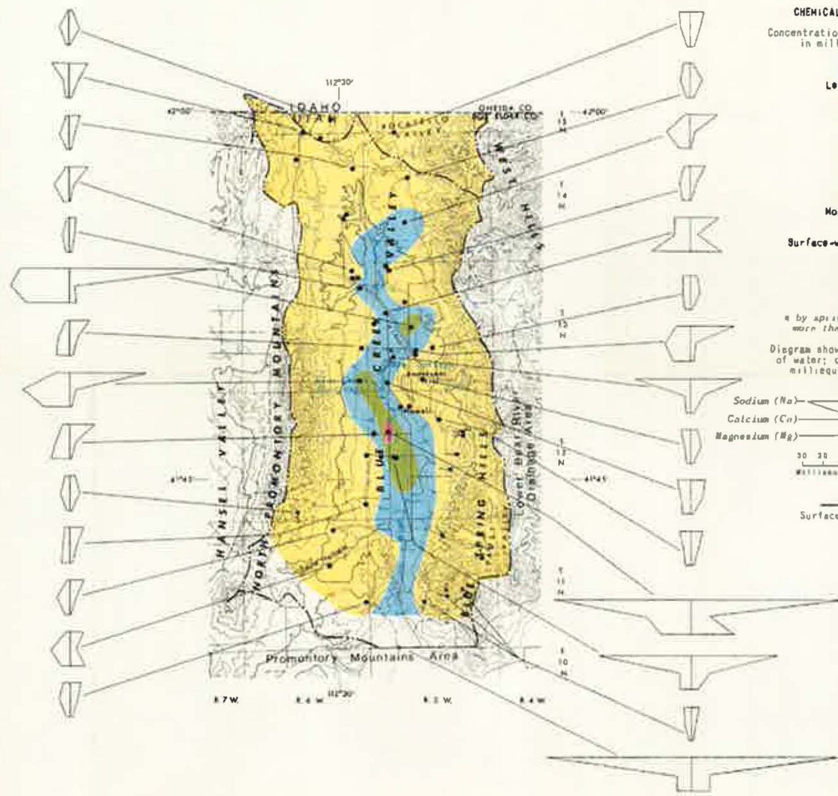
Well
Open circle indicates well used for water-level control; number by symbol indicates number of wells shown in the same location

Miscellaneous stream discharge measuring site

Partial-record gaging station

Surface-drainage divide

Hydrogeology by R. L. Bolke and Don Price 1970. Geology adapted from Stokes (1964). Climatologic data from U.S. Weather Bureau (1963)



Chemical quality of water and location of sampling sites

EXPLANATION

CHEMICAL QUALITY OF WATER

Concentration of dissolved solids, in milligrams per liter

Less than 1000

1000-3000

3000-6000

More than 6000

Surface-water sampling site

Well

Spring
a by spring symbol indicates more than one spring area

Diagram showing chemical analyses of water; constituents given in milliequivalents per liter

Sodium (Na)	Chloride (Cl)
Calcium (Ca)	Bicarbonate (HCO_3)
Magnesium (Mg)	Sulfate (SO_4)

30 20 10 0 10 20 30
Milliequivalents per liter

Surface drainage divide

Compiled by R. L. Bolke and Don Price 1970

Base from U.S. Geological Survey Pocatello and Brigham City, 1954

0 5 MILES
CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

HYDROGEOLOGIC MAPS OF THE BLUE CREEK VALLEY AREA, BOX ELDER COUNTY, UTAH

ATK

July 11, 2013
8200-FY14-033

Mr. Walter L Baker, Director
Division of Water Quality
Utah Department of Environmental Quality
195 N. 1950 W.
P.O. Box 144870
Salt Lake City, Utah 84114-4870

Attention: Chris Bittner

Re: ATK Launch Systems-Promontory UPDES Permit #0024805, Blue Creek Site-Specific Standard for Total Dissolved Solids (TDS) Criterion Monitoring Report

Dear Mr. Baker:

In June 2011 ATK Launch Systems Inc. ("ATK") submitted a work plan for the development of a new site-specific TDS standard for Blue Creek. ATK, in cooperation with Chris Bittner of your staff, has completed the monitoring and data collection outlined in the work plan. Enclosed are the monitoring results and data from the sampling that was collected.

ATK appreciates the opportunity to work with the Division in the development of this new stream criterion for Blue Creek.

Please contact me if you have any questions concerning this report. My telephone number is (435)863-2018 or you can contact Blair Palmer at (435)863-2430.

Sincerely

George E. Gooch, Manager
Environmental Services

1.0 Introduction

In June 2011 ATK Launch Systems Inc. submitted a work plan for use in the development of a site-specific criterion for Total Dissolved Solids (TDS) on a stream segment of Blue Creek. The stream segment of Blue Creek begins at 41°43'20.40" N, 112°26'33.58" W a location on the northern boundary of ATK's facility along Highway 83 that ATK identifies as Blue Creek Upper with the stream segment ending at the Great Salt Lake. ATK currently has two wastewater treatment discharges along this stream segment under UPDES Permit #UT0024805. (See Figures 1 & 2, Goggle Earth image) The objective of this monitoring report is to assist in the establishment of a site specific standard for the stream segment of Blue Creek from the Blue Creek Reservoir Dam flowing southward to the Great Salt Lake.

2.0 Background

Blue Creek originates approximately 8 miles north of the ATK Facility from Blue Springs. Blue Springs is a warm springs that has a TDS concentration of 2000 mg/L. The primary constituents of the TDS are sodium, chloride, and sulfate which are naturally found in the soils throughout the valley. These soils were generated from localized deposits from the ancient lake Bonneville. It is likely the source feeding the warms springs circulates slowly through these fine-grained sediments allowing these soluble minerals to leach into the groundwater.

The Blue Creek Reservoir Dam was constructed in 1904 and modified, enlarged and repaired in 1949, 1967 and 1986. The current capacity of the reservoir is about 2,185 acre-feet (UDWR, 2001). Water from Blue Springs is stored in the reservoir during the winter months and used for agricultural irrigation during the spring through fall season. The water in the reservoir is distributed by canals owned by the Blue Creek Irrigation Company. The two main canals, the East Canal and the West Canal, are used to irrigate a portion of the valley north of ATK's facility (Bolke and Price, 1972).

Several saline springs feed the main channel of Blue Creek once it leaves the Blue Creek Reservoir. These springs are the major source of flow in Blue Creek during most of the year as it passes through the ATK facility.

Prior to 1975, the stream segment of Blue Creek from the irrigation dam flowing southward was an intermittent stream only flowing significantly after rainfall events and snow melts. As a result of an earthquake in March 1975, Blue Creek became a perennial stream with year round flow resulting from the springs located below the Blue Creek Reservoir Dam.

3.0 Sampling and Investigation

The sampling and investigation was focused on determining the natural and unaltered TDS concentration for the stream segment of Blue Creek beginning at the Blue Creek Reservoir Dam flowing south to Blue Creek Upper (north boundary of ATK property, Hwy 83). This flow is predominantly made up of the springs below the dam.

ATK sampled each site identified below, once a month. During periods of transition, i.e. when conditions changed at the reservoir such as water being discharged or not discharged from the dam to Blue Creek or the irrigation channels, sampling was conducted once a week for a three week period.

- Blue Creek Reservoir below the dam;
- Blue Creek at crossing 14400 N; and
- Blue Creek Upper (north boundary of ATK property, Hwy 83).

These sites are illustrated in Figure 3 (Goggle Earth image), and are all north of the ATK facility.

The samples collected from these sites were analyzed for:

- Metals, Method 200.7 to include, Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, Ti, Tl, V, Zn, Sr;
- Mercury Method 245.1;
- Total Dissolved Solids (TDS), Method 160.1; and
- Anions, Method 300 IC to include, Fluoride, Chloride, Nitrite-N, Bromide, Nitrate-N, Orthophosphate-P, Sulfate.
- Flow (gallons/minute)

During each sampling event, a visual investigation was conducted to verify if water discharged from the Blue Creek Reservoir Dam was flowing into either of the irrigation canals or if it is being discharged directly to Blue Creek.

Sampling these sites and conducting the visual investigations allowed the development of two datasets:

- When water is being discharged from the Blue Creek Reservoir Dam into the main channel of Blue Creek thereby, lowering the TDS level of Blue Creek by dilution; and
- Periods when water is being discharged from the Blue Creek Reservoir into irrigation canals with no flow going to Blue Creek, which is intended to represent natural conditions that predominate most of the year. This would represent the flow and TDS level in the main channel of Blue Creek that result from springs or seeps that occur below the reservoir dam southward.

The development of these datasets will help characterize different flow conditions, as well as allowing the coordination of the sampling and analytical results with the flow conditions.

In addition to collecting samples, a velocity meter was used to measure the average flow velocity of Blue Creek at each sample site. The water depth was measured and used to determine a cross sectional area of the channel at each site providing an estimate for flow in gallons per minute. The flow measurements were used to determine if TDS concentrations correlated with the changing flows over the course of a year.

Field electrical conductivity measurements were also taken from several sources that flow to Blue Creek during a multi-day sampling event. These sources originate from springs and seeps in the property adjacent to Blue Creek as it flows from the reservoir below the dam to the Blue Creek Upper (north boundary of ATK property, Hwy 83) site (see figures 4 & 5). These electrical conductivity measurements were then correlated to calculate TDS concentrations and can be seen in Table 1.

4.0 Sampling Results

Sampling and visual investigations began April 14, 2011 and have been completed monthly for the past two years. The TDS concentrations of each sampling event have been collected over the course of that time and can be found in Table 2. This data has been plotted in Figure 6 to illustrate seasonal trends in concentrations.

Figure 6 shows the plotted results of the TDS concentrations for each of the sampling sites along with correlating flow measurements. The chart has been color coded to distinguish the two datasets listed on the previous page. The time period where Blue Creek was receiving additional flow from the dam is highlighted in blue. The time period when Blue Creek receives no flow from the dam is highlighted in yellow.

Concentrations have also been color coded to match the measured flow for each site to help decipher which concentration belongs to which flow reading. It can be seen that the flow in Blue Creek does not correlate with the TDS concentrations measured at each site along the stream. TDS concentrations below the dam remain consistent at around 2,000 mg/L while the Upper site and Crossing site show a greater deviation in concentrations and continuously fluctuate over the course of a year, however, they do show TDS levels increase due to the influence of the high TDS springs.

The variation in TDS concentrations and lack of correlation with flow data is most likely the combination of seasonal weather patterns and upstream irrigation practices. Due to the ever changing dynamics of the stream it is difficult to distinguish a specific dataset that would be considered the "natural and unaltered" state for the entire length of Blue Creek. As a result, the focus of the investigation has been directed toward determining the 95% Upper Tolerance Limit (UTL) based on data collected from the Blue Creek Upper site.

ProUCL 4.1 was used to calculate the 95% UTL of 5,918 mg/L for the Blue Creek Upper dataset found in column 4 of Table 2. The same method was used to calculate a second 95% UTL for historical data previously collected each quarter at the Upper site from year 2000 to year 2010. The results from the historical data showed a 95% UTL of 6,123 mg/L. Both levels are much higher than the current standard of 1,200 mg/L set for Blue Creek.

Electrical conductivity measurements taken from several sources that discharge to Blue Creek are identified in Figures 4 and 5 along with Table 1. The conductivity measurements show that those sources have higher levels of TDS than the average concentrations measured at the Upper site. This demonstrates that the high levels of TDS measured in Blue Creek are a result of naturally occurring saline springs that contribute to the TDS loading after the dam and prior to entering ATK property.

The high TDS levels seen in the upstream sources are consistent with concentrations found in groundwater wells and other springs in the area. Historical groundwater monitoring data shows TDS concentrations in wells located in the valley near Blue Creek range from 2,800 mg/L to 8,800 mg/L. Samples taken from nearby springs have TDS concentrations ranging from 4,500 mg/L to 7,170 mg/L. Therefore, it can be seen that the groundwater feeding the springs contributing to the flow of Blue Creek is naturally high in TDS.

5.0 Summary and Conclusions

The objective of this monitoring report is to assist in the establishment of a site specific standard for the stream segment of Blue Creek from the Blue Creek Reservoir Dam flowing southward to the Great Salt Lake. Through the sampling and investigation that was conducted, TDS concentrations, and the concentrations of the individual water constituents that contribute to the Blue Creek TDS have been sampled and monitored along with the different stream flow conditions that occur in Blue Creek. This information will allow a site-specific standard for TDS in Blue Creek to be established that represents the natural and unaltered TDS concentration that is protective of current uses.

ATK believes that the sampling and monitoring that has been completed is sufficient to allow the establishment of a site specific standard for the TDS in Blue Creek. The 95% upper tolerance limits for data from the time period of 2011-2013 and 2000-2010 are 5,918 mg/L and 6,123 mg/L respectively.

Figure 1. Point of Proposed Site Specific Standard for Blue Creek

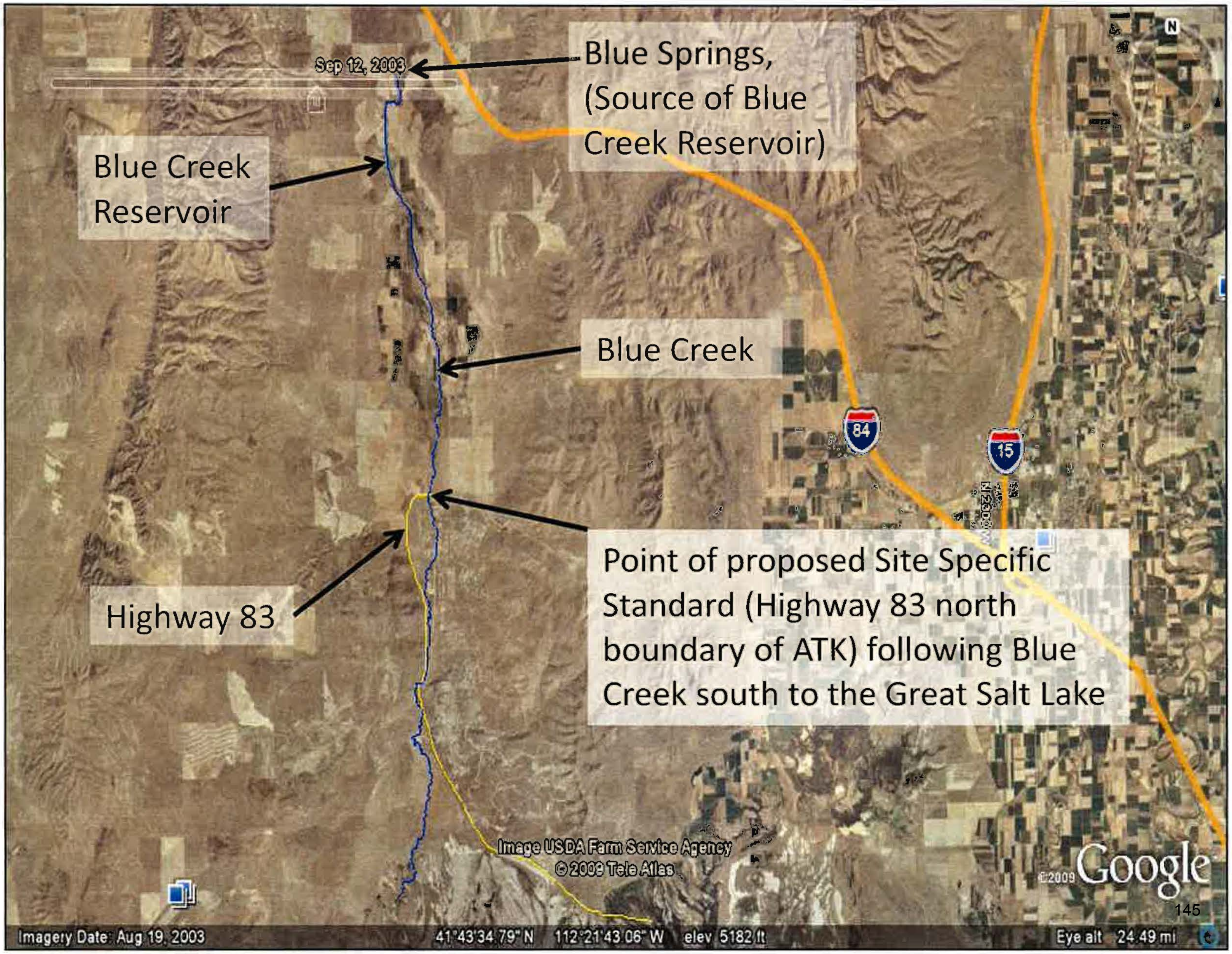


Figure 2. ATK Outfall Locations

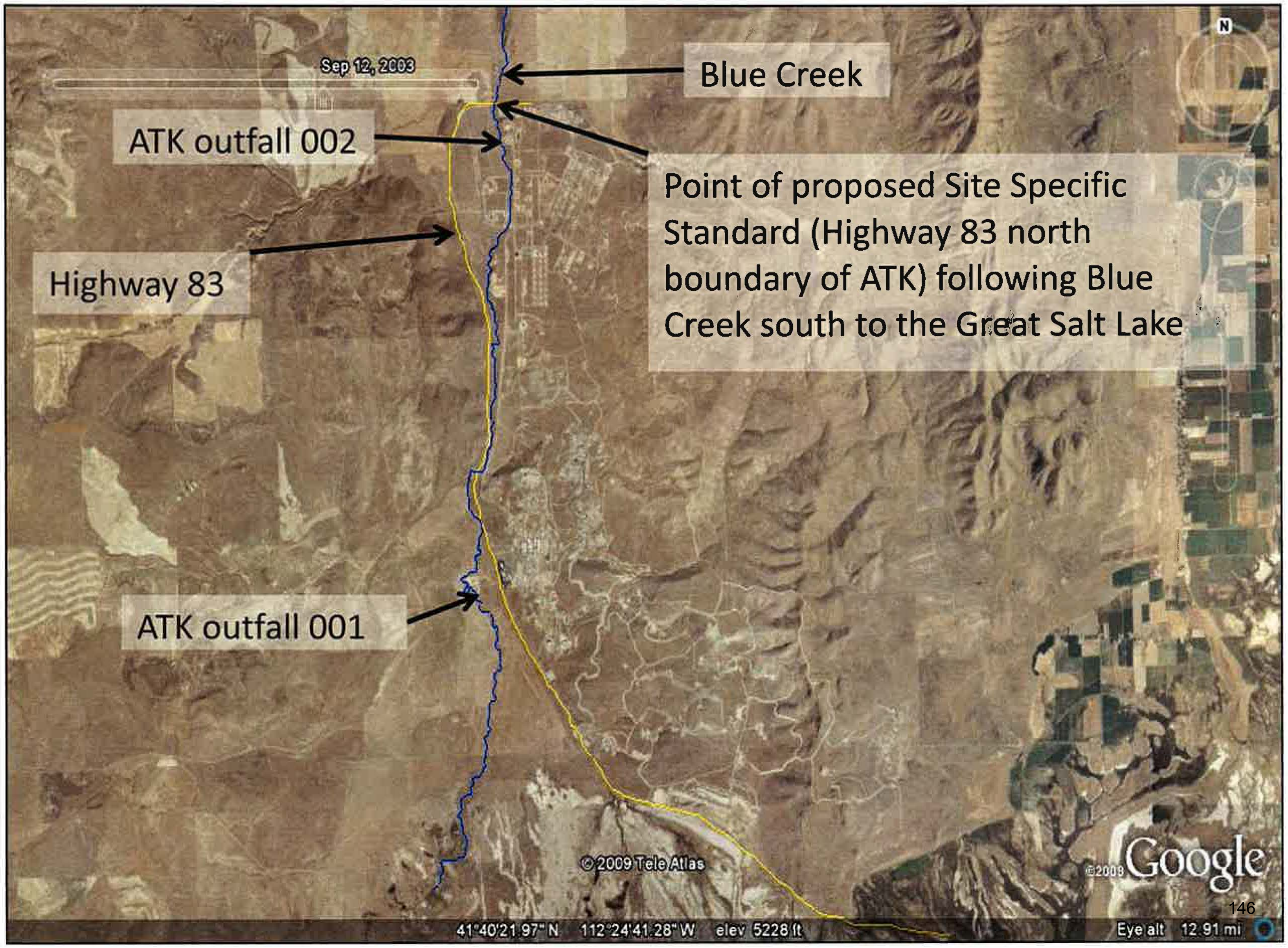


Figure 3. Blue Creek Source and Sample Sites

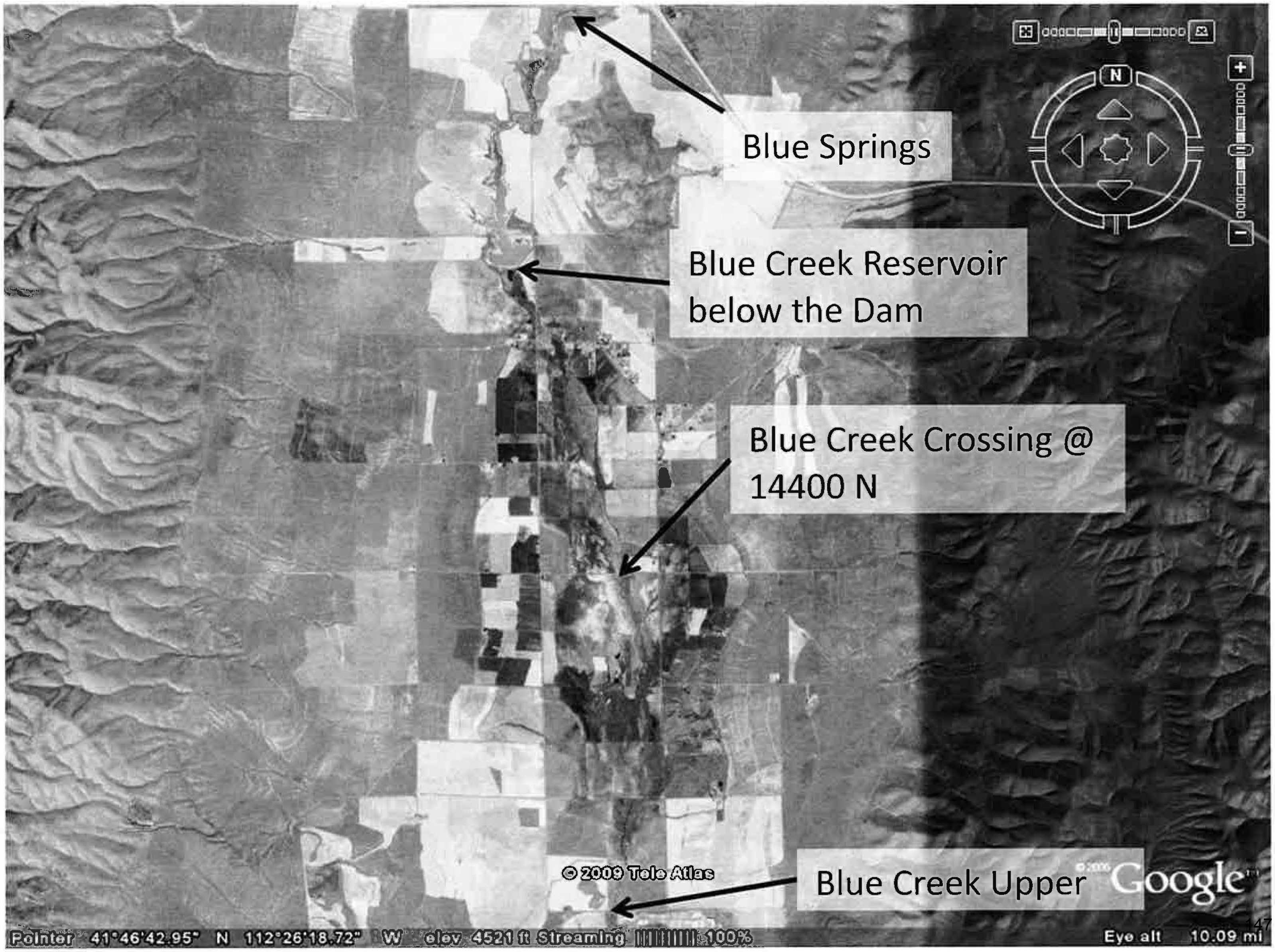


Figure 4. Conductivity Sample Sites of Blue Creek Sources

Figure 5. Conductivity Sample Sites of Blue Creek Sources (Continued)

Table 1. Conductivity Sample Site Descriptions and Concentrations

Sample Point	Site Description	Concentration (mg/L)	Sample Point	Site Description	Concentration (mg/L)
1	Below Dam	2,260	13	Cornwall Blue Creek	4,290
2	Blue Creek at Diversion	2,340	14	Cornwall 4	5,950
3	Sorensen 1	3,170	15	Cornwall 3	4,960
4	Irrigation (no sample)	-	16	Snowmelt	-
5	Sorensen 4	2,900	17	Douglass 2	5,050
6	Sorensen 3	5,690	18	Douglass 3.5	28,200
7	Odel 2	3,770	19	Douglass 3	31,300
8	Odel 1	3,840	20	Douglass 1	9,390
9	Blue Creek Crossing	9,320	21	Cornwall 2	4,930
10	Odel 3	448	22	Cornwall 1	4,800
11	Cornwall Pond	6,320	23	East Culvert	4,350
12	Odell's Discharge	6,330			

Table 2. TDS Concentrations from Blue Creek Study (mg/L)

Sample Date	Below Dam	Crossing	Upper
4-14-2011	1,890	3,350	5,270
5-26-2011	1,920	2,600	2,260
6-8-2011	1,910	3,370	3,930
7-26-2011	2,090	2,820	3,380
8-16-2011	1,990	3,310	3,230
9-29-2011	1,980	3,220	3,780
10-21-2011	1,960	4,020	4,260
11-17-2011	2,030	4,160	3,380
12-20-2011	2,080	3,740	4,850
1-27-2012	2,070	3,140	4,570
2-1-2012	2,020	3,140	4,550
2-9-2012	2,040	2,900	4,210
2-16-2012	2,030	3,310	4,890
3-19-2012	1,940	2,470	4,160
4-16-2012	2,070	5,060	6,270
4-23-2012	1,910	3,490	4,710
4-30-2012	1,990	3,410	4,730
5-7-2012	1,990	3,650	4,350
6-4-2012	1,990	2,930	3,720
7-10-2012	2,060	3,040	4,230
8-8-2012	2,110	3,220	2,980
9-5-2012	2,100	3,780	4,140
10-5-2012	2,050	3,120	3,760
11-5-2012	1,990	3,510	3,620
12-6-2012	1,920	4,670	5,630
1-14-2013	2,020	2,840	4,210
1-22-2013	2,100	2,810	4,050
1-30-2013	2,009	2,870	4,180
2-7-2013	2,009	2,640	5,170
3-4-2013	2,009	2,870	5,370
4-1-2013	1,990	2,980	4,260
5-7-2013	1,970	3,080	4,250
Average	2,009	3,298	4,261
95% UTL	2,115	4,315	5,918

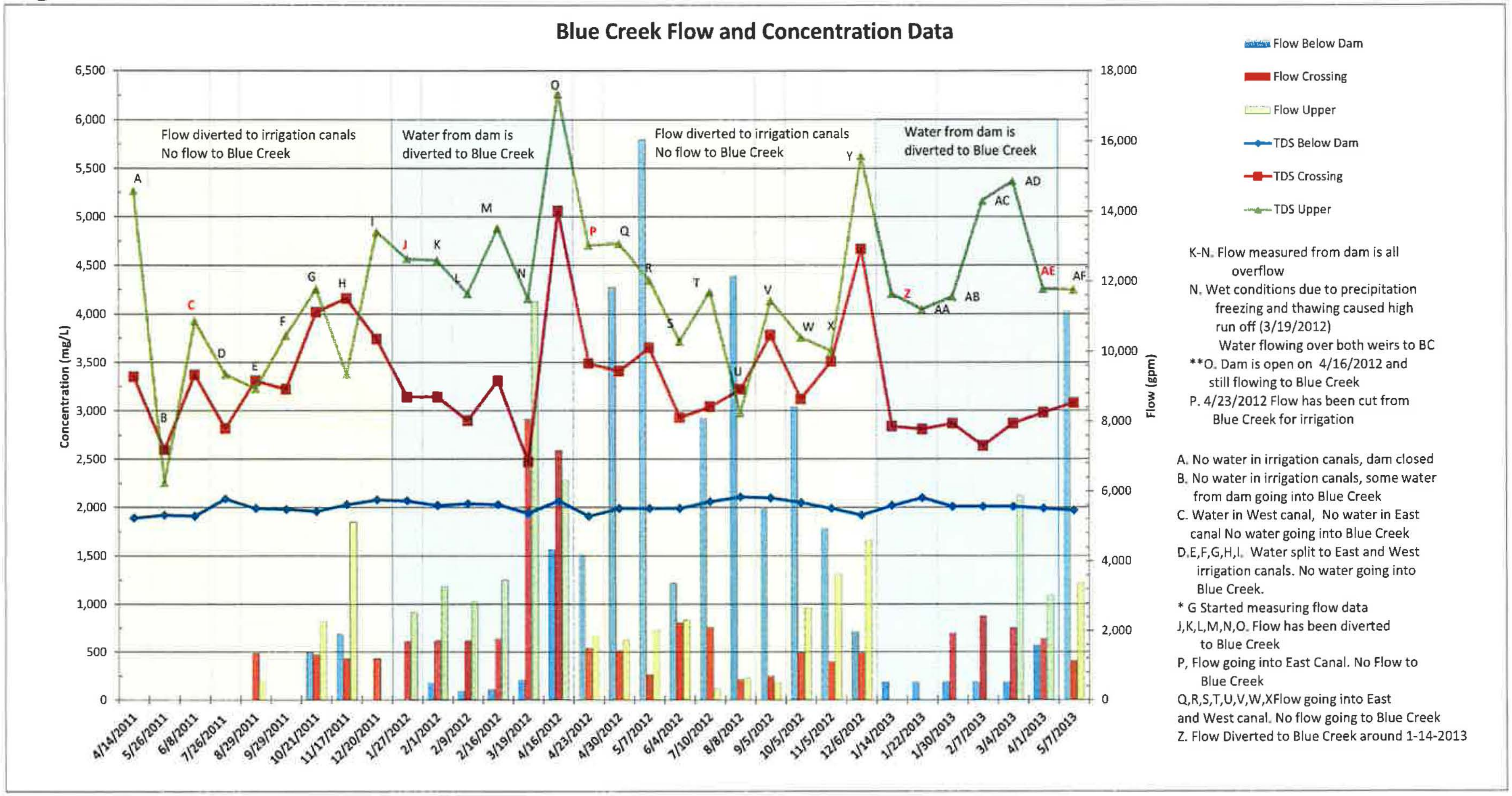
Table 3. ProUCL Results for 2010-2013 Upper Site Concentrations

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2,000
Log-Transformed Statistics	
Number of Valid Observations	32
Number of Distinct Observations	29
Minimum	7.723
Maximum	8.744
Second Largest	8.636
Mean	8.339
First Quartile	8.236
Median	8.348
Third Quartile	8.459
SD	0.198
Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.959
5% Shapiro Wilk Critical Value	0.93
Background Statistics Assuming Lognormal Distribution	
90% Percentile (z)	5,395
95% Percentile (z)	5,797
99% Percentile (z)	6,636
95% UPL	5,887
Tolerance Factor K	1.75
95% UTL with 90% Coverage	**5,918**
Some Nonparametric Background Statistics	
95% Chebyshev UPL	7,814
95% Bootstrap BCA UTL with 90% Coverage	5,604
95% Percentile Bootstrap UTL with 90% Coverage	5,604

Table 4. ProUCL Results for 2000-2010 Upper Site Concentrations

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
Different or Future K Values	1
Number of Bootstrap Operations	2000
Log-Transformed Statistics	
Number of Valid Observations	43
Number of Distinct Observations	40
Minimum	7.99
Maximum	8.753
Second Largest	8.723
Mean	8.341
First Quartile	8.162
Median	8.324
Third Quartile	8.5
SD	0.226
Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.938
5% Shapiro Wilk Critical Value	0.943
Background Statistics Assuming Lognormal Distribution	
90% Percentile (z)	5,604
95% Percentile (z)	6,084
99% Percentile (z)	7,098
95% UPL	6,162
Tolerance Factor K	1.67
95% UTL with 90% Coverage	**6,123**
Some Nonparametric Background Statistics	
95% Chebyshev UPL	8,690
95% Bootstrap BCA UTL with 90% Coverage	5,990
95% Percentile Bootstrap UTL with 90% Coverage	6,050

Figure 6.


Blue Creek Flow and Concentration Data
Concentration (mg/L)
Flow (gpm)
Flow diverted to irrigation canals
No flow to Blue Creek
Water from dam is
diverted to Blue Creek
Flow diverted to irrigation canals
No flow to Blue Creek
Water from dam is
diverted to Blue Creek
Flow Below Dam
Flow Crossing
Flow Upper
TDS Below Dam
TDS Crossing
TDS Upper
K-N. Flow measured from dam is all overflow
N. Wet conditions due to precipitation freezing and thawing caused high run off (3/19/2012)
Water flowing over both weirs to BC
**O. Dam is open on 4/16/2012 and still flowing to Blue Creek
P. 4/23/2012 Flow has been cut from Blue Creek for irrigation
A. No water in irrigation canals, dam closed
B. No water in irrigation canals, some water from dam going into Blue Creek
C. Water in West canal, No water in East canal No water going into Blue Creek
D,E,F,G,H,I. Water split to East and West irrigation canals. No water going into Blue Creek.
* G Started measuring flow data
J,K,L,M,N,O. Flow has been diverted to Blue Creek
P, Flow going into East Canal. No Flow to Blue Creek
Q,R,S,T,U,V,W,XFlow going into East and West canal. No flow going to Blue Creek
Z. Flow Diverted to Blue Creek around 1-14-2013

References

Bolke, E.L. and Price D. 1972. Hydrologic Reconnaissance of the Blue Creek Valley Area, Box Elder County, Utah. Utah Department of Natural Resources Technical Publication No. 37.

UDWR (Utah Division of Water Resources). 2001. Utah State Water Plan, West Desert Basin, Salt Lake City, Utah. 3-17p.

ANALYTE	RESULT	DATE_SAMPLED
TDS	1890	Apr-11
TDS	1920	May-11
TDS	1910	Jun-11
TDS	2090	Jul-11
TDS	1990	Aug-11
TDS	1980	Sep-11
TDS	1960	Oct-11
TDS	2030	Nov-11
TDS	2080	Dec-11
TDS	2070	Jan-12
TDS	2020	2-1-2012
TDS	2040	2-9-2012
TDS	2030	2-16-2012
TDS	1940	3-19-2012
TDS	2070	4-16-2012
TDS	1910	4-23-2012
TDS	1990	4-30-2012
TDS	1990	5-7-2012
TDS	1990	6-4-2012
TDS	2060	7-10-2012
TDS	2110	8-8-2012
TDS	2100	9-5-2012
TDS	2050	10-5-2012
TDS		11-5-2012
SODIUM	659	Apr-11
SODIUM	622	May-11
SODIUM	700	Jun-11
SODIUM	662	Jul-11
SODIUM	750	Aug-11
SODIUM	669	Sep-11
SODIUM	680	Oct-11
SODIUM	666	Nov-11
SODIUM	725	Dec-11
SODIUM	658	Jan-12
SODIUM	673	2-1-2012
SODIUM	679	2-9-2012
SODIUM	684	2-16-2012
SODIUM	711	3-19-2012
SODIUM	613	4-16-2012
SODIUM	558	4-23-2012
SODIUM	617	4-30-2012
SODIUM	713	5-7-2012
SODIUM	704	6-4-2012
SODIUM	682	7-10-12

SODIUM	642	8-8-2012
SODIUM	616	9-5-2012
SODIUM	758	10-5-2012
SODIUM		11-5-2012
CHLORIDE	912	Apr-11
	974	May-11
CHLORIDE	884	Jun-11
CHLORIDE	1000	Jul-11
CHLORIDE	1030	Aug-11
CHLORIDE	992	Sep-11
CHLORIDE	991	Oct-11
CHLORIDE	971	Nov-11
CHLORIDE	1010	Dec-11
CHLORIDE	951	Jan-12
CHLORIDE	985	2-1-2012
CHLORIDE	964	2-9-2012
CHLORIDE	976	2-16-2012
CHLORIDE	929	3-19-2012
CHLORIDE	932	4-16-2012
CHLORIDE	931	4-23-2012
CHLORIDE	952	4-30-2012
CHLORIDE	955	5-7-2012
CHLORIDE	863	6-4-2012
CHLORIDE	964	7-10-2012
CHLORIDE	1000	8-8-2012
CHLORIDE	946	9-5-2012
CHLORIDE	945	10-5-2012

ANALYTE	RESULT	DATE_SAMPLED
TDS	3350	Apr-11
TDS	2600	May-11
TDS	3370	Jun-11
TDS	2820	Jul-11
TDS	3310	Aug-11
TDS	3220	Sep-11
TDS	4020	Oct-11
TDS	4160	Nov-11
TDS	3740	Dec-11
TDS	3140	Jan-12
TDS	3140	2-1-2012
TDS	2900	2-9-2012
TDS	3310	2-16-2012
TDS	2470	3-19-2012
TDS	5060	4-16-2012
TDS	3490	4-23-2012
TDS	3410	4-30-2012
TDS	3650	5-7-2012
TDS	2930	6-4-2012
TDS	3040	7-10-2012
TDS	3220	8-8-2012
TDS	3780	9-5-2012
TDS	3120	10-5-2012
TDS		11-5-2012
SODIUM	1340	Apr-11
SODIUM	794	May-11
SODIUM	1220	Jun-11
SODIUM	896	Jul-11
SODIUM	1240	Aug-11
SODIUM	1050	Sep-11
SODIUM	1320	Oct-11
SODIUM	1320	Nov-11
SODIUM	1220	Dec-11
SODIUM	937	Jan-12
SODIUM	944	2-1-2012
SODIUM	895	2-9-2012
SODIUM	1080	2-16-2012
SODIUM	876	3-19-2012
SODIUM	689	4-16-2012
SODIUM	1110	4-23-2012
SODIUM	1020	4-30-2012
SODIUM	1260	5-7-2012
SODIUM	1070	6-4-2012
SODIUM	995	7-10-2012

SODIUM	1060	8-8-2012
SODIUM	1170	9-5-2012
SODIUM	1140	10-5-2012
SODIUM		11-5-2012
CHLORIDE	1550	Apr-11
CHLORIDE		Averaged May
CHLORIDE	1470	Jun-11
CHLORIDE	1350	Jul-11
CHLORIDE	1690	Aug-11
CHLORIDE	1570	Sep-11
CHLORIDE	1900	Oct-11
CHLORIDE	1890	Nov-11
CHLORIDE	1710	Dec-11
CHLORIDE	1460	Jan-12
CHLORIDE	1450	2-1-2012
CHLORIDE	1320	2-9-2012
CHLORIDE	1560	2-16-2012
CHLORIDE	1160	3-19-2012
CHLORIDE	1040	4-16-2012
CHLORIDE	1600	4-23-2012
CHLORIDE	1600	4-30-2012
CHLORIDE	1670	5-7-2012
CHLORIDE	687	6-4-2012
CHLORIDE	1400	7-10-2012
CHLORIDE	1490	8-8-2012
CHLORIDE	1680	9-5-2012
CHLORIDE	1420	10-5-2012
CHLORIDE		11-5-2012
SULFATE	274	Apr-11
SULFATE		Averaged May
SULFATE	258	Jun-11
SULFATE	198	Jul-11
SULFATE	274	Aug-11
SULFATE	253	Sep-11
SULFATE	350	Oct-11
SULFATE	359	Nov-11
SULFATE	300	Dec-11
SULFATE	239	Jan-12
SULFATE	236	2-1-2012
SULFATE	220	2-9-2012
SULFATE	259	2-16-2012
SULFATE	169	3-19-2012
SULFATE	136	4-16-2012
SULFATE	277	4-23-2012
SULFATE	274	4-30-2012

SULFATE	284	5-7-2012
SULFATE	103	6-4-2012
SULFATE	206	7-10-2012
SULFATE	241	8-8-2012
SULFATE	293	9-5-2012
SULFATE	212	10-5-2012

ANALYTE	RESULT	DATE_SAMPLED
TDS	5270	Apr-11
TDS	2260	May-11
TDS	3930	Jun-11
TDS	3380	Jul-11
TDS	3230	Aug-11
TDS	3780	Sep-11
TDS	4260	Oct-11
TDS	3380	Nov-11
TDS	4850	Dec-11
TDS	4570	Jan-12
TDS	4550	2-1-2012
TDS	4210	2-9-2012
TDS	4890	2-16-2012
TDS	4160	3-19-2012
TDS	6270	4-16-2012
TDS	4710	4-23-2012
TDS	4730	4-30-2012
TDS	4350	5-7-2012
TDS	3720	6-4-2012
TDS	4230	7-10-2012
TDS	2980	8-8-2012
TDS	4140	9-5-2012
TDS	3760	10-5-2012
TDS		11-5-2012
SODIUM	2110	Apr-11
SODIUM	684	May-11
SODIUM	1310	Jun-11
SODIUM	1050	Jul-11
SODIUM	1140	Aug-11
SODIUM	1200	Sep-11
SODIUM	1430	Oct-11
SODIUM	1100	Nov-11
SODIUM	1590	Dec-11
SODIUM	1360	Jan-12
SODIUM	1190	2-1-2012
SODIUM	1370	2-9-2012
SODIUM	1490	2-16-2012
SODIUM	1450	3-19-2012
SODIUM	921	4-16-2012
SODIUM	1530	4-23-2012
SODIUM	1520	4-30-2012
SODIUM	1470	5-7-2012
SODIUM	1330	6-4-2012
SODIUM	1510	7-10-2012

SODIUM	1100	8-8-2012
SODIUM	1300	9-5-2012
SODIUM	1350	10-5-2012
SODIUM		11-5-2012
CHLORIDE	2440	Apr-11
		May-11
CHLORIDE	1710	Jun-11
CHLORIDE	1520	Jul-11
CHLORIDE	1680	Aug-11
CHLORIDE	1820	Sep-11
CHLORIDE	2030	Oct-11
CHLORIDE	1590	Nov-11
CHLORIDE	2270	Dec-11
CHLORIDE	2070	Jan-12
CHLORIDE	1890	2-1-2012
CHLORIDE	1950	2-9-2012
CHLORIDE	2260	2-16-2012
CHLORIDE	1930	3-19-2012
CHLORIDE	1320	4-16-2012
CHLORIDE	2170	4-23-2012
CHLORIDE	2190	4-30-2012
CHLORIDE	2000	5/7/2012
CHLORIDE	469	6-4-2012
CHLORIDE	1940	7-10-2012
CHLORIDE	1430	8-8-2012
CHLORIDE	1910	9-5-2012
CHLORIDE	1710	10-5-2012
CHLORIDE		11-5-2012
SULFATE	501	Apr-11
		May-11
SULFATE	303	Jun-11
SULFATE	232	Jul-11
SULFATE	274	Aug-11
SULFATE	317	Sep-11
SULFATE	377	Oct-11
SULFATE	275	Nov-11
SULFATE	414	Dec-11
SULFATE	392	Jan-12
SULFATE	346	2-1-2012
SULFATE	373	2-9-2012
SULFATE	446	2-16-2012
SULFATE	348	3-19-2012
SULFATE	197	4-16-2012
SULFATE	402	4-23-2012
SULFATE	402	4-30-2012

SULFATE	337	5-7-2012
SULFATE	56	6-4-2012
SULFATE	274	7-10-2012
SULFATE	193	8-8-2012
SULFATE	332	9-5-2012
SULFATE	294	10-5-2012

Blue Creek Upper

Diameter = 12.3 ft

	August	September	October	November	December	January	2/1/2012	2/9/2012
Depth (ft)	0.5		0.75	1		0.7	0.83	0.88
Area (sqft)	1.63		2.98	4.56		2.69	3.48	3.74
Velocity (ft/sec)	0.8		1.7	2.5		2.1	2.1	1.7
Flow (cuft/sec)	1.31		5.07	11.40		5.65	7.32	6.37
Flow (gpm)	586		2275	5117		2537	3284	2857
		no data			no data			

2/16/2012	3/19/2012	4/16/2012	4/23/2012	4/30/2012	5/7/2012	6/4/2012	7/10/2012	8/8/2012
0.9583333	1.375	1.1	0.8	0.8	0.8	0.8	0.5	0.6
4.28	7.28	5.4	3.0	3.0	3.5	3.2	1.8	2.1
1.8	3.5	2.6	1.4	1.3	1.3	1.6	0.4	0.7
7.71	25.48	14.1	4.2	3.9	4.5	5.2	0.7	1.4
3460	11438	6329.7	1873.2	1739.4	2032.9	2319.2	330.2	645.2

9/5/2012	10/5/2012	11/5/2012
0.5	0.8	0.96
1.8	3.5	4.3
0.6	1.7	1.9
1.1	5.9	8.1
495.3	2658.4	3652.4

LAB_SAMPLE_ID	FIELD_SAMPLE_ID	METHOD	ANALYTE	MATRIX	RESULT	UNITS	BATCH_ID	DATE_SAMPLED	ANALYSIS_DATE	AS_NUMB	MDL	EQL	U_DILUTION
1104014-01	C8690 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	5270	mg/L	WS1104-072	14-Apr-11	21-Apr-11		19.8	40	1
1104014-02	C8691 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3350	mg/L	WS1104-072	14-Apr-11	21-Apr-11		19.8	40	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	1890	mg/L	WS1104-072	14-Apr-11	21-Apr-11		19.8	40	1
1105032-01	C8697 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	2600	mg/L	WS1106-007	26-May-11	02-Jun-11		19.8	40	1
1105032-02	C8698 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	2260	mg/L	WS1106-007	26-May-11	02-Jun-11		19.8	40	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	1920	mg/L	WS1106-007	26-May-11	02-Jun-11		19.8	40	1
1106015-01	C8702 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3930	mg/L	WS1106-031	08-Jun-11	22-Jun-11		19.8	40	1
1106015-02	C8703 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3370	mg/L	WS1106-031	08-Jun-11	22-Jun-11		19.8	40	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	1910	mg/L	WS1106-031	08-Jun-11	22-Jun-11		19.8	40	1
1107032-01	C8709 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3380	mg/L	WS1108-011	26-Jul-11	04-Aug-11		19.8	40	1
1107032-02	C8710 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	2820	mg/L	WS1108-011	26-Jul-11	04-Aug-11		19.8	40	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	2090	mg/L	WS1108-011	26-Jul-11	04-Aug-11		19.8	40	1
1108026-01	C8716 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3230	mg/L	WS1109-003	29-Aug-11	01-Sep-11		19.8	40	1
1108026-02	C8717 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3310	mg/L	WS1109-003	29-Aug-11	01-Sep-11		19.8	40	1
1108026-03	C8718 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	1990	mg/L	WS1109-003	29-Aug-11	01-Sep-11		19.8	40	1
1110003-01	C8722 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3780	mg/L	WS1110-007	29-Sep-11	05-Oct-11		19.8	40	1
1110003-02	C8723 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3220	mg/L	WS1110-007	29-Sep-11	05-Oct-11		19.8	40	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	1980	mg/L	WS1110-007	29-Sep-11	05-Oct-11		19.8	40	1
1110027-01	C8728 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	4260	mg/L	WS1110-035	21-Oct-11	25-Oct-11		19.8	40	1
1110027-02	C8729 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	4020	mg/L	WS1110-035	21-Oct-11	25-Oct-11		19.8	40	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	1960	mg/L	WS1110-035	21-Oct-11	25-Oct-11		19.8	40	1
1111013-01	C8733 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3380	mg/L	WS1111-031	17-Nov-11	22-Nov-11		19.8	40	1
1111013-02	C8734 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	4160	mg/L	WS1111-031	17-Nov-11	22-Nov-11		19.8	40	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	2030	mg/L	WS1111-031	17-Nov-11	22-Nov-11		19.8	40	1
1112019-01	C8740 - Blue Creek Upper	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	4850	mg/L	WS1112-035	20-Dec-11	21-Dec-11		19.8	40	1
1112019-02	C8741 - Blue Creek Crossing	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	3740	mg/L	WS1112-035	20-Dec-11	21-Dec-11		19.8	40	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 160.1	TOTAL DISSOLVED SOLIDS	Water	2080	mg/L	WS1112-035	20-Dec-11	21-Dec-11		19.8	40	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	6510.	ug/L	WS1106-001	26-May-11	02-Jun-11	5	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	2990.	ug/L	WS1106-001	26-May-11	02-Jun-11	5	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	309.	ug/L	WS1106-001	26-May-11	02-Jun-11	5	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	2650.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	5	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	1090.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	5	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	528.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	5	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	2140.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	5	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	232.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	5	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	1060.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	5	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	442.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	5	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	907.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	5	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	2460.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	5	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	450.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7429-90-5	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	370.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7429-90-5	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	1060.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7429-90-5	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	724.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7429-90-5	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	429.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7429-90-5	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	1900.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7429-90-5	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	532.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7429-90-5	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	610.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7429-90-5	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	1400.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7429-90-5	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	1740.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7429-90-5	10	50	1

1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	185.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7429-90-5	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	241.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7429-90-5	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ALUMINUM	Water	5870.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7429-90-5	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ALUMINUM	Water	5230.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7429-90-5	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ALUMINUM	Water	1060.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7429-90-5	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-36-0	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-36-0	20	100	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-36-0	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-36-0	20	100	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-36-0	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-36-0	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-36-0	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-36-0	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-36-0	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-36-0	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-36-0	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-36-0	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-36-0	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-36-0	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-36-0	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-36-0	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-36-0	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-36-0	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-36-0	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-36-0	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-36-0	20	100	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-36-0	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-36-0	20	100	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-36-0	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-36-0	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-36-0	20	100	1

1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ANTIMONY	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-36-0	20	100	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-38-2	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-38-2	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-38-2	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-38-2	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-38-2	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-38-2	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-38-2	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-38-2	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-38-2	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	70.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-38-2	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	73.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-38-2	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	59.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-38-2	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-38-2	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-38-2	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-38-2	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-38-2	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-38-2	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-38-2	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	59.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-38-2	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	70.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-38-2	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	36. J	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-38-2	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-38-2	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-38-2	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-38-2	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ARSENIC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-38-2	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ARSENIC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-38-2	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ARSENIC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-38-2	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	163.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-39-3	2	10	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	BARIUM	Water	151.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-39-3	2	10	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	136.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-39-3	2	10	1

1105033-01	C8690 - Blue Creek Upper	EPA 200.7	BARIUM	Water	126.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-39-3	2	10	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	122.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-39-3	2	10	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	124.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-39-3	2	10	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	BARIUM	Water	121.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-39-3	2	10	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	115.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-39-3	2	10	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	131.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-39-3	2	10	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	BARIUM	Water	118.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-39-3	2	10	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	124.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-39-3	2	10	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	168.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-39-3	2	10	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	BARIUM	Water	115.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-39-3	10	50	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	105.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-39-3	10	50	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	179.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-39-3	10	50	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	BARIUM	Water	112.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-39-3	2	10	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	111.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-39-3	2	10	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	147.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-39-3	2	10	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	BARIUM	Water	90.6	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-39-3	2	10	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	94.5	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-39-3	2	10	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	141.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-39-3	2	10	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	BARIUM	Water	120.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-39-3	2	10	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	94.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-39-3	2	10	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	132.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-39-3	2	10	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	BARIUM	Water	149.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-39-3	2	10	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	BARIUM	Water	152.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-39-3	2	10	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	BARIUM	Water	148.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-39-3	2	10	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-41-7	0.5	2.5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-41-7	0.5	2.5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-41-7	0.5	2.5	1

1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-41-7	0.5	2.5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-41-7	0.5	2.5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-41-7	0.5	2.5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-41-7	0.5	2.5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-41-7	0.5	2.5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-41-7	2.5	12.5	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-41-7	2.5	12.5	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-41-7	2.5	12.5	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-41-7	0.5	2.5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-41-7	0.5	2.5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-41-7	0.5	2.5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-41-7	0.5	2.5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-41-7	0.5	2.5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-41-7	0.5	2.5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-41-7	0.5	2.5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-41-7	0.5	2.5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-41-7	0.5	2.5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-41-7	0.5	2.5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-41-7	0.5	2.5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	BERYLLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-41-7	0.5	2.5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	BORON	Water	406.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-42-8	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	BORON	Water	284.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-42-8	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	BORON	Water	237.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-42-8	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	BORON	Water	797.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-42-8	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	BORON	Water	444.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-42-8	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	BORON	Water	182.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-42-8	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	BORON	Water	653.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-42-8	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	BORON	Water	550.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-42-8	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	BORON	Water	315.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-42-8	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	BORON	Water	688.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-42-8	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	BORON	Water	575.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-42-8	10	50	1

1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	BORON	Water	353.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-42-8	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	BORON	Water	766.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-42-8	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	BORON	Water	781.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-42-8	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	BORON	Water	400.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-42-8	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	BORON	Water	780.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-42-8	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	BORON	Water	603.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-42-8	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	BORON	Water	321.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-42-8	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	BORON	Water	839.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-42-8	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	BORON	Water	780.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-42-8	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	BORON	Water	324.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-42-8	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	BORON	Water	566.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-42-8	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	BORON	Water	743.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-42-8	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	BORON	Water	328.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-42-8	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	BORON	Water	763.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-42-8	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	BORON	Water	624.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-42-8	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	BORON	Water	325.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-42-8	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-43-9	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-43-9	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-43-9	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-43-9	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-43-9	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-43-9	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-43-9	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-43-9	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-43-9	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-43-9	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-43-9	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-43-9	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-43-9	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-43-9	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-43-9	5	25	5

1110003-01	C8722 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-43-9	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-43-9	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-43-9	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-43-9	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-43-9	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-43-9	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-43-9	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-43-9	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-43-9	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	CADMIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-43-9	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	CADMIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-43-9	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	CADMIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-43-9	1	5	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	136000.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7440-70-2	30	150	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	118000.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7440-70-2	30	150	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	60600.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7440-70-2	30	150	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	84900.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-70-2	30	150	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	76300.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-70-2	30	150	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	53900.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-70-2	30	150	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	139000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-70-2	30	150	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	117000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-70-2	30	150	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	62000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-70-2	30	150	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	118000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-70-2	30	150	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	116000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-70-2	30	150	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	56700.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-70-2	30	150	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	86600.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-70-2	30	150	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	95500.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-70-2	30	150	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	68900.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-70-2	30	150	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	68600.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-70-2	150	750	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	86900.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-70-2	150	750	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	64300.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-70-2	150	750	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	95600.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-70-2	30	150	1

1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	93800.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-70-2	30	150	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	56200.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-70-2	30	150	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	105000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-70-2	30	150	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	125000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-70-2	30	150	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	58100.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-70-2	30	150	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	102000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-70-2	30	150	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	137000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-70-2	30	150	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	61300.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-70-2	30	150	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	CALCIUM	Water	139000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-70-2	30	150	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	CALCIUM	Water	109000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-70-2	30	150	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	CALCIUM	Water	53700.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-70-2	30	150	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-47-3	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-47-3	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-47-3	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-47-3	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-47-3	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-47-3	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-47-3	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-47-3	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-47-3	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-47-3	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-47-3	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-47-3	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-47-3	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-47-3	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-47-3	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-47-3	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-47-3	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-47-3	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-47-3	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-47-3	10	50	1

1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-47-3	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-47-3	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-47-3	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-47-3	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-47-3	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-47-3	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	CHROMIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-47-3	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-48-4	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-48-4	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-48-4	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-48-4	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-48-4	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-48-4	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-48-4	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-48-4	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-48-4	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-48-4	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-48-4	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-48-4	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-48-4	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-48-4	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-48-4	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-48-4	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-48-4	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-48-4	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-48-4	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-48-4	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-48-4	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	COBALT	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-48-4	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	COBALT	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-48-4	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-48-4	1	5	1

1112019-01	C8740 - Blue Creek Upper	EPA 200.7	COBALT	Water	1.4 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-48-4	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	COBALT	Water	1.3 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-48-4	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	COBALT	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-48-4	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-50-8	2	10	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-50-8	2	10	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-50-8	2	10	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-50-8	2	10	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-50-8	2	10	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-50-8	2	10	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-50-8	2	10	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-50-8	2	10	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-50-8	2	10	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-50-8	2	10	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-50-8	2	10	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-50-8	2	10	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-50-8	10	50	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	COPPER	Water	25. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-50-8	10	50	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-50-8	10	50	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-50-8	2	10	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-50-8	2	10	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-50-8	2	10	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-50-8	2	10	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-50-8	2	10	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-50-8	2	10	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	COPPER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-50-8	2	10	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	COPPER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-50-8	2	10	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-50-8	2	10	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	COPPER	Water	2.1 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-50-8	2	10	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	COPPER	Water	3.6 J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-50-8	2	10	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	COPPER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-50-8	2	10	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.7	HARDNESS	Water	657.	mg/L	WS1104-051	14-Apr-11	20-Apr-11		0.03	0.15	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.7	HARDNESS	Water	478.	mg/L	WS1104-051	14-Apr-11	20-Apr-11		0.03	0.15	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.7	HARDNESS	Water	239.	mg/L	WS1104-051	14-Apr-11	20-Apr-11		0.03	0.15	1

1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	IRON	Water	5490.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-89-6	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	IRON	Water	2580.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-89-6	20	100	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	IRON	Water	281.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-89-6	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	IRON	Water	2240.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-89-6	20	100	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	IRON	Water	859.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-89-6	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	IRON	Water	371.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-89-6	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	IRON	Water	1330.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-89-6	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	IRON	Water	184.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-89-6	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	IRON	Water	648.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-89-6	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	IRON	Water	312.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-89-6	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	IRON	Water	770.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-89-6	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	IRON	Water	2080.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-89-6	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	IRON	Water	370. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-89-6	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	IRON	Water	850.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-89-6	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	IRON	Water	750.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-89-6	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	IRON	Water	492.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-89-6	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	IRON	Water	302.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-89-6	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	IRON	Water	1270.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-89-6	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	IRON	Water	293.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-89-6	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	IRON	Water	406.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-89-6	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	IRON	Water	807.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-89-6	20	100	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	IRON	Water	1260.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-89-6	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	IRON	Water	166.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-89-6	20	100	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	IRON	Water	176.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-89-6	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	IRON	Water	4230.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-89-6	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	IRON	Water	4000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-89-6	20	100	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	IRON	Water	752.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-89-6	20	100	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-92-1	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-92-1	20	100	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-92-1	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-92-1	20	100	1

1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-92-1	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-92-1	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-92-1	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-92-1	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-92-1	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-92-1	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-92-1	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-92-1	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-92-1	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-92-1	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-92-1	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-92-1	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-92-1	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-92-1	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-92-1	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-92-1	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-92-1	20	100	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-92-1	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-92-1	20	100	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-92-1	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	LEAD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-92-1	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	LEAD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-92-1	20	100	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	LEAD	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-92-1	20	100	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	77000.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7439-95-4	10	50	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	44500.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7439-95-4	10	50	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	21400.	ug/L	WS1104-051	14-Apr-11	20-Apr-11	7439-95-4	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	36700.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-95-4	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	28700.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-95-4	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	21400.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-95-4	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	83100.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-95-4	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	47900.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-95-4	10	50	1

1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	23700.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-95-4	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	53900.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-95-4	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	43900.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-95-4	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	21700.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-95-4	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	41900.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-95-4	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	37000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-95-4	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	27400.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-95-4	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	48100.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-95-4	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	52600.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-95-4	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	29700.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-95-4	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	49000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-95-4	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	38900.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-95-4	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	24000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-95-4	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	62700.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-95-4	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	54300.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-95-4	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	24300.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-95-4	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	52900.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-95-4	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	57800.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-95-4	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	24700.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-95-4	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	MAGNESIUM	Water	70700.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-95-4	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	MAGNESIUM	Water	42000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-95-4	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	MAGNESIUM	Water	21900.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-95-4	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	170.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-96-5	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	103.	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-96-5	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	13.2	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-96-5	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	253.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-96-5	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	230.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-96-5	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	15.7	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-96-5	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	119.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-96-5	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	123.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-96-5	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	24.8	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-96-5	1	5	1

1107032-01	C8709 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	9.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-96-5	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	23.8	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-96-5	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	54.4	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-96-5	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	8.9 J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-96-5	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	31.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-96-5	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	35.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-96-5	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	13.9	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-96-5	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	38.8	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-96-5	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	30.9	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-96-5	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	23.8	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-96-5	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	71.9	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-96-5	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	23.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-96-5	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	89.1	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-96-5	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	165.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-96-5	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	6.4	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-96-5	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	MANGANESE	Water	429.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-96-5	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	MANGANESE	Water	505.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-96-5	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	MANGANESE	Water	82.9	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-96-5	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-98-7	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-98-7	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7439-98-7	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-98-7	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-98-7	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7439-98-7	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-98-7	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-98-7	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7439-98-7	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-98-7	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-98-7	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7439-98-7	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-98-7	5	25	5

1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-98-7	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7439-98-7	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-98-7	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-98-7	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7439-98-7	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-98-7	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-98-7	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7439-98-7	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-98-7	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-98-7	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7439-98-7	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-98-7	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-98-7	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	MOLYBDENUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7439-98-7	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-02-0	5	25	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-02-0	5	25	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-02-0	5	25	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-02-0	5	25	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-02-0	5	25	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-02-0	5	25	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-02-0	5	25	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-02-0	5	25	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-02-0	5	25	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-02-0	5	25	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-02-0	5	25	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-02-0	5	25	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-02-0	25	125	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-02-0	25	125	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-02-0	25	125	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-02-0	5	25	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-02-0	5	25	1

1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-02-0	5	25	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-02-0	5	25	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-02-0	5	25	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-02-0	5	25	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-02-0	5	25	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-02-0	5	25	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-02-0	5	25	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	NICKEL	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-02-0	5	25	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	NICKEL	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-02-0	5	25	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	NICKEL	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-02-0	5	25	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	130.	ug/L	WS1106-001	26-May-11	02-Jun-11	7723-14-0	20	100	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7723-14-0	20	100	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7723-14-0	20	100	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	138.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7723-14-0	20	100	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	48. J	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7723-14-0	20	100	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7723-14-0	20	100	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7723-14-0	20	100	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7723-14-0	20	100	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7723-14-0	20	100	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7723-14-0	20	100	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7723-14-0	20	100	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7723-14-0	20	100	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7723-14-0	100	500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7723-14-0	100	500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7723-14-0	100	500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7723-14-0	20	100	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7723-14-0	20	100	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7723-14-0	20	100	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7723-14-0	20	100	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7723-14-0	20	100	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7723-14-0	20	100	1

1111013-01	C8733 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7723-14-0	20	100	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7723-14-0	20	100	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7723-14-0	20	100	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	PHOSPHORUS	Water	32. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7723-14-0	20	100	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	PHOSPHORUS	Water	87. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7723-14-0	20	100	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	PHOSPHORUS	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7723-14-0	20	100	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	35400.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-09-7	100	500	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	31100.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-09-7	100	500	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	24800.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-09-7	100	500	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	63100.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-09-7	100	500	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	45400.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-09-7	100	500	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	26600.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-09-7	100	500	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	46500.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-09-7	100	500	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	43100.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-09-7	100	500	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	26200.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-09-7	100	500	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	53400.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-09-7	100	500	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	63100.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-09-7	100	500	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	36000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-09-7	100	500	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	49100.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-09-7	500	2500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	48900.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-09-7	500	2500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	27700.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-09-7	500	2500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	49800.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-09-7	100	500	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	43000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-09-7	100	500	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	26000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-09-7	100	500	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	60400.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-09-7	100	500	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	57200.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-09-7	100	500	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	27600.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-09-7	100	500	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	47200.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-09-7	100	500	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	64600.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-09-7	100	500	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	31200.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-09-7	100	500	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	POTASSIUM	Water	59600.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-09-7	100	500	1

1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	POTASSIUM	Water	50900.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-09-7	100	500	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	POTASSIUM	Water	27900.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-09-7	100	500	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7782-49-2	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7782-49-2	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7782-49-2	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7782-49-2	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7782-49-2	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7782-49-2	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7782-49-2	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7782-49-2	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7782-49-2	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7782-49-2	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7782-49-2	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7782-49-2	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7782-49-2	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7782-49-2	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7782-49-2	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7782-49-2	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7782-49-2	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7782-49-2	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7782-49-2	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7782-49-2	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7782-49-2	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7782-49-2	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7782-49-2	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7782-49-2	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	SELENIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7782-49-2	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	SELENIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7782-49-2	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	SELENIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7782-49-2	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-22-4	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-22-4	1	5	1

1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-22-4	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-22-4	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-22-4	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-22-4	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-22-4	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-22-4	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-22-4	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-22-4	1	5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-22-4	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-22-4	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-22-4	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-22-4	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-22-4	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-22-4	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-22-4	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-22-4	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-22-4	1	5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-22-4	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-22-4	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-22-4	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-22-4	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-22-4	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	SILVER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-22-4	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	SILVER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-22-4	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	SILVER	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-22-4	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	794000.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-23-5	300	1500	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	SODIUM	Water	684000.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-23-5	300	1500	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	622000.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-23-5	300	1500	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	SODIUM	Water	2110000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-23-5	6000	30000	20
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	1340000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-23-5	6000	30000	20
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	659000.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-23-5	300	1500	1

1106015-01	C8702 - Blue Creek Upper	EPA 200.7	SODIUM	Water	1310000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-23-5	15000	75000	50
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	1220000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-23-5	15000	75000	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	700000.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-23-5	15000	75000	50
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	SODIUM	Water	1050000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-23-5	15000	75000	50
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	896000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-23-5	15000	75000	50
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	662000.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-23-5	15000	75000	50
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	SODIUM	Water	1140000.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-23-5	1500	7500	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	1240000.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-23-5	1500	7500	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	750000.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-23-5	1500	7500	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	SODIUM	Water	1200000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-23-5	15000	75000	50
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	1050000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-23-5	15000	75000	50
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	669000.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-23-5	15000	75000	50
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	SODIUM	Water	1430000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-23-5	15000	75000	50
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	1320000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-23-5	15000	75000	50
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	680000.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-23-5	15000	75000	50
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	SODIUM	Water	1100000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-23-5	15000	75000	50
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	1320000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-23-5	15000	75000	50
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	666000.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-23-5	15000	75000	50
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	SODIUM	Water	1590000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-23-5	15000	75000	50
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	SODIUM	Water	1220000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-23-5	15000	75000	50
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	SODIUM	Water	725000.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-23-5	15000	75000	50
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	2680.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-24-6	1	5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	2340.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-24-6	1	5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2050.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-24-6	1	5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	4790.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-24-6	1	5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3620.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-24-6	1	5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2030.	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-24-6	1	5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3770.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-24-6	1	5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3460.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-24-6	1	5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2110.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-24-6	1	5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3440.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-24-6	1	5	1

1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3400.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-24-6	1	5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2700.	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-24-6	1	5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3240.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-24-6	5	25	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3540.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-24-6	5	25	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2650.	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-24-6	5	25	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3660.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-24-6	1	5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3160.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-24-6	1	5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2340.	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-24-6	1	5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	4350.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-24-6	50	250	50
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	4100.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-24-6	1	5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2440.	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-24-6	1	5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	3740.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-24-6	1	5	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	4560.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-24-6	1	5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2560.	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-24-6	1	5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	STRONTIUM	Water	4580.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-24-6	1	5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	STRONTIUM	Water	3670.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-24-6	1	5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	STRONTIUM	Water	2430.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-24-6	1	5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-28-0	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-28-0	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-28-0	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-28-0	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-28-0	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-28-0	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-28-0	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-28-0	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-28-0	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-28-0	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-28-0	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-28-0	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-28-0	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-28-0	50	250	5

1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-28-0	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-28-0	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-28-0	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-28-0	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-28-0	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-28-0	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-28-0	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-28-0	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-28-0	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-28-0	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	THALLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-28-0	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	THALLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-28-0	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	THALLIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-28-0	10	50	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-31-5	30	150	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-31-5	30	150	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-31-5	30	150	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-31-5	30	150	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-31-5	30	150	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-31-5	30	150	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-31-5	30	150	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-31-5	30	150	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-31-5	30	150	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-31-5	30	150	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-31-5	30	150	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-31-5	30	150	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-31-5	150	750	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-31-5	150	750	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-31-5	150	750	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-31-5	30	150	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-31-5	30	150	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-31-5	30	150	1

1110027-01	C8728 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-31-5	30	150	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-31-5	30	150	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-31-5	30	150	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-31-5	30	150	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-31-5	30	150	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-31-5	30	150	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	TIN	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-31-5	30	150	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	TIN	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-31-5	30	150	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	TIN	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-31-5	30	150	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	200.	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	95.1	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	7.4	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	75.7	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	25.2	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-32-6	0.5	2.5	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	12.2	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-32-6	0.5	2.5	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	89.	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-32-6	0.5	2.5	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	4.3	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-32-6	0.5	2.5	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	40.9	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-32-6	0.5	2.5	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	7.2	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-32-6	0.5	2.5	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	24.4	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-32-6	0.5	2.5	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	74.8	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-32-6	0.5	2.5	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	11. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-32-6	2.5	12.5	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	11. J	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-32-6	2.5	12.5	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	31.2	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-32-6	2.5	12.5	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	14.7	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-32-6	0.5	2.5	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	6.8	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-32-6	0.5	2.5	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	46.1	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-32-6	0.5	2.5	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	13.9	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-32-6	0.5	2.5	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	17.9	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-32-6	0.5	2.5	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	50.4	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-32-6	0.5	2.5	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	46.7	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-32-6	0.5	2.5	1

1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	1. J	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-32-6	0.5	2.5	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	4.8	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-32-6	0.5	2.5	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	TITANIUM	Water	146.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-32-6	0.5	2.5	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	TITANIUM	Water	130.	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-32-6	0.5	2.5	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	TITANIUM	Water	22.9	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-32-6	0.5	2.5	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-62-2	5	25	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-62-2	5	25	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-62-2	5	25	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-62-2	5	25	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-62-2	5	25	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-62-2	5	25	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-62-2	5	25	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-62-2	5	25	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-62-2	5	25	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	8.4 J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-62-2	5	25	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	12. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-62-2	5	25	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	8. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-62-2	5	25	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-62-2	25	125	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-62-2	25	125	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-62-2	25	125	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	5.5 J	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-62-2	5	25	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	5.2 J	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-62-2	5	25	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-62-2	5	25	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	7.5 J	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-62-2	5	25	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	14. J	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-62-2	5	25	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-62-2	5	25	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	5.3 J	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-62-2	5	25	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	9.8 J	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-62-2	5	25	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-62-2	5	25	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	VANADIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-62-2	5	25	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	VANADIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-62-2	5	25	1

1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	VANADIUM	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-62-2	5	25	1
1105032-01	C8697 - Blue Creek Crossing	EPA 200.7	ZINC	Water	29. J	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-66-6	10	50	1
1105032-02	C8698 - Blue Creek Upper	EPA 200.7	ZINC	Water	22. J	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-66-6	10	50	1
1105032-03	C8699 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1106-001	26-May-11	02-Jun-11	7440-66-6	10	50	1
1105033-01	C8690 - Blue Creek Upper	EPA 200.7	ZINC	Water	14. J	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-66-6	10	50	1
1105033-02	C8691 - Blue Creek Crossing	EPA 200.7	ZINC	Water	11. J	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-66-6	10	50	1
1105033-03	C8692 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1106-001	14-Apr-11	02-Jun-11	7440-66-6	10	50	1
1106015-01	C8702 - Blue Creek Upper	EPA 200.7	ZINC	Water	12. J	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-66-6	10	50	1
1106015-02	C8703 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-66-6	10	50	1
1106015-03	C8704 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1106-023	08-Jun-11	15-Jun-11	7440-66-6	10	50	1
1107032-01	C8709 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-66-6	10	50	1
1107032-02	C8710 - Blue Creek Crossing	EPA 200.7	ZINC	Water	13. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-66-6	10	50	1
1107032-03	C8711 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	22. J	ug/L	WS1108-009	26-Jul-11	08-Aug-11	7440-66-6	10	50	1
1108026-01	C8716 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-66-6	50	250	5
1108026-02	C8717 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-66-6	50	250	5
1108026-03	C8718 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1108-112	29-Aug-11	06-Sep-11	7440-66-6	50	250	5
1110003-01	C8722 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-66-6	10	50	1
1110003-02	C8723 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-66-6	10	50	1
1110003-03	C8724 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1110-010	29-Sep-11	10-Oct-11	7440-66-6	10	50	1
1110027-01	C8728 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-66-6	10	50	1
1110027-02	C8729 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-66-6	10	50	1
1110027-03	C8730 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1110-056	21-Oct-11	26-Oct-11	7440-66-6	10	50	1
1111013-01	C8733 - Blue Creek Upper	EPA 200.7	ZINC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-66-6	10	50	1
1111013-02	C8734 - Blue Creek Crossing	EPA 200.7	ZINC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-66-6	10	50	1
1111013-03	C8735 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1111-033	17-Nov-11	22-Nov-11	7440-66-6	10	50	1
1112019-01	C8740 - Blue Creek Upper	EPA 200.7	ZINC	Water	19. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-66-6	10	50	1
1112019-02	C8741 - Blue Creek Crossing	EPA 200.7	ZINC	Water	18. J	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-66-6	10	50	1
1112019-03	C8742 - Blue Creek Below Dam	EPA 200.7	ZINC	Water	U	ug/L	WS1201-002	20-Dec-11	04-Jan-12	7440-66-6	10	50	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	200.8 ACID DIGESTION	Water	04/19/2011 12:00:00 am			14-Apr-11	19-Apr-11				1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	200.8 ACID DIGESTION	Water	04/19/2011 12:00:00 am			14-Apr-11	19-Apr-11				1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	200.8 ACID DIGESTION	Water	04/19/2011 12:00:00 am			14-Apr-11	19-Apr-11				1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	ALUMINUM	Water	2030.	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7429-90-5	2.5	12.5	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	ALUMINUM	Water	771.	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7429-90-5	2.5	12.5	1

1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	ALUMINUM	Water	275.	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7429-90-5	2.5	12.5	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	ARSENIC	Water	42.9	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-38-2	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	ARSENIC	Water	32.9	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-38-2	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	ARSENIC	Water	20.1	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-38-2	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	BERYLLIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-41-7	0.25	1.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	BERYLLIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-41-7	0.25	1.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	BERYLLIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-41-7	0.25	1.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	CADMIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-43-9	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	CADMIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-43-9	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	CADMIUM	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-43-9	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	CHROMIUM	Water	3.8	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-47-3	0.25	1.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	CHROMIUM	Water	1.5	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-47-3	0.25	1.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	CHROMIUM	Water	0.7 J	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-47-3	0.25	1.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	LEAD	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7439-92-1	2.5	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	LEAD	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7439-92-1	2.5	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	LEAD	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7439-92-1	2.5	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	SELENIUM	Water	12.1	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7782-49-2	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	SELENIUM	Water	9.2	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7782-49-2	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	SELENIUM	Water	5. J	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7782-49-2	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 200.8	SILVER	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-22-4	1.25	6.25	1
1104014-02	C8691 - Blue Creek Crossing	EPA 200.8	SILVER	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-22-4	1.25	6.25	1
1104014-03	C8692 - Blue Creek Below Dam	EPA 200.8	SILVER	Water	U	ug/L	WS1104-052	14-Apr-11	20-Apr-11	7440-22-4	1.25	6.25	1
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		5	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		5	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		5	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		2.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		2.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		2.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		5	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		5	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		5	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		5	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		5	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11		2.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		5	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		5	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		5	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		5	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		5	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		5	20	100

1111013-01	C8733 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		5	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		5	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		5	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	BROMIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		10	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	BROMIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		5	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	BROMIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		5	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	2440.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1550.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	912.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1710.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1470.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	884.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1520.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1350.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	1000.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1680.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1690.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	1030.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1820.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1570.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	992.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	2030.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1900.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	991.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	1590.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1890.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	971.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	CHLORIDE	Water	2270.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	CHLORIDE	Water	1710.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	CHLORIDE	Water	1010.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		2	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	3.5 J	mg/L	WS1104-066	14-Apr-11	20-Apr-11		2	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		2	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	4.8 J	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	2.4 J	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	1.9 J	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	2.1 J	mg/L	WS1108-027	26-Jul-11	08-Aug-11		2	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	2.2 J	mg/L	WS1108-027	26-Jul-11	08-Aug-11		2	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	2.2 J	mg/L	WS1108-027	26-Jul-11	08-Aug-11		2	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	3.3 J	mg/L	WS1109-006	29-Aug-11	07-Sep-11		2	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	5.5 J	mg/L	WS1109-006	29-Aug-11	07-Sep-11		2	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	2.6 J	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	2.2 J	mg/L	WS1110-028	29-Sep-11	11-Oct-11		2	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		2	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11		2	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		2	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		2	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11		2	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		2	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		2	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11		2	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		4	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		2	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	FLUORIDE	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		2	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100

1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11	3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12	6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12	3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	NITRATE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12	3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11	3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11	3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11	3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11	1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11	1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11	1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11	3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11	3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11	3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12	6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12	3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	NITRITE-N	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12	3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11	3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11	3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1104-066	14-Apr-11	20-Apr-11	3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11	1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11	1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1106-047	08-Jun-11	17-Jun-11	1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11	3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11	3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1108-027	26-Jul-11	08-Aug-11	3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1109-006	29-Aug-11	07-Sep-11	1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-028	29-Sep-11	11-Oct-11	3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1110-062	21-Oct-11	26-Oct-11	3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1111-036	17-Nov-11	22-Nov-11	3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12	6	40	200

1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	ORTHOPHOSPHATE-P	Water	U	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 300.0	SULFATE	Water	501.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-02	C8691 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	274.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1104014-03	C8692 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	107.	mg/L	WS1104-066	14-Apr-11	20-Apr-11		3	20	100
1106015-01	C8702 - Blue Creek Upper	EPA 300.0	SULFATE	Water	303.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-02	C8703 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	258.	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1106015-03	C8704 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	94.4	mg/L	WS1106-047	08-Jun-11	17-Jun-11		1.5	10	50
1107032-01	C8709 - Blue Creek Upper	EPA 300.0	SULFATE	Water	232.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-02	C8710 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	198.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1107032-03	C8711 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	114.	mg/L	WS1108-027	26-Jul-11	08-Aug-11		3	20	100
1108026-01	C8716 - Blue Creek Upper	EPA 300.0	SULFATE	Water	274.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-02	C8717 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	274.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		3	20	100
1108026-03	C8718 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	117.	mg/L	WS1109-006	29-Aug-11	07-Sep-11		1.5	10	50
1110003-01	C8722 - Blue Creek Upper	EPA 300.0	SULFATE	Water	317.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-02	C8723 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	253.	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110003-03	C8724 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	113	mg/L	WS1110-028	29-Sep-11	11-Oct-11		3	20	100
1110027-01	C8728 - Blue Creek Upper	EPA 300.0	SULFATE	Water	377.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-02	C8729 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	350.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1110027-03	C8730 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	115.	mg/L	WS1110-062	21-Oct-11	26-Oct-11		3	20	100
1111013-01	C8733 - Blue Creek Upper	EPA 300.0	SULFATE	Water	275.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-02	C8734 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	359.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1111013-03	C8735 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	106.	mg/L	WS1111-036	17-Nov-11	22-Nov-11		3	20	100
1112019-01	C8740 - Blue Creek Upper	EPA 300.0	SULFATE	Water	414.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		6	40	200
1112019-02	C8741 - Blue Creek Crossing	EPA 300.0	SULFATE	Water	300.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1112019-03	C8742 - Blue Creek Below Dam	EPA 300.0	SULFATE	Water	104.	mg/L	WS1201-010	20-Dec-11	03-Jan-12		3	20	100
1104014-01	C8690 - Blue Creek Upper	EPA 350.1	AMMONIA DISTILLATION	Water	04/26/2011 00:00			14-Apr-11	25-Apr-11				1
1105032-01	C8697 - Blue Creek Crossing	EPA 350.1	AMMONIA DISTILLATION	Water	06/07/2011 00:00			26-May-11	07-Jun-11				1
1104014-01	C8690 - Blue Creek Upper	EPA 350.1	AMMONIA-N	Water	U	mg/L	WS1104-078	14-Apr-11	25-Apr-11	7664-41-7	0.06	0.1	1
1105032-01	C8697 - Blue Creek Crossing	EPA 350.1	AMMONIA-N	Water	0.71	mg/L	WS1106-010	26-May-11	07-Jun-11	7664-41-7	0.06	0.1	1

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
6/2/1989	4038	Irrigate	June	Summer	4038
6/16/1989	3348	Irrigate	June	Summer	3348
6/29/1989	3536	Irrigate	June	Summer	3536
7/7/1989	3910	Irrigate	July	Summer	3910
7/21/1989	4200	Irrigate	July	Summer	4200
8/11/1989	3726	Irrigate	Aug	Summer	3726
8/25/1989	4864	Irrigate	Aug	Summer	4864
9/8/1989	3130	Irrigate	Sept	Summer	3130
9/22/1989	3020	Irrigate	Sept	Summer	3020
10/6/1989	3022	Irrigate	Oct	Summer	3022
10/20/1989	3066	Irrigate	Oct	Summer	3066
3/2/1990	2800	No_irr	March	Summer	2800
3/16/1990	2850	No_irr	March	Summer	2850
3/30/1990	4068	No_irr	March	Summer	4068
4/13/1990	3112	No_irr	April	Summer	3112
4/27/1990	3308	Irrigate	April	Summer	3308
5/11/1990	3768	Irrigate	May	Summer	3768
5/25/1990	4588	Irrigate	May	Summer	4588
6/7/1990	4030	Irrigate	June	Summer	4030
6/22/1990	3172	Irrigate	June	Summer	3172
7/6/1990	3744	Irrigate	July	Summer	3744
7/20/1990	3664	Irrigate	July	Summer	3664
8/3/1990	4202	Irrigate	Aug	Summer	4202
8/17/1990	3880	Irrigate	Aug	Summer	3880
8/31/1990	3660	Irrigate	Aug	Summer	3660
9/14/1990	3672	Irrigate	Sept	Summer	3672
9/28/1990	2250	Irrigate	Sept	Summer	2250
10/12/1990	2572	Irrigate	Oct	Summer	2572
10/26/1990	2624	Irrigate	Oct	Summer	2624
3/8/1991	3212	No_irr	March	Summer	3212
3/22/1991	4222	No_irr	March	Summer	4222
4/5/1991	2868	No_irr	April	Summer	2868
4/19/1991	3742	Irrigate	April	Summer	3742
5/3/1991	4364	Irrigate	May	Summer	4364
5/17/1991	3380	Irrigate	May	Summer	3380
5/31/1991	5620	Irrigate	May	Summer	5620
6/12/1991	3394	Irrigate	June	Summer	3394
6/18/1991	3172	Irrigate	June	Summer	3172
6/21/1991	3842	Irrigate	June	Summer	3842
6/25/1991	4766	Irrigate	June	Summer	4766
7/12/1991	3038	Irrigate	July	Summer	3038
7/26/1991	3698	Irrigate	July	Summer	3698

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
8/6/1991	3800	Irrigate	Aug	Summer	3800
8/23/1991	4200	Irrigate	Aug	Summer	4200
9/6/1991	3700	Irrigate	Sept	Summer	3700
9/20/1991	3500	Irrigate	Sept	Summer	3500
9/24/1991	3550	Irrigate	Sept	Summer	3550
10/1/1991	3500	Irrigate	Oct	Summer	3500
10/16/1991	3400	Irrigate	Oct	Summer	3400
3/6/1992	3600	No_irr	March	Summer	3600
3/20/1992	3000	No_irr	March	Summer	3000
4/3/1992	2600	No_irr	April	Summer	2600
4/14/1992	2718	No_irr	April	Summer	2718
4/17/1992	2800	Irrigate	April	Summer	2800
4/29/1992	4500	Irrigate	April	Summer	4500
5/15/1992	3800	Irrigate	May	Summer	3800
5/29/1992	4400	Irrigate	May	Summer	4400
6/2/1992	4702	Irrigate	June	Summer	4702
6/12/1992	3400	Irrigate	June	Summer	3400
6/25/1992	4000	Irrigate	June	Summer	4000
7/9/1992	4000	Irrigate	July	Summer	4000
7/21/1992	3924	Irrigate	July	Summer	3924
7/22/1992	3600	Irrigate	July	Summer	3600
8/6/1992	3930	Irrigate	Aug	Summer	3930
8/21/1992	4490	Irrigate	Aug	Summer	4490
9/2/1992	3530	Irrigate	Sept	Summer	3530
9/9/1992	3686	Irrigate	Sept	Summer	3686
10/2/1992	4020	Irrigate	Oct	Summer	4020
10/13/1992	5020	Irrigate	Oct	Summer	5020
10/20/1992	5242	Irrigate	Oct	Summer	5242
10/30/1992	7180	Irrigate	Oct	Summer	
3/12/1993	4437	No_irr	March	Summer	4437
3/26/1993	3293	No_irr	March	Summer	3293
4/9/1993	4488	No_irr	April	Summer	4488
4/28/1993	3264	Irrigate	April	Summer	3264
5/4/1993	3750	Irrigate	May	Summer	3750
5/13/1993	3106	Irrigate	May	Summer	3106
5/27/1993	4136	Irrigate	May	Summer	4136
6/4/1993	4231	Irrigate	June	Summer	4231
6/15/1993	4124	Irrigate	June	Summer	4124
6/18/1993	4528	Irrigate	June	Summer	4528
6/30/1993	3668	Irrigate	June	Summer	3668
7/9/1993	3536	Irrigate	July	Summer	3536
7/20/1993	3116	Irrigate	July	Summer	3116

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
8/6/1993	3652	Irrigate	Aug	Summer	3652
8/20/1993	4115	Irrigate	Aug	Summer	4115
8/24/1993	4728	Irrigate	Aug	Summer	4728
9/2/1993	3853	Irrigate	Sept	Summer	3853
9/16/1993	4233	Irrigate	Sept	Summer	4233
9/30/1993	4561	Irrigate	Sept	Summer	4561
10/12/1993	3556	Irrigate	Oct	Summer	3556
10/15/1993	3522	Irrigate	Oct	Summer	3522
10/29/1993	2918	Irrigate	Oct	Summer	2918
3/9/1994	3735	No_irr	March	Summer	3735
3/23/1994	4933	No_irr	March	Summer	4933
4/13/1994	3336	No_irr	April	Summer	3336
4/19/1994	2986	Irrigate	April	Summer	2986
4/29/1994	3456	Irrigate	April	Summer	3456
5/11/1994	5042	Irrigate	May	Summer	5042
5/26/1994	3333	Irrigate	May	Summer	3333
6/9/1994	3935	Irrigate	June	Summer	3935
6/24/1994	3710	Irrigate	June	Summer	3710
7/8/1994	3419	Irrigate	July	Summer	3419
7/19/1994	3321	Irrigate	July	Summer	3321
7/20/1994	3890	Irrigate	July	Summer	3890
8/4/1994	3934	Irrigate	Aug	Summer	3934
8/18/1994	3820	Irrigate	Aug	Summer	3820
9/1/1994	3846	Irrigate	Sept	Summer	3846
9/16/1994	3394	Irrigate	Sept	Summer	3394
9/26/1994	3512	Irrigate	Sept	Summer	3512
10/12/1994	3961	Irrigate	Oct	Summer	3961
10/28/1994	4048	Irrigate	Oct	Summer	4048
3/8/1995	4803	No_irr	March	Summer	4803
3/22/1995	4003	No_irr	March	Summer	4003
4/13/1995	3122	No_irr	April	Summer	3122
4/28/1995	5016	Irrigate	April	Summer	5016
5/4/1995	4567	Irrigate	May	Summer	4567
5/22/1995	5047	Irrigate	May	Summer	5047
5/24/1995	5264	Irrigate	May	Summer	5264
6/8/1995	3491	Irrigate	June	Summer	3491
6/21/1995	2787	Irrigate	June	Summer	2787
7/6/1995	3380	Irrigate	July	Summer	3380
7/13/1995	3081	Irrigate	July	Summer	3081
7/28/1995	3455	Irrigate	July	Summer	3455
8/10/1995	2859	Irrigate	Aug	Summer	2859
8/21/1995	3796	Irrigate	Aug	Summer	3796

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
9/7/1995	3315	Irrigate	Sept	Summer	3315
9/20/1995	4589	Irrigate	Sept	Summer	4589
10/4/1995	5097	Irrigate	Oct	Summer	5097
10/20/1995	4196	Irrigate	Oct	Summer	4196
10/27/1995	5016	Irrigate	Oct	Summer	5016
3/7/1996	3800	No_irr	March	Summer	3800
3/20/1996	3070	No_irr	March	Summer	3070
4/1/1996	2950	No_irr	April	Summer	2950
4/17/1996	4240	Irrigate	April	Summer	4240
5/8/1996	4074	Irrigate	May	Summer	4074
5/22/1996	4660	Irrigate	May	Summer	4660
6/7/1996	4240	Irrigate	June	Summer	4240
6/19/1996	3040	Irrigate	June	Summer	3040
7/16/1996	3780	Irrigate	July	Summer	3780
7/30/1996	3352	Irrigate	July	Summer	3352
7/31/1996	4170	Irrigate	July	Summer	4170
8/7/1996	3310	Irrigate	Aug	Summer	3310
8/22/1996	2970	Irrigate	Aug	Summer	2970
9/10/1996	4270	Irrigate	Sept	Summer	4270
9/25/1996	4740	Irrigate	Sept	Summer	4740
10/9/1996	4070	Irrigate	Oct	Summer	4070
10/24/1996	4824	Irrigate	Oct	Summer	4824
3/12/1997	3570	No_irr	March	Summer	3570
3/26/1997	3420	No_irr	March	Summer	3420
4/8/1997	3070	No_irr	April	Summer	3070
4/29/1997	3640	Irrigate	April	Summer	3640
5/8/1997	4728	Irrigate	May	Summer	4728
8/7/1997	3086	Irrigate	Aug	Summer	3086
10/22/1997	2506	Irrigate	Oct	Summer	2506
5/14/1998	4254	Irrigate	May	Summer	4254
7/14/1998	2766	Irrigate	July	Summer	2766
10/27/1998	3182	Irrigate	Oct	Summer	3182
4/13/1999	2794	No_irr	April	Summer	2794
8/18/1999	3662	Irrigate	Aug	Summer	3662
4/3/2000	3136	No_irr	April	Summer	3136
4/12/2000	2802	No_irr	April	Summer	2802
6/22/2000	3372	Irrigate	June	Summer	3372
7/12/2000	2977	Irrigate	July	Summer	2977
8/9/2000	3548	Irrigate	Aug	Summer	3548
10/6/2000	4485	Irrigate	Oct	Summer	4485
4/5/2001	3814	No_irr	April	Summer	3814
7/2/2001	2952	Irrigate	July	Summer	2952

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
7/26/2001	3958	Irrigate	July	Summer	3958
10/2/2001	3436	Irrigate	Oct	Summer	3436
4/2/2002	3812	No_irr	April	Summer	3812
7/11/2002	2968	Irrigate	July	Summer	2968
8/13/2002	4338	Irrigate	Aug	Summer	4338
10/29/2002	4910	Irrigate	Oct	Summer	4910
4/4/2003	4121	No_irr	April	Summer	4121
5/15/2003	5886	Irrigate	May	Summer	5886
7/8/2003	4147	Irrigate	July	Summer	4147
7/15/2003	4198	Irrigate	July	Summer	4198
8/19/2003	5228	Irrigate	Aug	Summer	5228
9/23/2003	3996	Irrigate	Sept	Summer	3996
10/2/2003	3965	Irrigate	Oct	Summer	3965
10/28/2003	5524	Irrigate	Oct	Summer	5524
3/16/2004	5520	No_irr	March	Summer	5520
4/7/2004	4590	No_irr	April	Summer	4590
7/2/2004	3450	Irrigate	July	Summer	3450
10/12/2004	4470	Irrigate	Oct	Summer	4470
4/4/2005	4400	No_irr	April	Summer	4400
4/20/2005	4942	Irrigate	April	Summer	4942
8/2/2005	3044	Irrigate	Aug	Summer	3044
8/3/2005	3860	Irrigate	Aug	Summer	3860
10/7/2005	3640	Irrigate	Oct	Summer	3640
10/18/2005	3716	Irrigate	Oct	Summer	3716
4/6/2006	3660	No_irr	April	Summer	3660
7/5/2006	3336	Irrigate	July	Summer	3336
7/10/2006	3560	Irrigate	July	Summer	3560
10/11/2006	2939	Irrigate	Oct	Summer	2939
4/3/2007	3440	No_irr	April	Summer	3440
5/14/2007	3180	Irrigate	May	Summer	3180
7/2/2007	2792	Irrigate	July	Summer	2792
7/10/2007	3160	Irrigate	July	Summer	3160
10/9/2007	3754	Irrigate	Oct	Summer	3754
10/11/2007	4260	Irrigate	Oct	Summer	4260
4/9/2008	2996	No_irr	April	Summer	2996
5/5/2008	3570	Irrigate	May	Summer	3570
7/2/2008	3450	Irrigate	July	Summer	3450
7/15/2008	3386	Irrigate	July	Summer	3386
8/4/2008	3438	Irrigate	Aug	Summer	3438
9/22/2008	3544	Irrigate	Sept	Summer	3544
10/12/2008	4470	Irrigate	Oct	Summer	4470
3/2/2009	5202	No_irr	March	Summer	5202

Date	BC Upper TDS (mg/l)	Irr Season	Month	Season	Blue Creek Upper TDS Final (mg/l)
4/8/2009	4140	No_irr	April	Summer	4140
7/1/2009	3320	Irrigate	July	Summer	3320
10/6/2009	3410	Irrigate	Oct	Summer	3410
5/10/2010	4010	Irrigate	May	Summer	4010
7/14/2010	3970	Irrigate	July	Summer	3970
10/6/2010	5680	Irrigate	Oct	Summer	5680
4/14/2011	5270	No_irr	April	Summer	5270
5/26/2011	2260	Irrigate	May	Summer	2260
6/8/2011	3930	Irrigate	June	Summer	3930
7/26/2011	3380	Irrigate	July	Summer	3380
8/29/2011	3230	Irrigate	Aug	Summer	3230
9/29/2011	3780	Irrigate	Sept	Summer	3780
10/21/2011	4260	Irrigate	Oct	Summer	4260
3/19/2012	4160	No_irr	March	Summer	4160
4/16/2012	6270	Irrigate	April	Summer	6270
4/23/2012	4710	Irrigate	April	Summer	4710
4/30/2012	4730	Irrigate	April	Summer	4730
5/7/2012	4350	Irrigate	May	Summer	4350
6/4/2012	3720	Irrigate	June	Summer	3720
7/10/2012	4230	Irrigate	July	Summer	4230
8/8/2012	2980	Irrigate	Aug	Summer	2980
9/5/2012	4140	Irrigate	Sept	Summer	4140
10/5/2012	3760	Irrigate	Oct	Summer	3760
3/4/2013	5370	No_irr	March	Summer	5370
4/1/2013	4260	No_irr	April	Summer	4260
5/7/2013	4250	Irrigate	May	Summer	4250

Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects

From File	F:\Permits\ATK Blue Creek\WriteUp\Blue Creek ProUCL.xls.wst	
Full Precision	OFF	
Confidence Coefficient	0.95	

Blue Creek Below Dam TDS (mg/l)

Raw Statistics	
Number of Valid Observations	29
Number of Missing Values	3
Number of Distinct Observations	18
Minimum	1890
Maximum	2110
Mean of Raw Data	2007
Standard Deviation of Raw Data	63.63
Kstar	920.8
Mean of Log Transformed Data	7.604
Standard Deviation of Log Transformed Data	0.0318

Normal Distribution Test Results

Correlation Coefficient R	0.985
Shapiro Wilk Test Statistic	0.954
Shapiro Wilk Critical (0.95) Value	0.926
Approximate Shapiro Wilk P Value	0.258
Lilliefors Test Statistic	0.124
Lilliefors Critical (0.95) Value	0.165

Data appear Normal at (0.05) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.982
A-D Test Statistic	0.406
A-D Critical (0.95) Value	0.742
K-S Test Statistic	0.122
K-S Critical(0.95) Value	0.162

Data appear Gamma Distributed at (0.05) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.984
Shapiro Wilk Test Statistic	0.953
Shapiro Wilk Critical (0.95) Value	0.926
Approximate Shapiro Wilk P Value	0.243
Lilliefors Test Statistic	0.118
Lilliefors Critical (0.95) Value	0.165

Data appear Lognormal at (0.05) Significance Level

Blue Creek Crossing TDS (mg/L)

Raw Statistics	
Number of Valid Observations	32
Number of Distinct Observations	28
Minimum	2470
Maximum	5060
Mean of Raw Data	3298
Standard Deviation of Raw Data	572.4
Kstar	34.52
Mean of Log Transformed Data	8.088
Standard Deviation of Log Transformed Data	0.161
Normal Distribution Test Results	
Correlation Coefficient R	0.944
Shapiro Wilk Test Statistic	0.898
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.00543
Lilliefors Test Statistic	0.141
Lilliefors Critical (0.95) Value	0.157
Data not Normal at (0.05) Significance Level	
Gamma Distribution Test Results	
Correlation Coefficient R	0.964
A-D Test Statistic	0.628
A-D Critical (0.95) Value	0.745
K-S Test Statistic	0.115
K-S Critical(0.95) Value	0.155
Data appear Gamma Distributed at (0.05) Significance Level	
Lognormal Distribution Test Results	
Correlation Coefficient R	0.974
Shapiro Wilk Test Statistic	0.95
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.175
Lilliefors Test Statistic	0.105
Lilliefors Critical (0.95) Value	0.157
Data appear Lognormal at (0.05) Significance Level	

Blue Creek Upper TDS (mg/L)

Raw Statistics	
Number of Valid Observations	32
Number of Distinct Observations	29
Minimum	2260
Maximum	6270
Mean of Raw Data	4261
Standard Deviation of Raw Data	802.7
Kstar	25.04
Mean of Log Transformed Data	8.339
Standard Deviation of Log Transformed Data	0.198
Normal Distribution Test Results	
Correlation Coefficient R	0.986
Shapiro Wilk Test Statistic	0.984
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.917
Lilliefors Test Statistic	0.125
Lilliefors Critical (0.95) Value	0.157
Data appear Normal at (0.05) Significance Level	
Gamma Distribution Test Results	
Correlation Coefficient R	0.986
A-D Test Statistic	0.381
A-D Critical (0.95) Value	0.745
K-S Test Statistic	0.122
K-S Critical(0.95) Value	0.155
Data appear Gamma Distributed at (0.05) Significance Level	
Lognormal Distribution Test Results	
Correlation Coefficient R	0.971
Shapiro Wilk Test Statistic	0.959
Shapiro Wilk Critical (0.95) Value	0.93
Approximate Shapiro Wilk P Value	0.307
Lilliefors Test Statistic	0.135
Lilliefors Critical (0.95) Value	0.157
Data appear Lognormal at (0.05) Significance Level	

Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects	
User Selected Options	
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst
Full Precision	OFF
Confidence Coefficient	0.95
BC_upper Sample Site All Data	
Raw Statistics	
Number of Valid Observations	349
Number of Distinct Observations	304
Minimum	1649
Maximum	7180
Mean of Raw Data	4121
Standard Deviation of Raw Data	943.7
Kstar	19.14
Mean of Log Transformed Data	8.298
Standard Deviation of Log Transformed Data	0.23
Normal Distribution Test Results	
Correlation Coefficient R	0.99
Approximate Shapiro Wilk Test Statistic	0.969
Approximate Shapiro Wilk P Value	0.0003089
Lilliefors Test Statistic	0.0704
Lilliefors Critical (0.95) Value	0.0474
Data not Normal at (0.05) Significance Level	
Gamma Distribution Test Results	
Correlation Coefficient R	0.997
A-D Test Statistic	0.724
A-D Critical (0.95) Value	0.751
K-S Test Statistic	0.0411
K-S Critical(0.95) Value	0.0486
Data appear Gamma Distributed at (0.05) Significance Level	
Lognormal Distribution Test Results	
Correlation Coefficient R	0.996
Approximate Shapiro Wilk Test Statistic	0.986
Approximate Shapiro Wilk P Value	0.648
Lilliefors Test Statistic	0.0303
Lilliefors Critical (0.95) Value	0.0474
Data appear Lognormal at (0.05) Significance Level	

	Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects
User Selected Options	
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst
Full Precision	OFF
Confidence Coefficient	0.95

TDS_Final Upper Blue Creek (irrigate)

Raw Statistics

Number of Valid Observations	233
Number of Missing Values	1
Number of Distinct Observations	210
Minimum	2250
Maximum	6564
Mean of Raw Data	3977
Standard Deviation of Raw Data	876.2
Kstar	21.42
Mean of Log Transformed Data	8.265
Standard Deviation of Log Transformed Data	0.215

Normal Distribution Test Results

Correlation Coefficient R	0.98
Approximate Shapiro Wilk Test Statistic	0.944
Approximate Shapiro Wilk P Value	8.278E-10
Lilliefors Test Statistic	0.0857
Lilliefors Critical (0.95) Value	0.058

Data not Normal at (0.05) Significance Level

Gamma Distribution Test Results

Correlation Coefficient R	0.992
A-D Test Statistic	1.049
A-D Critical (0.95) Value	0.751
K-S Test Statistic	0.0589
K-S Critical(0.95) Value	0.0597

Data follow Appr. Gamma Distribution at (0.05) Significance Level

Lognormal Distribution Test Results

Correlation Coefficient R	0.996
Approximate Shapiro Wilk Test Statistic	0.975
Approximate Shapiro Wilk P Value	0.0704
Lilliefors Test Statistic	0.0469
Lilliefors Critical (0.95) Value	0.058

Data appear Lognormal at (0.05) Significance Level

TDS_Final Upper Blue Creek (no_irr)

	A–E	F	G	H	I	J	K	L
51	**Raw Statistics**							
52	Number of Valid Observations	115						
53	Number of Distinct Observations	108						
54	Minimum	1649						
55	Maximum	6724						
56	Mean of Raw Data	4386						
57	Standard Deviation of Raw Data	980.3						
58	Kstar	17.96						
59	Mean of Log Transformed Data	8.359						
60	Standard Deviation of Log Transformed Data	0.243						
61								
62	**Normal Distribution Test Results**							
63								
64	Correlation Coefficient R	0.995						
65	Approximate Shapiro Wilk Test Statistic	0.981						
66	Approximate Shapiro Wilk P Value	0.565						
67	Lilliefors Test Statistic	0.0664						
68	Lilliefors Critical (0.95) Value	0.0826						
69	**Data appear Normal at (0.05) Significance Level**							
70								
71	**Gamma Distribution Test Results**							
72								
73	Correlation Coefficient R	0.985						
74	A-D Test Statistic	0.746						
75	A-D Critical (0.95) Value	0.75						
76	K-S Test Statistic	0.0734						
77	K-S Critical(0.95) Value	0.0854						
78	**Data appear Gamma Distributed at (0.05) Significance Level**							
79								
80	**Lognormal Distribution Test Results**							
81								
82	Correlation Coefficient R	0.976						
83	Approximate Shapiro Wilk Test Statistic	0.954						
84	Approximate Shapiro Wilk P Value	0.00298						
85	Lilliefors Test Statistic	0.0808						
86	Lilliefors Critical (0.95) Value	0.0826						
87	**Data appear Lognormal at (0.05) Significance Level**							

	Goodness-of-Fit Test Statistics for Full Data Sets without Non-Detects
User Selected Options	
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst
Full Precision	OFF
Confidence Coefficient	0.95
TDS_Final Blue Creek Upper (summer season)	
Raw Statistics	
Number of Valid Observations	235
Number of Missing Values	1
Number of Distinct Observations	206
Minimum	2250
Maximum	6270
Mean of Raw Data	3822
Standard Deviation of Raw Data	715.7
Kstar	29.05
Mean of Log Transformed Data	8.231
Standard Deviation of Log Transformed Data	0.185
Normal Distribution Test Results	
Correlation Coefficient R	0.989
Approximate Shapiro Wilk Test Statistic	0.968
Approximate Shapiro Wilk P Value	0.00439
Lilliefors Test Statistic	0.0587
Lilliefors Critical (0.95) Value	0.0578
Data not Normal at (0.05) Significance Level	
Gamma Distribution Test Results	
Correlation Coefficient R	0.998
A-D Test Statistic	0.383
A-D Critical (0.95) Value	0.751
K-S Test Statistic	0.0376
K-S Critical(0.95) Value	0.0595
Data appear Gamma Distributed at (0.05) Significance Level	
Lognormal Distribution Test Results	
Correlation Coefficient R	0.999
Approximate Shapiro Wilk Test Statistic	0.985
Approximate Shapiro Wilk P Value	0.693
Lilliefors Test Statistic	0.0319
Lilliefors Critical (0.95) Value	0.0578
Data appear Lognormal at (0.05) Significance Level	
TDS_Final Blue Creek Upper (winter season)	

	A–E	F	G	H	I	J	K	L
51	**Raw Statistics**							
52	Number of Valid Observations	113						
53	Number of Distinct Observations	107						
54	Minimum	1649						
55	Maximum	6724						
56	Mean of Raw Data	4714						
57	Standard Deviation of Raw Data	1035						
58	Kstar	17.37						
59	Mean of Log Transformed Data	8.43						
60	Standard Deviation of Log Transformed Data	0.251						
61								
62	**Normal Distribution Test Results**							
63								
64	Correlation Coefficient R	0.988						
65	Approximate Shapiro Wilk Test Statistic	0.965						
66	Approximate Shapiro Wilk P Value	0.0425						
67	Lilliefors Test Statistic	0.0705						
68	Lilliefors Critical (0.95) Value	0.0833						
69	**Data appear Normal at (0.05) Significance Level**							
70								
71	**Gamma Distribution Test Results**							
72								
73	Correlation Coefficient R	0.968						
74	A-D Test Statistic	1.683						
75	A-D Critical (0.95) Value	0.75						
76	K-S Test Statistic	0.0928						
77	K-S Critical(0.95) Value	0.0859						
78	**Data not Gamma Distributed at (0.05) Significance Level**							
79								
80	**Lognormal Distribution Test Results**							
81								
82	Correlation Coefficient R	0.953						
83	Approximate Shapiro Wilk Test Statistic	0.908						
84	Approximate Shapiro Wilk P Value	3.755E-09						
85	Lilliefors Test Statistic	0.106						
86	Lilliefors Critical (0.95) Value	0.0833						
87	**Data not Lognormal at (0.05) Significance Level**							

	A	B	C	D	E	F	G	H	I	J	K	L
1					**Outlier Tests for Selected Variables**							
2				**User Selected Options**								
3				From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst							
4				Full Precision	OFF							
5				Test for Suspected Outliers with Dixon test	1							
6				Test for Suspected Outliers with Rosner test	1							
7												
8												
9				**Rosner's Outlier Test for BC_upper**								
10												
11												
12			**Mean**	**4121**								
13			**Standard Deviation**	**943.7**								
14			**Number of data**	**349**								
15			**Number of suspected outliers**	**1**								
16												
17				Potential	Obs.	Test	Critical	Critical				
18	#	Mean	sd	outlier	Number	value	value (5%)	value (1%)				
19	1	4121	942.4	7180	99	3.246	3.767	4.137				
20												
21	For 5% Significance Level, there is no Potential Outlier											
22												
23	For 1% Significance Level, there is no Potential Outlier											
24												

	Outlier Tests for Selected Variables
User Selected Options	
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst
Full Precision	OFF
Test for Suspected Outliers with Dixon test	1
Test for Suspected Outliers with Rosner test	1

Rosner's Outlier Test for BC_upper (irrigate)

Mean	3990
Standard Deviation	899
Number of data	234
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	3990	897.1	7180	74	3.555	3.65	4.021

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Rosner's Outlier Test for BC_upper (no_irr)

Mean	4386
Standard Deviation	980.3
Number of data	115
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	4386	976	1649	56	2.804	3.422	3.792

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Outlier Tests for Selected Variables

User Selected Options	
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst
Full Precision	OFF
Test for Suspected Outliers with Dixon test	1
Test for Suspected Outliers with Rosner test	1

Rosner's Outlier Test for BC_upper (summer)

Mean	**3836**
Standard Deviation	**746.9**
Number of data	**236**
Number of suspected outliers	**1**

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	3836	745.3	7180	71	4.486	3.653	4.023

For 5% Significance Level, there is 1 Potential Outlier

Therefore, Observation 7180 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier

Therefore, Observation 7180 is a Potential Statistical Outlier

Rosner's Outlier Test for BC_upper (winter)

Mean	**4714**
Standard Deviation	**1035**
Number of data	**113**
Number of suspected outliers	**1**

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	4714	1030	1649	65	2.975	3.416	3.786

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Outlier Tests for Selected Variables

User Selected Options	
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper proUCL.wst
Full Precision	OFF
Test for Suspected Outliers with Dixon test	1
Test for Suspected Outliers with Rosner test	1

Rosner's Outlier Test for TDS_Final (summer)

Mean	3822
Standard Deviation	715.7
Number of data	235
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	3822	714.2	6270	224	3.427	3.651	4.022

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

Rosner's Outlier Test for TDS_Final (winter)

Mean	4714
Standard Deviation	1035
Number of data	113
Number of suspected outliers	1

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	4714	1030	1649	65	2.975	3.416	3.786

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

▼Analysis of Variance with Irrigation Status and Season

Effects coding used for categorical variables in model.
The categorical values encountered during processing are

Variables	Levels	
IRR_STATUS$ (2 levels)	Irrigate	No_irr
SEASON$ (2 levels)	Summer	Winter
Summer irrigations status (2 levels)	Irrigate	No_irr

2 case(s) are deleted due to missing data.

Dependent Variable	TDS Blue Creek Upper Final (no outlier)
N	349
Multiple R	0.443
Squared Multiple R	0.197

Estimates of Effects $B = (X'X)^{-1}X'Y$

Factor	Level	TDS Blue Creek Upper no outlier
CONSTANT		4,266.409
IRR_STATUS$	Irrigate	13.152
SEASON$	Summer	-449.473
IRR_STATUS$*SEASON$	Irrigate*Summer	8.297

Analysis of Variance

Source	Type III SS	df	Mean Squares	F-Ratio	p-Value
IRR_STATUS$	40,011.452	1	40,011.452	0.057	0.812
SEASON$	46,733,061.177	1	46,733,061.177	66.082	0.000
IRR_STATUS$*SEASON$	15,922.964	1	15,922.964	0.023	0.881
Error	2.440E+008	345	707,194.753		

▼Nonparametric: Kruskal-Wallis Test for TDS Concentrations by Season

Mann-Whitney U Test for 351 Cases

```
The categorical values encountered during processing are

Variables                            ¦      Levels
-------------------------------------+------------------
SEASON$ (2 levels)                   ¦ Summer     Winter

Dependent Variable   ¦ TDS Blue Creek
                     ¦ Upper no
                     ¦ outlier
Grouping  Variable   ¦ SEASON$

Group    Count      Rank Sum
---------------------------
Summer     236   34,167.000
Winter     113   26,908.000

Mann-Whitney U Test Statistic : 6,201.000
p-Value                       : 0.000
Chi-Square Approximation      : 65.414
df                            : 1

Kruskal-Wallis Test Statistic: 65.414
The p-value is 0.000 assuming chi-square distribution with 1 df.
```

	Background Statistics for Uncensored Full Data Sets
User Selected Options	
Date/Time of Computation	9/3/2015 11:04:49 AM
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2014 Analyses\Blue Creek upper all data.xls
Full Precision	OFF
Confidence Coefficient	95%
Coverage	90%
New or Future K Observations	10
Number of Bootstrap Operations	2000

BC_Upper_NoOutlier (summer)

General Statistics

Total Number of Observations	235	Number of Distinct Observations	206
		Number of Missing Observations	1
Minimum	2250	First Quartile	3335
Second Largest	5886	Median	3744
Maximum	6270	Third Quartile	4232
Mean	3822	SD	715.7
Coefficient of Variation	0.187	Skewness	0.57
Mean of logged Data	8.231	SD of logged Data	0.185

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.435	d2max (for USL)	3.481

Normal GOF Test

Shapiro Wilk Test Statistic	0.968	**Normal GOF Test**
5% Shapiro Wilk P Value	0.00439	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.0587	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0578	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 90% Coverage	4849	90% Percentile (z)	4739
95% UPL (t)	5007	95% Percentile (z)	4999
95% UPL for Next 10 Observations	5685	99% Percentile (z)	5487
95% UPL for Mean of 10 Observations	4204	95% USL	6314

Gamma GOF Test

A-D Test Statistic	0.383	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.0376	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.0595	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	29.43	k star (bias corrected MLE)	29.05
Theta hat (MLE)	129.9	Theta star (bias corrected MLE)	131.6
nu hat (MLE)	13830	nu star (bias corrected)	13655
MLE Mean (bias corrected)	3822	MLE Sd (bias corrected)	709.1

Background Statistics Assuming Gamma Distribution			
95% Wilson Hilferty (WH) Approx. Gamma UPL	5061	90% Percentile	4754
95% Hawkins Wixley (HW) Approx. Gamma UPL	5071	95% Percentile	5058
95% WH UPL for Next 10 Observations	5912	99% Percentile	5662
95% HW UPL for Next 10 Observations	5950		
95% WH Approx. Gamma UTL with 90% Coverage	4876	95% HW Approx. Gamma UTL with 90% Coverage	4881
95% WH USL	6781	95% HW USL	6862
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.985	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.693	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0319	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0578	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Background Statistics assuming Lognormal Distribution			
95% UTL with 90% Coverage	4899	90% Percentile (z)	4762
95% UPL (t)	5103	95% Percentile (z)	5094
95% UPL for Next 10 Observations	6081	99% Percentile (z)	5778
95% UPL for Mean of 10 Observations	4147	95% USL	7153
Nonparametric Distribution Free Background Statistics			
Data appear Gamma Distributed at 5% Significance Level			
Nonparametric Upper Limits for Background Threshold Values			
Order of Statistic, r	218	95% UTL with 90% Coverage	5016
Approximate f	1.346	Confidence Coefficient (CC) achieved by UTL	0.908
95% Percentile Bootstrap UTL with 90% Coverage	5016	95% BCA Bootstrap UTL with 90% Coverage	5016
95% UPL	5207	90% Percentile	4788
90% Chebyshev UPL	5974	95% Percentile	5129
95% Chebyshev UPL	6949	99% Percentile	5660
95% USL	6270		
Note: The use of USL to estimate a BTV is recommended only when the data set represents a background			
data set free of outliers and consists of observations collected from clean unimpacted locations.			
The use of USL tends to provide a balance between false positives and false negatives provided the data			
represents a background data set and when many onsite observations need to be compared with the BTV.			
BC_Upper_NoOutlier (winter)			
General Statistics			
Total Number of Observations	113	Number of Distinct Observations	107
Minimum	1649	First Quartile	4100
Second Largest	6564	Median	4738
Maximum	6724	Third Quartile	5534
Mean	4714	SD	1035
Coefficient of Variation	0.22	Skewness	-0.535
Mean of logged Data	8.43	SD of logged Data	0.251

Row	A–E	F	G–K	L
101	**Critical Values for Background Threshold Values (BTVs)**			
102	Tolerance Factor K (For UTL)	1.508	d2max (for USL)	3.251
103				
104	**Normal GOF Test**			
105	Shapiro Wilk Test Statistic	0.965	**Normal GOF Test**	
106	5% Shapiro Wilk P Value	0.0425	Data Not Normal at 5% Significance Level	
107	Lilliefors Test Statistic	0.0705	**Lilliefors GOF Test**	
108	5% Lilliefors Critical Value	0.0833	Data appear Normal at 5% Significance Level	
109	**Data appear Approximate Normal at 5% Significance Level**			
110				
111	**Background Statistics Assuming Normal Distribution**			
112	95% UTL with 90% Coverage	6275	90% Percentile (z)	6040
113	95% UPL (t)	6438	95% Percentile (z)	6416
114	95% UPL for Next 10 Observations	7438	99% Percentile (z)	7122
115	95% UPL for Mean of 10 Observations	5281	95% USL	8078
116				
117	**Gamma GOF Test**			
118	A-D Test Statistic	1.683	**Anderson-Darling Gamma GOF Test**	
119	5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	
120	K-S Test Statistic	0.0928	**Kolmogrov-Smirnoff Gamma GOF Test**	
121	5% K-S Critical Value	0.0859	Data Not Gamma Distributed at 5% Significance Level	
122	**Data Not Gamma Distributed at 5% Significance Level**			
123				
124	**Gamma Statistics**			
125	k hat (MLE)	17.84	k star (bias corrected MLE)	17.37
126	Theta hat (MLE)	264.2	Theta star (bias corrected MLE)	271.3
127	nu hat (MLE)	4032	nu star (bias corrected)	3927
128	MLE Mean (bias corrected)	4714	MLE Sd (bias corrected)	1131
129				
130	**Background Statistics Assuming Gamma Distribution**			
131	95% Wilson Hilferty (WH) Approx. Gamma UPL	6728	90% Percentile	6209
132	95% Hawkins Wixley (HW) Approx. Gamma UPL	6779	95% Percentile	6716
133	95% WH UPL for Next 10 Observations	8194	99% Percentile	7736
134	95% HW UPL for Next 10 Observations	8338		
135	95% WH Approx. Gamma UTL with 90% Coverage	6506	95% HW Approx. Gamma UTL with 90% Coverage	6548
136	95% WH USL	9237	95% HW USL	9467
137				
138	**Lognormal GOF Test**			
139	Shapiro Wilk Test Statistic	0.908	**Shapiro Wilk Lognormal GOF Test**	
140	5% Shapiro Wilk P Value	3.7548E-9	Data Not Lognormal at 5% Significance Level	
141	Lilliefors Test Statistic	0.106	**Lilliefors Lognormal GOF Test**	
142	5% Lilliefors Critical Value	0.0833	Data Not Lognormal at 5% Significance Level	
143	**Data Not Lognormal at 5% Significance Level**			
144				
145	**Background Statistics assuming Lognormal Distribution**			
146	95% UTL with 90% Coverage	6697	90% Percentile (z)	6325
147	95% UPL (t)	6967	95% Percentile (z)	6931
148	95% UPL for Next 10 Observations	8883	99% Percentile (z)	8226
149	95% UPL for Mean of 10 Observations	5259	95% USL	10379
150				

	A	B	C	D	E	F	G	H	I	J	K	L
151	**Nonparametric Distribution Free Background Statistics**											
152	**Data appear Approximate Normal at 5% Significance Level**											
153												
154	**Nonparametric Upper Limits for Background Threshold Values**											
155					Order of Statistic, r	106					95% UTL with 90% Coverage	6007
156					Approximate f	1.472					Confidence Coefficient (CC) achieved by UTL	0.888
157	95% Percentile Bootstrap UTL with 90% Coverage					6007					95% BCA Bootstrap UTL with 90% Coverage	6007
158					95% UPL	6243					90% Percentile	5951
159					90% Chebyshev UPL	7832					95% Percentile	6173
160					95% Chebyshev UPL	9245					99% Percentile	6537
161					95% USL	6724						
162												
163	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background											
164	data set free of outliers and consists of observations collected from clean unimpacted locations.											
165	The use of USL tends to provide a balance between false positives and false negatives provided the data											
166	represents a background data set and when many onsite observations need to be compared with the BTV.											
167												

	Background Statistics for Uncensored Full Data Sets	
User Selected Options		
Date/Time of Computation	8/25/2015 8:25:38 AM	
From File	U:\ENG_WQ\CBITTNER\Permits\ATK Blue Creek\2015\BlueCreekRes.xlsx	
Full Precision	OFF	
Confidence Coefficient	95%	
Coverage	90%	
New or Future K Observations	10	
Number of Bootstrap Operations	2000	

BCBD_TDS

General Statistics

Total Number of Observations	29	Number of Distinct Observations	18
		Number of Missing Observations	3
Minimum	1890	First Quartile	1970
Second Largest	2100	Median	1990
Maximum	2110	Third Quartile	2060
Mean	2007	SD	63.63
Coefficient of Variation	0.0317	Skewness	-0.13
Mean of logged Data	7.604	SD of logged Data	0.0318

Critical Values for Background Threshold Values (BTVs)

Tolerance Factor K (For UTL)	1.788	d2max (for USL)	2.73

Normal GOF Test

Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.124	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.165	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Background Statistics Assuming Normal Distribution

95% UTL with 90% Coverage	2121	90% Percentile (z)	2089
95% UPL (t)	2117	95% Percentile (z)	2112
95% UPL for Next 10 Observations	2186	99% Percentile (z)	2155
95% UPL for Mean of 10 Observations	2047	95% USL	2181

Gamma GOF Test

A-D Test Statistic	0.406	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.162	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1027	k star (bias corrected MLE)	920.8
Theta hat (MLE)	1.954	Theta star (bias corrected MLE)	2.18
nu hat (MLE)	59570	nu star (bias corrected)	53408
MLE Mean (bias corrected)	2007	MLE Sd (bias corrected)	66.15

Background Statistics Assuming Gamma Distribution

95% Wilson Hilferty (WH) Approx. Gamma UPL	2119	90% Percentile	2092
95% Hawkins Wixley (HW) Approx. Gamma UPL	2119	95% Percentile	2117
95% WH UPL for Next 10 Observations	2191	99% Percentile	2164
95% HW UPL for Next 10 Observations	2192		
95% WH Approx. Gamma UTL with 90% Coverage	2123	95% HW Approx. Gamma UTL with 90% Coverage	2123
95% WH USL	2186	95% HW USL	2186

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.953	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.926	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.118	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.165	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Background Statistics assuming Lognormal Distribution

95% UTL with 90% Coverage	2124	90% Percentile (z)	2090
95% UPL (t)	2120	95% Percentile (z)	2114
95% UPL for Next 10 Observations	2194	99% Percentile (z)	2160
95% UPL for Mean of 10 Observations	2046	95% USL	2188

Nonparametric Distribution Free Background Statistics

Data appear Normal at 5% Significance Level

Nonparametric Upper Limits for Background Threshold Values

Order of Statistic, r	28	95% UTL with 90% Coverage	2100
Approximate f	1.556	Confidence Coefficient (CC) achieved by UTL	0.801
95% Percentile Bootstrap UTL with 90% Coverage	2102	95% BCA Bootstrap UTL with 90% Coverage	2100
95% UPL	2105	90% Percentile	2092
90% Chebyshev UPL	2201	95% Percentile	2100
95% Chebyshev UPL	2289	99% Percentile	2107
95% USL	2110		

Note: The use of USL to estimate a BTV is recommended only when the data set represents a background data set free of outliers and consists of observations collected from clean unimpacted locations.
The use of USL tends to provide a balance between false positives and false negatives provided the data represents a background data set and when many onsite observations need to be compared with the BTV.

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-196** APPLICATION/CLAIM NO.: **A29767** CERT. NO.: 7733

==

OWNERSHIP

==

NAME: Merlin H. Larsen
ADDR: Promontory Route
Corinne UT 84307

==

DATES, ETC.

==

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 03/11/1958|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-3]|MAP: [123a]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**---*

Type of Right: Application to Appropriate Source of Info: Proposed Determination Status: Certificate

==

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)*************MAP VIEWER*****************

==

FLOW: 2.39 cfs SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION:

POINTS OF DIVERSION -- SURFACE:
(1) S 2030 ft W 2310 ft from NE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source:
(2) S 3250 ft W 2530 ft from NE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source:
(3) S 4010 ft W 1040 ft from NE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source:
(4) S 5240 ft W 1700 ft from NE cor, Sec 07, T 10N, R 5W, SLBM

Diverting Works:
Source:
(5) N 30 ft W 700 ft from SE cor, Sec 18, T 10N, R 5W, SLBM
Diverting Works:
Source:
(6) S 1460 ft W 1650 ft from NE cor, Sec 18, T 10N, R 5W, SLBM
Diverting Works:
Source:

Stream Alt Required?: No
===

USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.)*** ******** ***EDU -- Equivalent Domestic Unit or 1 Family***
===

SUPPLEMENTAL GROUP NO.: 6272.

....
IRRIGATION: 349.0 acres
Div Limit: 0.0 acft. PERIOD OF USE: 04/01 TO 10/31
....
###PLACE OF USE: *-------NORTH WEST QUARTER------*-------NORTH EAST QUARTER------*-------SOUTH WEST QUARTER------*-------SOUTH EAST QUARTER------* Section
* NW | NE | SW | SE * NW | NE | SW | SE * NW | NE | SW | SE * NW | NE | SW | SE * Totals
Sec 07 T 10N R 5W SLBM
*_______|_______|_______|_______*_______|_______|23.5000|11.0000*_______|_______|_______|_______*30.8000|12.1000|30.0000|26.8000* 134.2000
Sec 08 T 10N R 5W SLBM
*_______|_______|_______|_______*_______|_______|_______|_______*9.5000|_______|30.4000|_______*_______|_______|_______|_______* 39.9000
Sec 18 T 10N R 5W SLBM *_______|_______|_______|_______*6.3000|18.4000|8.3000|21.8000*_______|_______|_______|13.6000*22.6000|31.3000|31.5000|21.1000* 174.9000

GROUP ACREAGE TOTAL: 349.0000
****
E N D O F D A T A
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2043** APPLICATION/CLAIM NO.: CERT. NO.:

==

OWNERSHIP

==

NAME: Salt Wells Cattle Company, LLC
ADDR: 192 North Highland Blvd
Brigham UT 84302
INTEREST: 100% REMARKS:

==

DATES, ETC.

==

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 08/28/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-3]|MAP: [108]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**---*

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

==

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)***********MAP VIEWER*****************

==

FLOW: SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Howell Valley

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. E 660 ft. from W4 corner, Sec 20, T11N, R5W, SLBM,
to a point at N 660 ft. W 660 ft. from S4 corner, Sec 32, T11N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==

USES OF WATER RIGHT****** *ELU -- Equivalent Livestock Unit (cow, horse, etc.)* ******** *EDU -- Equivalent Domestic Unit or 1 Family***

==
==
SUPPLEMENTAL GROUP NO.: 6183. Water Rights Appurtenant to the following use(s):
13-1796(WUC),2043(DIL),2634(DIL)

....
....
STOCKWATER: Sole Supply: UNEVALUATED ELUs   Group Total: 1000.0000
Div Limit: 28.0 acft.   PERIOD OF USE: 01/01 TO 12/31
==
==
PLACE OF USE for STOCKWATERING
==
==

```
                               NORTH-WEST¼       NORTH-EAST¼
SOUTH-WEST¼       SOUTH-EAST¼
                               NW NE SW SE       NW NE SW SE       NW
NE SW SE       NW NE SW SE
Sec 20 T 11N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     * X:
:  :  *     *  :  :  :  *
Sec 32 T 11N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     *  :
:  : X*     *  :  :  :  *
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****
E N D   O F   D A T A
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2044** APPLICATION/CLAIM NO.: CERT. NO.:

==
OWNERSHIP*
==

NAME: Conner Cattle Company
ADDR: c/o Parley Holmgren
Bear River City UT 84301

==
DATES, ETC.*
==

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 08/23/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-3]|MAP: [123a]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**--*

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

==
LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)***********MAP VIEWER*****************
==

FLOW: SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Howell Valley

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from N4 corner, Sec 05, T10N, R5W, SLBM,
to a point at N 660 ft. E 660 ft. from SW corner, Sec 05, T10N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==
USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family***

==
===
SUPPLEMENTAL GROUP NO.: 5791. Water Rights Appurtenant to the following use(s):
13-1104(DIL),1105(DIL),2044(DIL),2047(DIL),2050(DIL)
2201(DIL),2202(DIL),2203(DIL)

....
....
STOCKWATER: Sole Supply: UNEVALUATED ELUs Group Total: 400.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31
*==
==
========================*
SUPPLEMENTAL GROUP NO.: 7097. Water Rights Appurtenant to the following use(s):
13-1104(DIL),1105(DIL),2044(DIL),2047(DIL),2050(DIL)
2201(DIL),2202(DIL),2203(DIL),3407(WUC)

....
....
STOCKWATER: Sole Supply: UNEVALUATED ELUs Group Total: 500.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31
==
===

PLACE OF USE for STOCKWATERING*

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===

NORTH-WEST¼ NORTH-EAST¼ SOUTH-WEST¼ SOUTH-EAST¼
NW NE SW SE NW NE SW SE NW NE SW SE NW NE SW SE
Sec 05 T 10N R 5W SLBM * : X: : * * : : : * * : : X: * * : : : *

****
E N D O F D A T A
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2045** APPLICATION/CLAIM NO.: CERT. NO.:

==

OWNERSHIP*

==

NAME: Merlin H. Larsen
ADDR: Promontory Route
Corrine UT 84307

==

DATES, ETC.*

==

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 08/22/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-3]|MAP: [123a]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**---*

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

==

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)***********MAP VIEWER*****************

==

FLOW: SOURCE: Blue creek
COUNTY: Box Elder COMMON DESCRIPTION: Lampo Junction

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at N 660 ft. W 660 ft. from SE corner, Sec 06, T10N, R5W, SLBM,
to a point at N 660 ft. W 660 ft. from SE corner, Sec 18, T10N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==

USES OF WATER RIGHT****** *ELU -- Equivalent Livestock Unit (cow, horse, etc.)* ******** *EDU -- Equivalent Domestic Unit or 1 Family***

==

SUPPLEMENTAL GROUP NO.: 6267. Water Rights Appurtenant to the following use(s):
13-284(UGWC),1955(DIL),1956(DIL),1957(UGWC),1958(UGWC)
1959(UGWC),1960(UGWC),1961(UGWC),1962(UGWC),1963(UGWC)
1964(UGWC),1965(UGWC),1966(UGWC),1967(UGWC),2045(DIL)

....
  STOCKWATER: Sole Supply: UNEVALUATED ELUs   Group Total: 210.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31
==

PLACE OF USE for STOCKWATERING

==

```
                               NORTH-WEST¼       NORTH-EAST¼
SOUTH-WEST¼       SOUTH-EAST¼
                               NW NE SW SE       NW NE SW SE       NW
NE SW SE       NW NE SW SE
Sec 06 T 10N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     *  :
:  :  *     *  :  :  : X*
Sec 18 T 10N R  5W SLBM       *  :  :  :  *     *  :  :  :  *     *  :
:  :  *     *  :  :  : X*
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****
E N D   O F   D A T A
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(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2046** APPLICATION/CLAIM NO.: CERT. NO.:

==

OWNERSHIP

==

NAME: Security Title Company
ADDR: 330 East 4th South
Salt Lake City UT 84111

==

DATES, ETC.

==

LAND OWNED BY APPLICANT? COUNTY TAX ID#:
FILED: |PRIORITY: 00/00/1869|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate: |PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: 11/01/1967|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-3]|MAP: [123d]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**--*

Type of Right: Diligence Claim Source of Info: Proposed Determination Status:

==

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)***********MAP VIEWER******************

==

FLOW: SOURCE: Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Lampo Junction

POINT OF DIVERSION -- POINT TO POINT:
(1)Stockwatering directly on stream from a point at S 660 ft. W 660 ft. from NE corner, Sec 19, T10N, R5W, SLBM,
to a point at N 660 ft. W 660 ft. from SE corner, Sec 19, T10N, R5W, SLBM.
COMMENT: Administratively updated by State Engineer.

==

USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family***

==
==

SUPPLEMENTAL GROUP NO.: 5903. Water Rights Appurtenant to the following use(s):
13-481(DIL),1248(DIL),1250(DIL),1347(DIL),1413(DIL)
1415(DIL),1467(DIL),1860(DIL),1873(DIL),2046(DIL)
2051(DIL)

....
....

STOCKWATER: Sole Supply: UNEVALUATED ELUs Group Total: 100.0000
Div Limit: 2.8 acft. PERIOD OF USE: 01/01 TO 12/31

*==
==
========================*

SUPPLEMENTAL GROUP NO.: 6332. Water Rights Appurtenant to the following use(s):
13-2046(DIL),2048(DIL),2051(DIL)

....
....

STOCKWATER: Sole Supply: UNEVALUATED ELUs Group Total: 300.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31

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PLACE OF USE for STOCKWATERING

==
==

	NORTH-WEST¼	NORTH-EAST¼	SOUTH-WEST¼	SOUTH-EAST¼
	NW NE SW SE	NW NE SW SE	NW NE SW SE	NW NE SW SE
Sec 19 T 10N R 5W SLBM	* : : : *	* : X: : *	* : : : *	* : : : X*

****
****
E N D O F D A T A
****
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-2873** APPLICATION/CLAIM NO.: **A42932** CERT. NO.:
CHANGES: a13790 Water User's Claim (Issued: 05/05/1987)

==

OWNERSHIP*

==

NAME: Stangl B-21 Associates Inc.
ADDR: 90 East 7200 South, Suite 200
Midvale UT 84047
INTEREST: 100% REMARKS:

==

DATES, ETC.*

==

LAND OWNED BY APPLICANT? Yes COUNTY TAX ID#:
FILED: 09/26/1973|PRIORITY: 09/26/1973|PUB BEGAN: |PUB ENDED: |NEWSPAPER:
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE ACTION: [ ]|ActionDate:12/14/1974|PROOF DUE: 01/04/1988
EXTENSION: |ELEC/PROOF:[Election]|ELEC/PROOF:12/04/1985|CERT/WUC: 05/05/1987|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-]|MAP: [123d,c]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**---*

Type of Right: Application to Appropriate Source of Info: Water User's Claim Status: Water User's Claim

==

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)************MAP VIEWER*****************

==

FLOW: 3300.0 acre-feet SOURCE: Unnamed Stream (Blue Creek)
COUNTY: Box Elder COMMON DESCRIPTION: 4 1/2 miles SW of Lampo Jnct.

POINTS OF DIVERSION -- SURFACE:
(1) N 1900 ft E 2650 ft from NW cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(2) S 1900 ft W 730 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:

(3) S 2050 ft W 1250 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(4) S 2200 ft W 2450 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(5) S 2700 ft W 2600 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(6) S 2800 ft W 1400 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(7) S 1850 ft E 2350 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(8) S 2100 ft E 1520 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(9) S 1700 ft W 500 ft from NE cor, Sec 29, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(10)S 1750 ft E 100 ft from NW cor, Sec 29, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(11)S 2150 ft W 500 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(12)S 2800 ft W 480 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(13)N   50 ft E 800 ft from SW cor, Sec 31, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(14)S 800 ft E 450 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(15)S 1000 ft E 2100 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(16)S 1100 ft W 1950 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(17)S 1250 ft W 2250 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(18)S 1600 ft W 1000 ft from NE cor, Sec 36, T 10N, R 6W, SLBM
      Diverting Works:
Source:

Stream Alt Required?: No

==
==

USES OF WATER RIGHT***** ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family***

==
==

SUPPLEMENTAL GROUP NO.: 6642.

13-2873(WUC)

....
....
  STOCKWATER: Sole Supply: UNEVALUATED ELUs   Group Total: 50.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31
....
....
  WILDLIFE: Waterfowl propogation in marshes and ponds
PERIOD OF USE: 01/01 TO 12/31
                Acre Feet Contributed by this Right for this Use:
Unevaluated
A network of earth dikes are used to impound water for wildlife
propagation.
*==
===
=========================*
SUPPLEMENTAL GROUP NO.: 7337. Water Rights Appurtenant to the
following use(s):
13-2873(WUC),3632(APP)

....
....
  IRRIGATION: Sole Supply: UNEVALUATED acres   Group Total: 2900.0
Div Limit: 0.0 acft.   PERIOD OF USE: 04/01 TO 10/31
....
....
  STOCKWATER: Sole Supply: UNEVALUATED ELUs   Group Total: 399.0000
Div Limit: PERIOD OF USE: 01/01 TO 12/31
....
....
  ###PLACE OF USE: *-------NORTH WEST QUARTER------*-------NORTH
EAST QUARTER------*-------SOUTH WEST QUARTER------*-------SOUTH EAST
QUARTER------*   Section
                         * NW | NE | SW | SE   * NW | NE
| SW | SE   * NW | NE | SW | SE   * NW | NE | SW
| SE   *   Totals
 Sec 05 T 9N R 5W SLBM *X |X |X |X   *X |X
|X |X   *X |X |X |X   *X |X |X
|X   *   0.0000
 Sec 19 T 10N R 5W SLBM *X |X |X |X   *X |X
|X |X   *X |X |X |X   *X |X |X
|X   *   0.0000
 Sec 29 T 10N R 5W SLBM *X |X |X |X   *X |X
|X |X   *X |X |X |X   *X |X |X
|X   *   0.0000
 Sec 31 T 10N R 5W SLBM *X |X |X |X   *X |X
|X |X   *X |X |X |X   *X |X |X
|X   *   0.0000

GROUP ACREAGE TOTAL: 0.0000
===
==
PLACE OF USE for
STOCKWATERING*
****
**

==
==
NORTH-WEST¼ NORTH-EAST¼
SOUTH-WEST¼ SOUTH-EAST¼
NW NE SW SE NW NE SW SE NW
NE SW SE NW NE SW SE
Sec 05 T 9N R 5W SLBM * X: X: X: X* * X: X: X: X* * :
X: : X* * X: X: X: X*
Sec 19 T 10N R 5W SLBM * : X: : X* * X: X: X: X* * :
X: : * * X: X: X: X*
Sec 20 T 10N R 5W SLBM * X: X: X: X* * : : : * * X:
X: X: X* * : : : *
Sec 29 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 30 T 10N R 5W SLBM * : : : * * X: X: X: X* * :
: : * * X: X: X: X*
Sec 31 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 32 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 36 T 10N R 5W SLBM * : : : * * : X: : X* * :
: : * * : X: : X*
==
==
Storage from 01/01 to 12/31, inclusive, in Earthen Dikes and Ditches
with a maximum capacity of 3300.000 acre-feet, located in:
Height of Dam: 4 NORTH-WEST¼ NORTH-EAST¼
SOUTH-WEST¼ SOUTH-EAST¼
Area Inundated: 2200.00 NW NE SW SE NW NE SW SE NW
NE SW SE NW NE SW SE

Small Dam Required?: No
****
****
***E N D O F D
A T A**
****
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-3642** APPLICATION/CLAIM NO.: **A69440** CERT. NO.:

==

OWNERSHIP*

==

NAME: Randy Marriott
ADDR: 5238 West 2150 North
      Plain City UT 84404

==

DATES, ETC.*

==

LAND OWNED BY APPLICANT? Yes COUNTY TAX ID#:
FILED: 11/02/1995|PRIORITY: 11/02/1995|PUB BEGAN: 11/22/1995|PUB ENDED: 11/29/1995|NEWSPAPER: The Leader
ProtestEnd:12/19/1995|PROTESTED: [HearHeld]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:06/25/1997|PROOF DUE: 08/31/2002
EXTENSION: |ELEC/PROOF:[Proof]|ELEC/PROOF:09/03/2002|CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-]|MAP: [123d,c]|PUB DATE:

***TYPE -- DOCUMENT -- STATUS**---*

Type of Right: Application to Appropriate Source of Info: Application to Appropriate Status: Approved

==

LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)***********MAP VIEWER*****************

==

FLOW: 20000.0 acre-feet SOURCE: Unnamed Stream (Blue Creek)
COUNTY: Box Elder COMMON DESCRIPTION: 4 1/2 miles SW of Lampo Jnct.

POINTS OF DIVERSION -- SURFACE:
(1) N 1900 ft E 2650 ft from NW cor, Sec 19, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(2) S 1900 ft W 730 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
      Diverting Works:
Source:
(3) S 2050 ft W 1250 ft from NE cor, Sec 19, T 10N, R 5W, SLBM

Diverting Works:
Source:
(4) S 2200 ft W 2450 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(5) S 2700 ft W 2600 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(6) S 2800 ft W 1400 ft from NE cor, Sec 19, T 10N, R 5W, SLBM
Diverting Works:
Source:
(7) S 1850 ft E 2350 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
Diverting Works:
Source:
(8) S 2100 ft E 1520 ft from NW cor, Sec 20, T 10N, R 5W, SLBM
Diverting Works:
Source:
(9) S 1700 ft W 500 ft from NE cor, Sec 29, T 10N, R 5W, SLBM
Diverting Works:
Source:
(10)S 1750 ft E 100 ft from NW cor, Sec 29, T 10N, R 5W, SLBM
Diverting Works:
Source:
(11)S 2150 ft W 500 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
Diverting Works:
Source:
(12)S 2800 ft W 480 ft from NE cor, Sec 30, T 10N, R 5W, SLBM
Diverting Works:
Source:
(13)N 50 ft E 800 ft from SW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(14)S 800 ft E 450 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(15)S 1000 ft E 2100 ft from NW cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(16)S 1100 ft W 1950 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(17)S 1250 ft W 2250 ft from NE cor, Sec 31, T 10N, R 5W, SLBM
Diverting Works:
Source:
(18)S 1600 ft W 1000 ft from NE cor, Sec 36, T 10N, R 6W, SLBM
Diverting Works:
Source:

Stream Alt Required?: No

==

USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.)*** ******** ***EDU -- Equivalent Domestic Unit or 1 Family***

==

SUPPLEMENTAL GROUP NO.: 7345.

....
....
IRRIGATION: 3000.0 acres
Div Limit: 0.0 acft.   PERIOD OF USE: 04/01 TO 10/31
....
....
STOCKWATER: 300.0000 Stock Units
Div Limit: PERIOD OF USE: 01/01 TO 12/31
....
....
WILDLIFE: Waterfowl propogation in marshes and ponds
PERIOD OF USE: 01/01 TO 12/31
Acre Feet Contributed by this Right for this Use:
10991.6
A network of earth dikes are used to impound water for wildlife
propagation.
....
....
###PLACE OF USE: *-------NORTH WEST QUARTER------*-------NORTH
EAST QUARTER------*-------SOUTH WEST QUARTER------*-------SOUTH EAST
QUARTER------*   Section

	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	Totals
Sec 05 T 9N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000
Sec 19 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000
Sec 20 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000
Sec 29 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000
Sec 30 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000
Sec 31 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000
Sec 32 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000
Sec 36 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0.0000

GROUP ACREAGE TOTAL: 0.0000
===
===
PLACE OF USE for
STOCKWATERING*
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===
===

NORTH-WEST¼ NORTH-EAST¼
SOUTH-WEST¼ SOUTH-EAST¼
NW NE SW SE NW NE SW SE NW
NE SW SE NW NE SW SE
Sec 05 T 9N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 19 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 20 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 29 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 30 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 31 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 32 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
Sec 36 T 10N R 5W SLBM * X: X: X: X* * X: X: X: X* * X:
X: X: X* * X: X: X: X*
==
===

Storage from 01/01 to 12/31, inclusive, in Earthen Dikes and Ditches
with a maximum capacity of 3300.000 acre-feet, located in:
Height of Dam: 4 NORTH-WEST¼ NORTH-EAST¼
SOUTH-WEST¼ SOUTH-EAST¼
Area Inundated: 2200.00 NW NE SW SE NW NE SW SE NW
NE SW SE NW NE SW SE

Small Dam Required?: No

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===

OTHER
COMMENTS*
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The applicant has a prior application 13-2873 to fill marsh
habitat. This
water right is being filed to create year-round waterfowl habitat
and will be
diverted as needed to keep water levels constant in existing ponds
through
each year.

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===

PROTESTANTS*
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NAME: Blue Creek Irrigation Company
NAME: Stangl B-21 Inc.
ADDR: c/o Ray D. Sorensen, President
ADDR: c/o F.C. Stangl III, President
Box 67
1515 West 2200 South, Suite B-2

      Howell UT 84316
Salt Lake City UT 84119
==
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****
****
***E N D   O F   D
A T A***
****
****

(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010

WATER RIGHT: **13-3810** APPLICATION/CLAIM NO.: **A75052** CERT. NO.:

==

OWNERSHIP*

==

NAME: Stangl B-21 Associates Inc.
ADDR: 90 East 7200 South, Suite 200
Salt Lake City UT 84047

==

DATES, ETC.

==

LAND OWNED BY APPLICANT? Yes COUNTY TAX ID#:
FILED: 08/04/2003|PRIORITY: 08/04/2003|PUB BEGAN: 08/20/2003|PUB ENDED: 08/27/2003|NEWSPAPER: The Leader
ProtestEnd:09/16/2003|PROTESTED: [No Hear]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:03/17/2004|PROOF DUE: 03/31/2013
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF: |CERT/WUC: |LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE: [ ]
PD BOOK: [13-]|MAP: [ ]|PUB DATE:

TYPE -- DOCUMENT -- STATUS---

Type of Right: Application to Appropriate Source of Info: Application to Appropriate Status: Approved

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LOCATION OF WATER RIGHT*(Points of Diversion: Click on Location to access PLAT Program.)***********MAP VIEWER*****************

==

FLOW: 2.5 cfs SOURCE: Shotgun Springs & Blue Creek
COUNTY: Box Elder COMMON DESCRIPTION: Lampo Junction

POINT OF DIVERSION -- SURFACE:
(1) N 634 ft W 1050 ft from SE cor, Sec 07, T 10N, R 5W, SLBM
Diverting Works:
Source: Blue Creek

Stream Alt Required?: No

POINT OF SPRING:
(1) N 2307 ft W 312 ft from S4 cor, Sec 09, T 10N, R 5W, SLBM

Diverting Works:
Source: Shotgun Springs

==
==

USES OF WATER RIGHT******** ***ELU -- Equivalent Livestock Unit (cow, horse, etc.) ******** EDU -- Equivalent Domestic Unit or 1 Family***

==
==

SUPPLEMENTAL GROUP NO.: 7526.

....
....

WILDLIFE:
PERIOD OF USE: 09/01 TO 10/30
Acre Feet Contributed by this Right for this Use: 1809.94995

....
....

OTHER:
PERIOD OF USE: 03/01 TO 04/30
Acre Feet Contributed by this Right for this Use: 1809.94995
Wetland

==
==

PLACE OF USE for STOCKWATERING

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	NORTH-WEST¼				NORTH-EAST¼				SOUTH-WEST¼				SOUTH-EAST¼			
	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE
Sec 09 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sec 16 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sec 20 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sec 21 T 10N R 5W SLBM	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

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==

OTHER COMMENTS

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The applicant proposes to construct 35 small retention ponds to enhance vegetative growth.

==
==

PROTESTANTS

==
==

NAME: Connor Cattle Company
NAME:
ADDR: c/o Clair Holmgren
ADDR:
      13599 West Hwy 102
      Tremonton UT 84337
==
==
==
==

APPLICATIONS FOR EXTENSIONS OF TIME WITHIN WHICH TO SUBMIT PROOF*

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FILED: 03/15/2007|PUB BEGAN: |PUB ENDED:
|NEWSPAPER: No Adv Required
ProtestEnd: |PROTESTED: [No]|HEARNG HLD: |SE
ACTION: [Approved]|ActionDate:03/26/2007|PROOF DUE: 03/31/2010
==
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FILED: 03/31/2010|PUB BEGAN: |PUB ENDED:
|NEWSPAPER: No Adv Required
ProtestEnd: |PROTESTED: [ ]|HEARNG HLD: |SE
ACTION: [Approved]|ActionDate:04/29/2010|PROOF DUE: 03/31/2013
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****
***E N D O F D
A T A***
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(WARNING: Water Rights makes NO claims as to the accuracy of this data.) RUN DATE: 08/24/2010 Page 1

CHANGE: **a13790** WATER RIGHT: 13-2873 CERT. NO.:
COUNTY TAX ID#: AMENDATORY? Yes
BASE WATER RIGHTS: 13-2873
RIGHT EVIDENCED BY: A42932
CHANGES: Point of Diversion [X], Place of Use [X], Nature of Use [X], Reservoir Storage [X].

NAME: Stangle B-21 Associates Inc.
ADDR: 90 East 7200 South, Suite 200
Midvale UT 84047
INTEREST: 100% REMARKS:

FILED: 12/26/1986|PRIORITY: 12/26/1986|ADV BEGAN: 01/14/1987|ADV ENDED: |NEWSPAPER: The Leader
ProtestEnd:02/27/1987|PROTESTED: [Yes]|HEARNG HLD: |SE ACTION: [Approved]|ActionDate:04/17/1987|PROOF DUE:
EXTENSION: |ELEC/PROOF:[ ]|ELEC/PROOF:
|CERT/WUC: 05/05/1987|LAP, ETC: |LAPS LETTER:
RUSH LETTR: |RENOVATE: |RECON REQ: |TYPE:
[ ]
Status: Water User's Claim

*************************H E R E T O F O R E*************************
*************************H E R E A F T E R*************************

|FLOW: 76.0 cfs
||FLOW: 3300.0 acre-feet |

|SOURCE: Unnamed Springs & Streams (Blue Cr.)
||SOURCE: Unnamed Streams (Blue Creek) |

|COUNTY: Box Elder
||COUNTY: Box Elder COM DESC: 4-1/2 mi SW Lampo Junction |

| ||
A network of earth dikes is used to |
| ||
impound water for wildlife propagation. |

|POINT(S) OF DIVERSION ------> MAP VIEWER
||CHANGED AS FOLLOWS: (Click Location link for WRPLAT) |

```
|-----------------------------------------------------------------||----
------------------------------------------------------------|
|Point Surface:
||Point Surface:                                                   |
|(1)  N 2400 ft E    5 ft from SW cor, Sec 05, T  9N, R  5W, SLBM||(1)
S 1900 ft W  730 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(2)  N 1850 ft E    5 ft from SW cor, Sec 05, T  9N, R  5W, SLBM||(2)
S 2050 ft W 1250 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(3)  N  200 ft E 4500 ft from SW cor, Sec 17, T 10N, R  5W, SLBM||(3)
S 2800 ft W 1400 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(4)  N  300 ft E 5050 ft from SW cor, Sec 17, T 10N, R  5W, SLBM||(4)
S 2200 ft W 2450 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(5)  S  100 ft E    5 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(5)
S 2700 ft W 2600 ft from NE cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(6)  S 3150 ft E    5 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(6)
N 1900 ft E 2650 ft from SW cor, Sec 19, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(7)  S 4830 ft E    5 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(7)
S 1850 ft E 2350 ft from NW cor, Sec 20, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(8)  S    5 ft E 1450 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(8)
S 2100 ft E 1520 ft from NW cor, Sec 20, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                     ||
Dvrting Wks:                                                     |
| Source:                                                          ||
Source:                                                          |
|(9)  S    5 ft E  300 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(9)
S 1750 ft E  100 ft from NW cor, Sec 29, T 10N, R  5W, SLBM|
```

```
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(10) S    5 ft E 4125 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(10)
S 1700 ft W  500 ft from NE cor, Sec 29, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(11) S    5 ft E 4810 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(11)
S 2150 ft W  500 ft from NE cor, Sec 30, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(12) S    5 ft E 2250 ft from NW cor, Sec 19, T 10N, R  5W, SLBM||(12)
S 2800 ft W  480 ft from NE cor, Sec 30, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(13) S    5 ft E 1180 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(13)
S 1100 ft W 1950 ft from NE cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(14) S    5 ft E 1725 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(14)
S 1250 ft W 2250 ft from NE cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(15) S    5 ft E 1700 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(15)
S 1000 ft E 2100 ft from NW cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(16) S    5 ft E 3050 ft from NW cor, Sec 20, T 10N, R  5W, SLBM||(16)
S  800 ft E  450 ft from NW cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(17) N 2080 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||(17)
N   50 ft E  800 ft from SW cor, Sec 31, T 10N, R  5W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
| Source:                                                         ||
Source:                                                         |
|(18) N 2780 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||(18)
S 1600 ft W 1000 ft from NE cor, Sec 36, T 10N, R  6W, SLBM|
| Dvrting Wks:                                                    ||
Dvrting Wks:                                                    |
```

```
| Source:                                                         ||
Source:                                                         |
|(19) N 3300 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|(20) N 3700 ft E    5 ft from SW cor, Sec 29, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|(21) N 4550 ft E 2325 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|(22) N    5 ft E  100 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|(23) N 4180 ft E  350 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|(24) N 1880 ft E    5 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|(25) N 3490 ft E    5 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|(26) N 4750 ft E 3300 ft from SW cor, Sec 31, T 10N, R  5W, SLBM||
| Dvrting Wks:                                                    ||
|
| Source:                                                         ||
|
|                                                                 ||
|
|
||Stream Alt?: No                                                  |
|-----------------------------------------------------------------||----
-------------------------------------------------------------|
```

|PLACE OF USE ------>
||CHANGED as follows: |

```
|-----------------------------------------------------------------||----
-------------------------------------------------------------|
```

```
|                             --NW¼--  --NE¼--  --SW¼--  --SE¼-- ||
--NW¼--  --NE¼--  --SW¼--  --SE¼-- |
|                            |N N S S||N N S S||N N S S||N N S S|||
|N N S S||N N S S||N N S S||N N S S||
|                            |W E W E||W E W E||W E W E||W E W E|||
|W E W E||W E W E||W E W E||W E W E||
|Sec 05 T  9N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
05 T  9N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X: :X**X:X:X:X*|
|Sec 19 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
19 T 10N R  5W SLBM     * :X: :X**X:X:X:X** :X: :X**X:X:X:X*|
|Sec 20 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
20 T 10N R  5W SLBM     *X:X:X:X** : : : **X:X:X:X** : : : *|
|Sec 29 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
29 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
|Sec 31 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*||Sec
30 T 10N R  5W SLBM     * : : : **X:X:X:X** : : : **X:X:X:X*|
|                                                                ||Sec
31 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
|                                                                ||Sec
32 T 10N R  5W SLBM     *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
|                                                                ||Sec
36 T 10N R  6W SLBM     * : : : ** :X: :X** : : : ** :X: :X*|
 ________________________________________________________________
________________________________________________________________
 ________________________________________________________________
________________________________________________________________
|NATURE OF USE ------>
||CHANGED as follows:                                            |
|----------------------------------------------------------------||----
------------------------------------------------------------|
|IRR  = values are in acres.                                     ||
|
|STK  = values are in ELUs meaning Cattle or Equivalent.         ||
|
|DOM  = values are in EDUs meaning Equivalent Domestic Units (F  ||
|
|----------------------------------------------------------------||----
------------------------------------------------------------|
|SUPPLEMENTAL to Other Water Rights: No
||SUPPLEMENTAL to Other Water Rights: No                         |
|----------------------------------------------------------------||----
------------------------------------------------------------|
|IRR:   3184.0000 acres.                      USED 04/01 - 10/31||
|
|................................................................||....
............................................................|
|................................................................||....
............................................................|
|STK:   1000.0000 Cattle or Equivalent        USED 01/01 - 12/31||STK:
50.0000 Cattle or Equivalent        USED 01/01 - 12/31|
|................................................................||....
............................................................|
|................................................................||....
............................................................|
|OTH: WILDLIFE:         Waterfowl propogation  USED 01/01 - 12/31||OTH:
OTHER:             Waterfowl Propagation  USED 01/01 - 12/31|
```

| in marshes and ponds ||
|
|---||----
---|

|RESERVOIR STORAGE -->
||CHANGED as follows: |
|---||----
---|
|
||Storage 01/01 to 12/31, in Earthen Dikes and Ditches |
| ||
with a maximum capacity of 3300.000 acre-feet, located in: |
| ||
--NW¼-- --NE¼-- --SW¼-- --SE¼-- |
| ||
Height of Dam: 4 ft |N N S S||N N S S||N N S S||N N S S||
| ||
Area Inundat 2200.000 acs|W E W E||W E W E||W E W E||W E W E||
| ||Sec
05 T 9N R 5W SLBM   *X:X:X:X**X:X:X:X**X:X: :X**X:X:X:X*|
| ||Sec
19 T 10N R 5W SLBM   * :X: :X**X:X:X:X** :X: :X**X:X:X:X*|
| ||Sec
20 T 10N R 5W SLBM   *X:X:X:X** : : : **X:X:X:X** : : : *|
| ||Sec
29 T 10N R 5W SLBM   *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
| ||Sec
30 T 10N R 5W SLBM   * : : : **X:X:X:X** : : : **X:X:X:X*|
| ||Sec
31 T 10N R 5W SLBM   *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
| ||Sec
32 T 10N R 5W SLBM   *X:X:X:X**X:X:X:X**X:X:X:X**X:X:X:X*|
| ||Sec
36 T 10N R 6W SLBM   * : : : ** :X: :X** : : : ** :X: :X*|
|---||----
---|
|---||----
---|
|
||Small Dam Permit Required?: No |

****
****
***E N D O F D
A T A***
****
****

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ProUCL Version 5.0.00 Technical Guide

Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations

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CHAPTER 3

Computing Upper Limits to Estimate Background Threshold Values Based Upon Uncensored Data Sets without Nondetect Observations

3.1 Introduction

In background evaluation studies, site-specific (e.g., soils, groundwater) background level constituent concentrations are needed to compare site concentrations with background level concentrations also known as background threshold values (BTVs). The BTVs are estimated, based upon sampled data collected from reference areas and/or unimpacted site-specific background areas (e.g., upgradient wells) as determined by the project team. The first step in establishing site-specific background level constituent concentrations is to collect an appropriate number of samples from the designated background or reference areas. The Stats/Sample Sizes module of ProUCL software can be used to compute DQOs based sample sizes. Once an adequate amount of data has been collected, the next step is to determine the data distribution. This is typically done using exploratory graphical tools (e.g., quantile-quantile [Q-Q] plot) and formal goodness-of-fit (GOF) tests. Depending upon the data distribution, one uses parametric or nonparametric methods to estimate BTVs. An onsite observation in exceedance of a BTV may be considered as not coming from the background population; such a site observation may be considered as exhibiting some evidence of contamination due to site-related activities. Sometimes, locations exhibiting concentrations higher than a BTV estimate are re-sampled to verify the possibility of contamination. Onsite values less than BTVs potentially represent unimpacted locations and are considered coming from the background (or comparable to the background) population. This approach, comparing individual site or groundwater monitoring well (MW) observations with BTVs, is particularly helpful to: 1) identify and screen constituents/contaminants of concern (COCs); and 2) use after some remediation activities (e.g., installation of a GW treatment plant) have already taken place and the objective is to determine if the remediated areas have been remediated close enough to the background level constituent concentrations.

BTV estimation methods described in this chapter are useful when not enough site data are available to perform hypotheses tests such as the two-sample t-test or the nonparametric Wilcoxon Rank Sum (WRS) test. When enough (e.g., more than 8 to10 observations) site data are available, one may use hypotheses testing approaches to compare onsite and background data or onsite data with some pre-established threshold or screening values. The single-sample hypothesis tests (e.g., t-test, WRS test, proportion test) are used when screening levels or BTVs are known or pre-established. The two-sample hypotheses tests are used when enough data (e.g., at least 8-10 observations from each population) are available from background (e.g., upgradient wells) as well as site (e.g., monitoring wells) areas. This chapter describes statistical limits that may be used to estimate the BTVs for full uncensored data sets without any nondetect (ND) observations. Statistical limits for data sets consisting of NDs are discussed in Chapter 5.

It is implicitly assumed that the background data set used to estimate BTVs represents a single statistical population. However, since outliers (well-separated from the main dominant data) are inevitable in most environmental applications, some outliers such as the observations coming from populations other than the background population may also be present in a background data set. Outliers, when present, distort decision statistics of interest (e.g., upper prediction limits [UPLs], upper tolerance limits [UTLs]), which in turn may lead to incorrect remediation decisions that may not be cost-effective or protective of human health and the environment. The BTVs should be estimated by statistics representing the dominant background population represented by the majority of the data set. *Upper limits computed by including a few low probability high outliers (e.g., coming from the far tails of data distribution) tend to represent locations with those elevated concentrations rather than representing the main dominant background population.* It is suggested to compute all relevant statistics using data sets with outliers and without outliers, and compare the results. This extra step often helps the project team to see the potential influence of outlier(s) on the various decision making statistics (e.g., upper confidence limits [UCLs], UPLs, UTLs), and to make informative decisions about the disposition of outliers. That is, the project team and experts familiar with the site should decide which of the computed statistics (with outliers or without outliers) represent more accurate estimate(s) of the population parameters (e.g., mean, exposure point concentration [EPC], BTV) under consideration. Since the treatment and handling of outliers in environmental applications is a subjective and controversial topic, it is also suggested that the outliers be treated on a site-specific basis using all existing knowledge about the site and reference areas under investigation. A couple of classical outlier tests, incorporated in ProUCL, are described in Chapter 7.

<u>Extracting a Site-Specific Background Data Set From a Broader Mixture Data Set:</u> In practice, not many background samples are collected due to resource constraints and difficulties in identifying suitable background areas with anthropogenic activities and natural geological characteristics comparable to onsite areas (e.g., at large Federal Facilities). Under these conditions, due to confounding of site related chemical releases with anthropogenic influences and natural geological variability, it becomes challenging to: 1) identify background/reference areas with comparable anthropogenic activities and geological conditions/formations; and 2) collect adequate amount of data needed to perform meaningful and defensible site versus background comparisons for each geological stratum to determine chemical releases only due to the site related operations and releases. Moreover, a large number of background samples (not impacted by site related chemical releases) may need to be collected representing the various soil types and anthropogenic activities present at the site; which may not be feasible due to several reasons including resource constraints and difficulties in identifying background areas with anthropogenic activities and natural geological characteristics comparable to onsite areas. The lack of sufficient amount of background data makes it difficult to perform defensible background versus site comparisons and computing reliable estimates of BTVs. A small background data set may not adequately represent the background population; and due to uncertainty and larger variability, the use of a small data set tends to yield non-representative estimates of BTVs.

Under these complex conditions present at a site, and using the known fact that that within all environmental site samples (data sets) exist both background level concentrations and concentrations indicative of site-related releases, sometimes it is desirable to extract a site-specific background data set from a mixture data set consisting of all available onsite and offsite concentrations. Several researchers (e.g., Sinclair [1976], Holgresson and Jorner [1978], Fleischhauer and Korte [1990]) have used normal Q-Q plots/probability plots methods to delineate multiple populations potentially present in a mixture data set collected from environmental, geological and mineral exploration studies.

Therefore, when not enough observations are available from reference areas with geological and anthropogenic influences comparable to onsite areas, the project team may want to use population partitioning methods (e.g., Singh, Singh, and Flatman [1994], Fleischhauer and Korte [1990]) on a broader mixture data set to extract a site-specific background data set with geological conditions and anthropogenic influences comparable to those of the various onsite areas. The extraction of a site-specific background data set from a mixture data set is useful when not enough background data are available to properly represent the background of larger sites (e.g., Federal Facilities covering hundreds of acres of land) consisting of areas with varying geological formations and soil types where it becomes necessary to establish site-specific background.

The topics of population partitioning and the extraction of a site-specific background data set from a mixture data set are beyond the scope of ProUCL software and this technical guidance document. It requires developing a separate chapter describing the iterative population partitioning method including the identification and extraction of a defensible background data set from a mixture data set consisting of all available data collected from background areas (if available), and unimpacted and impacted onsite locations. Currently, work is in progress to develop a background issue paper describing population methods to extract a site-specific background data set from a mixture data set consisting of concentrations from the various onsite areas and offsite areas (if available).

A review of the environmental literature reveals that one or more of the following statistical upper limits are used to estimate BTVs:

- Upper percentiles
- Upper prediction limits (UPLs)
- Upper tolerance limits (UTLs)
- Upper Simultaneous Limits (USLs) – New in ProUCL 5.0

It is noted that the differences between the various limits used to estimate BTVs are not clear to many practitioners. Therefore, a detailed discussion about the use of the various limits with their interpretation is provided in the following sections. Since 0.95 is the commonly used confidence coefficient (CC), these limits are described for a CC of 0.95 and coverage probability of 0.95 associated with a UTL. ProUCL can compute these limits for any valid combination of CC and coverage probabilities including some commonly used values of CC levels (e.g., 0.80, 0.90, 0.95, 0.99) and coverage probabilities (e.g., 0.80, 0.90, 0.95, 0.975).

Caution: To provide a proper balance between false positives and false negatives, the upper limits described above, especially a 95% USL (USL95) should be used only when the background data set represents a single environmental population without outliers (observations not belonging to background). Inclusion of multiple populations and/or outliers tends to yield elevated values of USLs (and also of UPLs and UTLs) which can result in a high number (and not necessarily high percentage) of undesirable false negatives, especially for data sets of larger sizes (e.g., $n > 30$).

Note on Computing Lower Limits: In many environmental applications (e.g., groundwater monitoring), one needs to compute lower limits including: lower prediction limits (LPLs), lower tolerance limits (LTLs), or lower simultaneous limit (LSLs). At present, ProUCL does not directly compute a LPL, LTL, or a LSL. It should be noted that for data sets with and without nondetects, ProUCL outputs the several intermediate results and critical values (e.g., khat, nuhat, K, d2max) needed to compute the interval estimates and lower limits. For data sets with and without nondetects, except for the bootstrap methods, the same critical value (e.g., normal z value, Chebyshev critical value, or t-critical value) can be used to compute a parametric LPL, LSL, or a LTL (for samples of size >30 to be able to use Natrella's approximation in LTL) as used in the computation of a UPL, USL, or a UTL (for samples of size >30). Specifically, to compute a LPL, LSL, and LTL (n>30) the '+' sign used in the computation of the corresponding UPL, USL, and UTL (n>30) needs to be replaced by the '-' sign in the equations used to compute UPL, USL, and UTL (n>30). For specific details, the user may want to consult a statistician. For data sets *without nondetect* observations, the user may want to use the Scout 2008 software package (EPA 2009c) to compute the various parametric and nonparametric LPLs, LTLs (all sample sizes), and LSLs.

3.1.1 Description and Interpretation of Upper Limits used to Estimate BTVs

Based upon a background data set, upper limits such as a 95% upper confidence limit of the 95^{th} percentile (UTL95-95) are used to estimate upper threshold value(s) of the background population. It is expected that observations coming from the background population will lie below that BTV estimate with a specified CC. BTVs should be estimated based upon an "established" data set representing the background population under consideration.

Established background data set: represents background conditions free of outliers which potentially represent locations impacted by the site and/or other activities. An established background data set should be representative of a single environmental background population. This can be determined by using a normal Q-Q plot on a background data set. If there are no jumps and breaks in the normal Q-Q plot, the data set may be considered to represent a single environmental population. Outliers when present in a data set result in inflated values of the various decision statistics including: UPL, UTL, and USL. The use of inflated statistics as BTV estimates tends to result in a higher number of false negatives.

Notes: The user specifies the allowable false positive error rate, α (=1-CC), and the false negative error rate (declaring a location clean when in fact it is contaminated) is controlled by making sure that one is dealing with a defensible/established background data set representing a single background population and the data set is free of outliers.

Let x_1, x_2, x_n represent sampled concentrations of an established background data set collected from some site-specific or general background reference area.

Upper Percentile, $x_{0.95}$: Based upon an established background data set, a 95^{th} percentile represents that statistic such that 95% of the sampled data will be less than or equal to ($\leq$) $x_{0.95}$. It is expected that an observation coming from the background population (or comparable to the background population) will be $\leq x_{0.95}$ with probability 0.95.

Upper Prediction Limit (UPL): Based upon an established background data set, a 95% UPL (UPL95) represents that statistic such that an independently collected new/future observation from the target population (e.g., background, comparable to background) will be less than or equal to the UPL95 with CC of 0.95. We are 95% sure that a *single future value* from the background population will be less than the UPL95 with CC= 0.95. A parametric UPL takes data variability into account.

In practice, many onsite observations are compared with a BTV estimate. It is noted that the use of a UPL95 to compare many observations may result in a higher number of false positives; that is the use of a UPL95 to compare many observations just by chance tends to incorrectly classify observations coming from the background or comparable to background population as coming from the impacted site locations. For example, if many (e.g., 30) independent onsite comparisons (e.g., Ra-226 activity from 10 onsite locations) are made with the same UPL95, each onsite value may exceed that UPL95 with a probability of 0.05 just by chance. The overall probability, α_{actual} of at least one of those 30 comparisons being significant (exceeding BTV) just by chance is given by:

$\alpha_{actual} = 1\text{-}(1\text{-}\alpha)^k = 1 - 0.95^{30} \sim 1\text{-}0.21 = 0.79$ (false positive rate).

This means that the probability (overall false positive rate) is 0.79 (and is not equal to 0.05) that at least one of the 30 onsite locations will be considered contaminated even when they are comparable to background. The use of a UPL95 is not recommended when multiple comparisons are to be made.

Upper Tolerance Limit (UTL): Based upon an established background data set, a UTL95-95 represents that statistic such that 95% observations (current and future) from the target population (background, comparable to background) will be less than or equal to the UTL95-95 with CC of 0.95. A UTL95-95 represents a 95% UCL of the 95th percentile of the data distribution (population). A UTL95-95 is designed to simultaneously provide coverage for 95% of all potential observations (current and future) from the background population (or comparable to background) with a CC of 0.95. A UTL95-95 can be used when many (unknown) current or future onsite observations need to be compared with a BTV. A parametric UTL95-95 takes the data variability into account.

By definition a UTL95-95 computed based upon a background data set just by chance can classify 5% of background observations as not coming from the background population with CC 0.95. This percentage (false positive error rate) stays the same irrespective of the number of comparisons that will be made with a UTL95-95. However, when a large number of observations coming from the target population (background, comparable to background) are compared with a UTL95-95, the number of exceedances (not the percentage of exceedances) of UTL95-95 by background observations can be quite large. This implies that a larger number (but not greater than 5%) of onsite locations comparable to background may be falsely declared as requiring additional investigation which may not be cost-effective.

To avoid this situation, it is suggested to use a USL95 to estimate the BTV provided the background data set represents a single population free of outliers.

Upper Simultaneous Limit (USL): Based upon an established background data set free of outiers and representing a single statistical population, a USL95 represents that statistic such that *all* observations from the "established" background data set are less than or equal to the USL95 with a CC of 0.95. A parametric USL takes the data variability into account. It is expected that all current or future observations coming from the background population (comparable to background population, unimpacted site locations) will be less than or equal to the USL95 with CC, 0.95 (Singh and Nocerino, 2002). The use of a USL as a BTV estimate is suggested when a large number of onsite observations (current or future) need to be compared with a BTV.

It is noted that by definition, USL95 does not discard any observation. The false positive error rate does not change with the number of comparisons, as the USL95 is designed to perform many comparisons simultaneously. Furthermore, the USL95 also has a built in outlier test (Wilks, 1963), and if an observation (current or future) exceeds USL95, then that value definitely represents an outlier and may not come from the background population. The false negative error rate is controlled by making sure that the background data set represents a single background population free of outliers. Typically, the use of a USL95 tends to result in a smaller number of false positives than a UTL95-95, especially when the size of the background data set is greater than 15.

3.1.2 Confidence Coefficient (CC) and Sample Size

This section briefly discusses sample sizes and the selection of CCs associated with various upper limits used to estimate BTVs.

- Higher statistical limits are associated with higher levels of CCs. For an example, a 95% UPL is higher than a 90% UPL.

- Higher values of a CC (e.g., 99%) tend to decrease the power of a test, resulting in a higher number of false negatives- dismissing contamination when present.

Therefore, the CC should not be set higher than necessary.

- Smaller values of the CC (e.g., 0.80) tend to result in a higher number of false positives (e.g., declaring contamination when it is not present).

- In most practical applications, choice of a 95% CC provides a good compromise between confidence and power.

- Higher level of uncertainty in a background data set (e.g., due to a smaller background data set) and higher values of critical values associated with smaller (e.g., <15-20) samples tend to dismiss contamination as representing background conditions (results in higher number of false negatives, i.e., identifying a location that may be dirty as background). This is especially true when one uses UTLs and UPLs to estimate BTVs.

- Nonparametric upper limits based upon order statistics (e.g., the largest, the second largest,…) may not provide the desired coverage as they do not take data variability into account. Nonparametric methods are less powerful than the parametric methods; and they require larger data sets to achieve power comparable to parametric methods.

3.2 Treatment of Outliers

The inclusion of outliers in a background data set tends to yield distorted (inflated) estimates of BTVs. Outlying observations which are significanly higher than the majority of the background data may not be used in establishing background data sets and in the computation of BTV estimates. A couple of classical outlier tests cited in environmental literature (EPA, 2006b, Navy, [2002a, 2002b]) are available in the ProUCL software. It is noted that the classical outlier procedures suffer from masking effects as they get distorted by the same outlying observations that they are supposed to find! It is therefore recommended to supplement outlier tests with graphical displays such as box plots, Q-Q plots. On a Q-Q plot, elevated observations which are well-separated from the majority of data represent potential outliers.

It is noted that nonparametric upper percentiles, UPLs, and UTLs are often represented by higher order statistics such as the largest value or the second largest value. When high outlying observations are present in a background data set, the higher order statistics may represent observations coming from the contaminated onsite/offsite areas. Decisions made based upon outlying observations or distorted upper limits can be incorrect and misleading. Therefore, special attention should be given to outlying observations. The project team and the decision makers involved should decide about the proper disposition of outliers, to include or not include them, in the computation of the various decision making statistics such as the UCL95 and the UTL95-95. Sometimes, performing statistical analyses twice on the same data set – once using the data set with outliers and once using the data set without outliers can help the project team in determining the proper disposition of high outliers. Some examples elaborating on these issues have been discussed in this document.

Notes: It should be pointed out that methods incorporated in ProUCL can be used on any data set with or without nondetects and with or without outliers. It may not be misinterpreted that ProUCL 5.0 is restricted and can only be used on data sets without outliers. It is not a requirement to exclude outliers before using any of the statistical methods incorporated in ProUCL. The intent of the developers of ProUCL software is to inform the users how the inclusion of a few outliers coming from the *low probability tails of the data distribution* can yield distorted values of UCL95, UPLs, UTLs, and various other statistics. The decision limits and test statistics should be computed based upon the majority of data representing the main dominant population and not by accommodating a few low probability outliers resulting in distorted and inflated values of the decision statistics. The inflated decision statistics tend to represent the locations with those elevated observations rather than representing the main dominant population. The outlying observations may be separately investigated to determine the reasons for their occurrences (e.g., errors or contaminated locations). It is suggested to compute the statistics with and without the outliers, and compare the potential impact of outliers on the decision making processes.

Let $x_1, x_2, \ldots, x_n$ represent concentrations of a contaminant/constituent of concern (COC) collected from some site-specific or general background reference area. The data are arranged in ascending order and the ordered sample (called ordered statistics) is denoted by $x_{(1)} \le x_{(2)} \le \ldots \le x_{(n)}$. The ordered statistics are used as nonparametric estimates of upper percentiles, UPLs, UTLs and USLs. Also, let $y_i = \ln(x_i)$; $i = 1, 2, \ldots, n$, and $\bar{y}$ and s_y represent the mean and standard deviation (*sd*) of the log-transformed data. Statistical details of some parametric and nonparametric upper limits used to estimate BTVs are described in the following sections.

3.3 Upper p*100% Percentiles as Estimates of BTVs

In most statistical textbooks (e.g., Hogg and Craig, 1995), the p^{th} (e.g., $p = 0.95$) sample percentile of the measured sample values is defined as that value, $\hat{x}_p$, such that p*100% of the sampled data set lies at or below it. The carat sign over x_p, indicates that it represents a statistic/estimate computed using the sampled data. The same use of the carat sign is found throughout this guidance document. The statistic $\hat{x}_p$ represents an estimate of the p^{th} population percentile. It is expected that about p*100% of the population values will lie below the p^{th} percentile. Specifically, $x_{0.95}$ represents an estimate of the of the 95th percentile of the background population.

*3.3.1 Nonparametric p*100% Percentile*

Nonparametric 95% percentiles are used when the background data (raw or transformed) do not follow a discernible distribution at some specified (e.g., $\alpha = 0.05, 0.1$) level of significance. It is noted that different software packages (e.g., SAS, Minitab, and Microsoft Excel) use different formulae to compute nonparametric percentiles, and therefore yield slightly different estimates of population percentiles, especially when the sample size is small such as less than 20-30. Specifically, some software packages estimate the p^{th} percentile by using the $p*n^{th}$ order statistic, which may be a whole number between 1 and n or a fraction lying between 1 and n, while other software packages compute the p^{th} percentile by the $p*(n+1)^{th}$ order statistic (e.g., used in ProUCL versions 4.00.02 and 4.00.04) or by the $(pn+0.5)^{th}$ order statistic. For example, if $n = 20$, and $p = 0.95$, then 20*0.95 = 19, thus the 19th ordered statistic represents the 95th percentile. If $n = 17$, and $p = 0.95$, then 17*0.95= 16.15, thus the 16.15th ordered value represents the 95th percentile. The 16.15th ordered value lies between the 16th and the 17th order statistics and can be computed by using a simple linear interpolation given by:

$$x_{(16.15)} = x_{(16)} + 0.15\,(x_{(17)} - x_{(16)}). \qquad (3\text{-}1)$$

It should be noted that the earlier versions (e.g., ProUCL 4.00.02, 4.00.04) of ProUCL used $p*(n+1)^{th}$ order statistic to estimate the nonparametric p^{th} percentile. However, since most users are familiar with Excel and some consultants have developed statistical software packages using Excel, at the request of some users, it was decided to use the same algorithm as incorporated in Excel to compute nonparametric percentiles. ProUCL 4.1 and higher versions compute nonparametric percentiles using the same algorithm as used in Excel 2007. This algorithm is used on data sets with and without ND observations.

Notes: From a practical point of view, nonparametric percentiles computed using the various percentile computation methods described in the literature are comparable unless the data set is small (e.g., n <20-30) and/or comes from a mixed population consisting of some extreme high values. No single percentile computation method should be considered superior to other percentile computation methods available in the statistical literature. In addition to nonparametric percentiles, ProUCL also computes several parametric percentiles described as follows.

3.3.2 Normal p*100% Percentile

The sample mean, $\bar{x}$. and sd, s, are computed first. For normally distributed data sets, the p*100th sample percentile is given by the following statement:

$$\hat{x}_p = \bar{x} + s z_p \tag{3-2}$$

Here z_p is the p*100th percentile of a standard normal, N(0, 1), distribution, which means that the area (under the standard normal curve) to the left of z_p is p. If the distributions of the site and background data are comparable, then it is expected that an observation coming from a population (e.g., site) comparable to the background population would lie at or below the p*100% upper percentile, $\hat{x}_p$, with probability p.

3.3.3 Lognormal p*100% Percentile

To compute the p^{th} percentile, $\hat{x}_p$, of a lognormally distributed data set, the sample mean, $\bar{y}$, and sd, s_y, of log-transformed data, y are computed first. For lognormally distributed data sets, the p*100th percentile is given by the following statement:

$$\hat{x}_p = \exp(\bar{y} + s_y z_p), \tag{3-3}$$

z_p is the p*100th percentile of a standard normal, N(0,1), distribution.

3.3.4 Gamma p*100% Percentile

Since the introduction of a gamma distribution, G (k, θ), is relatively new in environmental applications, a brief description of the gamma distribution is given first; more details can be found in Section 2.3.3. The maximum likelihood estimator (MLE) equations to estimate gamma parameters, k (shape parameter) and θ (scale parameter), can be found in Singh, Singh, and Iaci (2002). A random variable (RV), X (arsenic concentrations), follows a gamma distribution, G(k,θ), with parameters $k > 0$ and $\theta > 0$, if its probability density function is given by the following equation:

$$\begin{aligned} f(x;k,\theta) &= \frac{1}{\theta^k \Gamma(k)} x^{k-1} e^{-x/\theta}; \qquad && x > 0 \\ &= 0; && otherwise \end{aligned} \tag{3-4}$$

The mean, variance, and skewness of a gamma distribution are: $\mu = k\theta$, variance $= \sigma^2 = k\theta^2$, and skewness $= 2/\sqrt{k}$. Note that as k increases, the skewness decreases, and, consequently, a gamma distribution starts approaching a normal distribution for larger values of k (e.g., $k \geq 10$). In practice, k is not known and a normal approximation may be used even when the MLE estimate of k is as small as 6. If needed, the user may want to use graphical Q-Q plots and perform GOF tests to verify if data sets with smaller values of the *MLE* estimates of k follow normal distributions.

Let $\hat{k}$ and $\hat{\theta}$ represent the *MLE*s of k and θ respectively. The relationship between a gamma RV, X = G (k, θ), and a chi-square RV, Y, is given by X = Y * θ/2, where Y follows a chi-square distribution with 2k degrees of freedom (*df*). Thus, the percentiles of a chi-square distribution (as programmed in ProUCL) can be used to determine the percentiles of a gamma distribution. In practice, k is replaced by its *MLE*. Once an α*100% percentile, $y_{(\alpha)\ 2k}$, of a chi-square distribution with 2k *df* is obtained, the α*100% percentile for a gamma distribution is computed using the following equation:

$$x_\alpha = y_\alpha * \theta/2 \qquad (3\text{-}5)$$

3.4 Upper Tolerance Limits

A UTL (1-α)-p (e.g., UTL95-95) based upon an established background data set represents that limit such that p*100% of the observations (current and future) from the target population (background, comparable to background) will be less than or equal to UTL with a *CC*, (1-α). It is expected that p*100% of the observations belonging to the background population will be less than or equal to a UTL with a *CC,* (1-α). A UTL (1-α)-p represents a (1 – α) 100% UCL for the unknown p^{th} percentile of the underlying background population.

A UTL95-95 is designed to provide coverage for 95% of all observations potentially coming from the background or comparable to background population(s) with a CC of 0.95. A UTL95-95 will be exceeded by all (current and future) values coming from the background population less than 5% of the time with a CC of 0.95, that is 5 exceedances per 100 comparisons (of background values) can result just by chance for an overall CC of 0.95. Unlike a UPL95, a UTL95-95 can be used when many ,or unknown number of, current or future onsite observations need to be compared with a BTV. A parametric UTL95-95 takes the data variability into account.

When a large number of comparisons are made with a UTL95-95, the number of exceedances (not the percentage of exceedances) of the UTL95-95 by those observations can also be large just by chance. This implies that just by chance, a larger number (but not larger than 5%) of onsite locations comparable to background can be greater than a UTL95-95 potentially requiring unnecessary investigation which may not be cost-effective. In order to avoid this situation, it is suggested to use a USL95 to estimate a BTV, provided the background data set represents a single statistical population, free of outliers.

3.4.1 Normal Upper Tolerance Limits

First, compute the sample mean, $\bar{x}$, and *sd*, s, using a defensible data set representing a single background population. For normally distributed data sets, an upper (1 – α)*100% UTL with coverage coefficient, p, is given by the following statement.

$$UTL = \bar{x} + K * s \qquad (3\text{-}6)$$

Here, $K = K$ (n, α, p) is the tolerance factor and depends upon the sample size, n, CC = (1 – α), and the coverage proportion = p. For selected values of n, p, and (1-α), values of the tolerance factor, K, have been tabulated extensively in the various statistical books (e.g., Hahn and Meeker 1991). Those K values are based upon the non-central t-distribution. Also, some large sample approximations (e.g., Natrella, 1963) are available to compute the *K* values for one-sided tolerance intervals (same for both UTLs and lower tolerance limits). The approximate value of *K* is also a function of the sample size, *n*, coverage coefficient, *p*, and the CC, $(1 - \alpha)$. For samples of small sizes, $n \leq 30$, ProUCL uses the tabulated (Hahn and Meeker, 1991) *K* values. Tabulated K values are available only for some selected combinations of *p* (e.g., 0.90, 0.95, 0.975) and $(1\text{-}\alpha)$ values (e.g., 0.90, 0.95, 0.99). For sample sizes larger than 30, ProUCL computes the *K* values using the large sample approximations, as given in Natrella (1963). The Natrella's approximation seems to work well for samples of sizes larger than 30. ProUCL computes these *K* values for all valid values of *p* and $(1\text{-}\alpha)$ and samples of sizes as large as 5000.

3.4.2 Lognormal Upper Tolerance Limits

The procedure to compute UTLs for lognormally distributed data sets is similar to that for normally distributed data sets. First, the sample mean, $\bar{y}$, and *sd*, s_y, of the log-transformed data are computed. An upper $(1 - \alpha)$*100% tolerance limit with tolerance or coverage coefficient, *p* is given by the following statement:

$$UTL = \exp(\bar{y} + K * s_y) \tag{3-7}$$

The *K* factor in (3-7) is the same as the one used to compute the normal UTL.

Notes: It is noted that even though there in no back-transformation bias present in the computation of a lognormal UTL, a lognormal distribution based UTL is typically higher (sometimes unrealistically higher as shown in the following example) than other parametric and nonparametric UTLs; especially when the sample size is less than 20. Therefore, the use of a lognormal UTLs to estimate BTVs should be avoided when skewness is high (e.g., *sd* of logged data > 1 or 1.5) and sample size is small (e.g., < 20-30).

3.4.3 Gamma Distribution Upper Tolerance Limits

Positively skewed environmental data can often be modeled by a gamma distribution. ProUCL software has two goodness-of-fit tests: the Anderson-Darling (A-D) and Kolmogorov-Smirnov (K-S) tests for a gamma distribution. These GOF tests are described in Chapter 2. UTLs based upon normal approximation to the gamma distribution (Krishnamoorthy *et al*., 2008) have been incorporated in ProUCL. Those approximations are based upon Wilson-Hilferty (WH; 1931) and Hawkins-Wixley (H-W; 1986) approximations. A description of the procedure to compute gamma UTLs is given as follows.

Let $x_1, x_2, \ldots, x_n$ represent a data set of size n from a gamma distribution, $G(k, \theta)$ with shape parameter, *k* and scale parameter θ.

- According to the WH approximation, the transformation, $Y = X^{1/3}$ follows an approximate normal distribution.
- According to the HW approximation, the transformation, $Y = X^{1/4}$ follows an approximate normal distribution.

Let $\bar{y}$ and s_y represent the mean and *sd* of the observations in the transformed scale (Y).

Using the WH approximation, the gamma UTL (in original scale, X), is given by:

$$UTL = \max\left(0, \left(\bar{y} + K * s_y\right)^3\right) \quad (3\text{-}8)$$

Similarly, using the HW approximation, the gamma UTL in original scale is given by:

$$UTL = \left(\bar{y} + K * s_y\right)^4 \quad (3\text{-}9)$$

The tolerance factor, K is defined earlier in (3-6) while computing a UTL based upon normal distribution.

Note: that for mildly skewed to moderately skewed gamma distributed data sets, HW and WH approximations yield fairly comparable UTLs. However for highly skewed data sets (e.g., k<0.5) with higher variability, HW method tends to yield higher limits than the WH method. A couple of examples are discussed as follows.

3.4.4 Nonparametric Upper Tolerance Limits

The computation of nonparametric UTLs and associated achieved confidence levels are described as follows. A nonparametric $UTL_{p,(1-\alpha)}$ =UTL p-(1 - α) providing coverage to p*100% observations with CC, (1 – α) represents an (1 – α)*100% UCL for the p^{th} percentile of the target population under study. It is expected that about p*100% of the observations (current and future) coming from the target population (e.g., background, comparable to background) will be ≤ $UTL_{p,(1-\alpha)}$ with CC, (1 – α)*100.

Let $x_{(1)} \le x_{(2)} \le \ldots x_{(r)} \le \ldots \le x_{(n)}$ represent n ordered statistics (arranged in ascending order) of a given data set, $x_{1,} x_2, \ldots., x_n$. A nonparametric UTL is computed by the higher order statistics such as the largest, the second largest, the third largest, and so on. The order, r of the statistic, $x_{(r)}$ used to compute a nonparametric UTL depends upon the sample size, n, coverage probability, p, and the desired CC, (1 - α). It is noted that in comparison with parametric UTLs, nonparametric UTLs require larger data sets to achieve the desired CC; a nonparametric UTL p-(1 - α) computed by order statistics often fails to exactly achieve the specified CC, (1 – α). The formula to compute the order statistic, sample size, and CC achieved by nonparametric UTLs are described as follows. More details can be found in David and Nagaraja (2003), Conover (1999), Hahn and Meeker (1991), Wald (1963), Scheffe and Tukey (1944) and Wilks (1941).

3.4.4.1 Determining the Order, r, of the Statistic, $x_{(r)}$, to Compute UTLp,(1-α)

Using the cumulative binomial probabilities, a number, r: 1 ≤ r ≤ n, is chosen such that the cumulative binomial probability: $\sum_{i=0}^{i=r} \binom{n}{i} p^i (1-p)^{(n-i)}$ becomes as close as possible to (1 – α). The binomial distribution (BD) based algorithm has been incorporated in ProUCL for data sets of sizes up to 2000. For data sets of size, n >2000, ProUCL computes the r^{th} (r: 1 ≤ r ≤ n) order statistic by using the normal approximation (Conover, 1999) given by the equation (3-10).

$$r = np + z_{(1-\alpha)} \sqrt{np(1-p)} + 0.5 \quad (3\text{-}10)$$

Depending upon the sample size, p, and (1 - α) the largest, the second largest, the third largest, and so forth order statistic is used to estimate the UTL. As mentioned earlier for a given data set of size n, the r^{th}

order statistic, $x_{(r)}$ may or may not achieve the specified CC, (1 - α). ProUCL uses the following F-distribution based probability statement to compute the CC achieved by the UTL determined by the r^{th} order statistic.

3.4.4.2 Determining the Achieved Confidence Coefficient, $CC_{achieve,}$ Associated with $x_{(r)}$

For a given data set of size, *n*, once the r^{th} order statistic, $x_{(r)}$, has been determined, ProUCL can be used to determine if a UTL computed using $x_{(r)}$ achieves the specified CC, (1 - α). ProUCL computes the achieved CC by using the following approximate probability statement based upon the F-distribution with ν_1 and ν_2 *df*.

$$CC_{Achieve} = (1-\alpha_*) = \text{Probability } (F_{(\nu_1,\nu_2)} \le f); \ \nu_1 = 2(n-r+1), \text{ and } \nu_2 = 2r$$

$$f = \frac{r(1-p)}{(n-r+1)p} \qquad (3\text{-}11)$$

For a given data set of size *n*, ProUCL 5.0 first computes the order statistic that is used to compute a nonparametric UTL$p,(1\text{-}\alpha)$. Once the order statistic has been determined, ProUCL 5.0 computes the CC actually achieved by that UTL.

3.4.4.3 Determining the Sample Size

For specified values of *p* and (1 - α), the minimum sample size can be computed using Scheffe and Tukey (1944) approximate sample size formula given by equation (3-12). The minimum sample size formula should be used before collecting any data /samples. Once the data set of size, *n* has been collected, using the binomial distribution or approximate normal distribution, one can compute the order, *r* of the statistic that can be used to compute a UTL. As mentioned earlier, the UTLs based upon order statistics often do not achieve the desired confidence level. One can use equation (3-11) to compute the CC achieved by a UTL.

$$n_{needed} = 0.25 * \chi^2_{2m,(1-\alpha)} * (1+p)/(1-p) + (m-1)/2 \qquad (3\text{-}12)$$

In equation (3-12), $\chi^2_{2m,(1-\alpha)}$ represents the (1 - α) quantile of a chi-square distribution with *2m df*. It should be noted that in addition to *p* and (1 - α), the Scheffe and Tukey (1944) approximate minimum sample size formula (3-12) also depends upon the order, *r* of the statistic, $x_{(r)}$ used to compute the UTLp, (1 - α)). Here m: 1≤ m≤n; and m=1 when the largest value, $x_{(n)}$, is used to compute the UTL; and m=2, when the second largest value, $x_{(n-1)}$ is used to compute a UTL, and $m=n-r+1$ when the r^{th} order statistic, $x_{(r)}$, is used to compute a UTL. For an example, if the largest sample value, $x_{(n)}$, is used to compute a UTL95-95, then a minimum sample size of 59 (see equation (3-12)) will be needed to achieve a confidence level of 0.95 providing coverage to 95% of the observations coming from the target population. A UTL95-95 computed based upon a data set of size less than 59 may not achieve the desired confidence of 0.95 for the 95th percentile of the target population.

For example, when the largest order statistic (with m=1) is used to compute a nonparametric UTL95-95, the approximate minimum sample size needed 0.25*5.99*1.95/0.05 ≈ 58.4 which is rounded upward to 59; and when the second largest value (with m=2) is used to compute a UTL95-95, the approximate minimum sample size needed [(0.25*9.488*1.95)/0.05]+0.5 ≈ 93. Similarly to compute a UTL90-95 by the largest sample value, about 29 observations will be needed to provide coverage for 90% of the observations from the target population with CC = 0.95. In environmental applications, the number of available observations from the target population is much smaller than 29, 59 or 93 and a UTL computed based upon those data sets may not provide specified coverage with the desired CC.

3.4.4.4 Nonparametric UTL Based Upon the Percentile Bootstrap Method

A couple of bootstrap methods to compute nonparametric UTLs are also available in ProUCL 5.0. Like the percentile bootstrap UCL computation method, for data sets without a discernible distribution, one can use percentile bootstrap resampling method to compute $\mathrm{UTL}_{p,(1-\alpha)}$ =UTL p,(1 - α). The N bootstrapped nonparametric p^{th} percentiles, p,(i:=1,2,...,N), are arranged in ascending order: $p_1 \le p_2 \le \ldots \le p_N$. The $\mathrm{UTL}_{p,(1-\alpha)}$ for the target population is given by the value that exceeds the (1 – α)*100 of the N bootstrap percentile values. The UTL95-95 is the 95th percentile and is given by:

95% Percentile UTL = 95th percentile of p_i *values; i*: = *1, 2, ..., N*

For example when N = 1000, the ULT95-95 is given by the 950th order percentile value of the 1000 bootstrapped 95th percentiles. Typically, this method yields the largest value in the data set to compute a UTL which may not provide the desired coverage (e.g., 0.95) to the 95th population percentile.

3.4.4.5 Nonparametric UTL Based Upon the Bias-Corrected Accelerated (BCA) Percentile Bootstrap Method

Like the percentile bootstrap method, one can use the BCA bootstrap method (Efron and Tibshirani 1993) to compute nonparametric UTLs. However, this method needs further investigation. This method is incorporated in ProUCL 4.00.04 and higher versions for interested users. In this method one replaces the sample mean, bootstrap and jackknife (deleting one observation at a time) means by the corresponding bootstrap percentiles and jackknife (computed using (n - 1) observations by deleting one observation at a time) percentiles. The details of the BCA bootstrap method are given in Section 2.4.9.4.

3.5 Upper Prediction Limits

Based upon a background data set, UPLs are computed for a single (UPL_1) and k (UPL_k) future observations. Additionally, in groundwater monitoring applications, an upper prediction limit of the mean of the k future observations, UPL_k (mean) is also used. A brief description of parametric and nonparametric upper prediction limits is provided in this section.

<u>UPL_1 for a Single Future Observation:</u> A UPL_1 computed based upon an established background data set represents that statistic such that a single future observation from the target population (e.g., background, comparable to background) will be less than or equal to $\mathrm{UPL}_1$95 with a CC of 0.95. A parametric UPL takes the data variability into account. A UPL_1 is designed for a *single future* observation comparison; however in practice users tend to use $\mathrm{UPL}_1$95 to perform many future comparisons which results in a high number of false postives (observations declared contaminated when in fact they are clean).

When k>1 future comparisons are made with a UPL_1, some of those future observations will exceed the UPL_1 just by chance, each with probability 0.05. For proper comparison, a UPL needs to be computed accounting for the number of comaprisons that will be performed. For example, if 30 independent onsite comparisons (e.g., Pu-238 activity from 30 onsite locations) are made with the same background $\mathrm{UPL}_1$95, each onsite value comparable to background may exceed that $UPL_1 95$ with probability 0.05. The overall probability of at least one of those 30 comparisons being significant (exceeding the BTV) just by chance is given by:

$\alpha_{actual} = 1-(1-\alpha)^k = 1 - 0.95^{30} \sim 1-0.21 = 0.79$ (false positive rate).

This means that the probability (overall false positive rate) is 0.79 (and not 0.05) that at least one of the 30 onsite observations will be considered contaminated even when they are comparable to background. Similar arguments hold when multiple *(=j,* a positive integer*)* constituents are analyzed, and status (clean or impacted) of an onsite location is determined based upon *j* comparisons (one for each analyte). The use of a UPL_1 is not recommended when multiple comparisons are to be made.

3.5.1 Normal Upper Prediction Limit

The sample mean, $\bar{x}$, and the *sd, s,* are computed first based upon a defensible background data set. For normally distributed data sets, an upper (1 – *α*)*100% prediction limit is given by the following well known equation:

$$UPL = \bar{x} + t_{((1-\alpha),(n-1))} * s * \sqrt{(1+1/n)} \qquad (3\text{-}13)$$

Here $t_{((1-\alpha),(n-1))}$ is a critical value from the Student's t-distribution with (*n*–1) *df*.

3.5.2 Lognormal Upper Prediction Limit

An upper (1 – *α*)*100% lognormal UPL is similarly given by the following equation:

$$UPL = \exp(\bar{y} + t_{((1-\alpha),(n-1))} * s_y * \sqrt{(1+1/n)}) \qquad (3\text{-}14)$$

Here $t_{((1-\alpha),(n-1))}$ is a critical value from the Student's t-distribution with (*n*–1) *df*.

3.5.3 Gamma Upper Prediction Limit

Given a sample, $x_1, x_2, \ldots, x_n$ of size n from a gamma distribution $G(k, \theta)$, approximate (based upon WH and HW approximations described earlier in Section 3.4.3, Gamma Distribution Upper Tolerance Limits), (1 – *α*)*100% upper prediction limits for a future observation from the same gamma distributed population are given by:

$$\textit{Wilson-Hilferty (WH) UPL} = \max\left(0, \left(\bar{y} + t_{((1-\alpha),(n-1))} * s_y * \sqrt{1+1/n}\right)^3\right) \qquad (3\text{-}15)$$

$$\textit{Hawkins-Wixley (HW) UPL} = \left(\bar{y} + t_{((1-\alpha),(n-1))} * s_y * \sqrt{1+1/n}\right)^4 \qquad (3\text{-}16)$$

Here $t_{((1-\alpha),(n-1))}$ is a critical value from the Student's t-distribution with (*n*–1)*df*.

3.5.4 Nonparametric Upper Prediction Limit

A one-sided nonparametric UPL is simple to compute and is given by the following m[th] order statistic. One can use linear interpolation if the resulting number, m, given below does not represent a whole number (a positive integer).

$$UPL = X_{(m)}, \text{ where } m = (n + 1) * (1 - \alpha). \qquad (3\text{-}17)$$

For example, for a nonparametric data set of size n=25, a 90% UPL is desired. Then m = (26*0.90) = 23.4. Thus, a 90% nonparametric UPL can be obtained by using the 23[rd] and the 24[th] ordered statistics and is given by the following equation:

$$UPL = X_{(23)} + 0.4 * (X_{(24)} - X_{(23)})$$

Similarly, if a nonparametric 95% UPL is desired, then m = 0.95 * (25 + 1) = 24.7, and a 95% UPL can be similarly obtained by using linear interpolation between the 24[th] and 25[th] order statistics. However, if a 99% UPL needs to be computed, then m = 0.99 * 26 = 25.74, which exceeds 25, the sample size; for such cases, the highest order statistic is used to compute the 99% UPL of the background data set. The largest value(s) should be used with caution (as they may represent outliers) to estimate the BTVs.

Since nonparametric upper limits (e.g., UTLs, UPLs) are based upon higher order statistics, often the CC achieved by these nonparametric upper limits is much lower than the specified CC of 0.95, especially when the sample size is small. In order to address this issue, one may want to compute a UPL based upon the Chebyshev inequality. In addition to various parametric and nonparametric upper limits, ProUCL computes Chebyshev inequality based UPL.

3.5.4.1 Upper Prediction Limit Based Upon the Chebyshev Inequality

Like UCL of mean, the Chebyshev inequality can be used to obtain a reasonably conservative but stable UPL and is given by the following equation:

$$UPL = \bar{x} + [\sqrt{((1/\alpha)-1)*(1+1/n)}]s_x$$

This is a nonparametric method since the Chebyshev inequality does not require any distributional assumptions. It should be noted that just like the Chebyshev UCL, a UPL based upon the Chebyshev inequality tends to yield higher estimates of BTVs than the various other methods. This is especially true when skewness is mild (e.g., *sd* of log-transformed data is low < 0.75), and the sample size is large (e.g., > 30). The user is advised to use professional judgment before using this method to compute a UPL. Specifically, for larger skewed data sets, instead of using a 95% UPL based upon the Chebyshev inequality, the user may want to compute a Chebyshev UPL with a lower CC (e.g., 85%, 90%) to estimate a BTV. ProUCL can compute a Chebyshev UPL (and all other UPLs) for any user specified CC in the interval [0.5, 1].

3.5.5 Normal, Lognormal, and Gamma Distribution based Upper Prediction Limits for k Future Comparisons

A UPL_k95 computed based upon an established background data set represents that statistic such that k future (next, independent andnot belonging to the current data set) observations from the target population (e.g., background, comparable to background) will be less than or equal to the UPL_k95 with a CC of 0.95.

A UPL_k95 for k (≥1) future observations is designed to compare k future observations; we are 95% sure that "k" future values from the background population will be less than or equal to UPL_k95 with CC of 0.95. In addition to UPL_k, ProUCL also computes an upper prediction limit of the mean of k future observations, UPL_k (mean). A UPL_k (mean) is commonly used in groundwater monitoring applications. A UPL_k controls the false positive error rate by using the Bonferroni inequality based critical values to perform k future comparisons. These UPLs satisfy the relationship: $UPL_1 \leq UPL_2 \leq UPL_3 \leq \ldots \leq UPL_k \ldots$

A normal distribution based UPL_k (1 - α) for k future observations, $x_{n+1}, x_{n+2}, ..., x_{n+k}$ is given by the probability statement:

$$P\left(x_{n+1}, x_{n+2}, ..., x_{n+k} \leq \bar{x} + t_{((1-\alpha/k),n-1)} s\sqrt{1+\frac{1}{n}}\right) = 1-\alpha \qquad (3\text{-}18)$$

$$UPL_k = \bar{x} + s * t_{(1-\alpha/k),n-1}\sqrt{1+\frac{1}{n}}$$

$$UPL_k 95 = \left(\bar{x} + t_{((1-0.05/k),n-1)} s\sqrt{1+\frac{1}{n}}\right)$$

For an example, a UPL_3 95 for 3 future observations: $x_{01,} x_{02}, x_{03}$ is given by:

$$UPL_3 95 = \left(\bar{x} + t_{((1-0.05/3),n-1)} s\sqrt{1+\frac{1}{n}}\right)$$

A lognormal distribution based UPL_k (1 - α) for k future observations, $x_{n+1}, x_{n+2}, ..., x_{n+k}$ is given by the following equation:

$$UPL_k = \exp(\bar{y} + s_y * t_{(1-\alpha/k),n-1}\sqrt{1+\frac{1}{n}})$$

A gamma distribution based UPL_k for the next k > 1 (k future observations) are computed similarly using the WH and HW approximations described in Section 3.4.3.

3.5.6 Proper Use of Upper Prediction Limits

It is noted that some users tend to use UPLs without taking their definition and intended use into consideration; this is an incorrect application of a UPL. Some important points to note about the proper use of UPL_1 and UPL_k for *k>1* are described as follows.

- When a UPL_k is computed to compare k future observations collected from a site area or a group of MW within an operating unit (OU), it is assumed that the project team will make a decision about the status (clean or not clean) of the site (MWs in an OU) based upon those *k* future observations.

- The use of an UPL_k implies that a decision about the site-wide status will be made only after k comparisons have been made with the UPL_k. It does not matter if those k observations are collected (and compared) simultaneously or successively. The k observations are compared with the UPL_k as they become available and a decision (about site status) is made based upon those k observations.

- An incorrect use of a UPL_1 95 is to compare many (e.g., 5, 10, 20,…) future observations. This results in a higher than 0.05 false positive rate. Similarly, an inappropriate use of a UPL_{100} would be to compare less than 100 (i.e., 10, 20, or 50 observations) future observations.. Using a UPL_{100} to compare 10 or 20 observations can potentially result in a high number of false negatives (a test with reduced power) declaring contaminated areas comparable to background.

- The use of other statistical limits such as 95%-95% UTLs (UTL95-95) is preferred to estimate BTVs and not-to-exceed values. The computation of a UTL does not depend upon the number of future comparisons which will be made with the UTL.

3.6 Upper Simultaneous Limits

An (1 – α) * 100% upper simultaneous limit (USL) based upon an established background data set is meant to provide coverage for <u>all</u> observations, x_i, $i = 1, 2, n$ simultaneously in the background data set. It is implicitly assumed that the data set comes from a single background population and is free of outliers (established background data set). A USL95 represents that statistic such that_all observations from the "established" background data set will be less than or equal to the USL95 with a CC of 0.95. It is expected that observations coming from the background population will be less than or equal to the USL95 with a 95% CC. A USL95 can be used to perform any number (unknown) of comparisons of future observations. The false positive error rate does not change with the number of comparisons as the purpose of the USL95 is to perform any number of comparisons simultaneously.

<u>Notes:</u> If a background population is established based upon a small data set; as one collects more observations from the background populations, some of the new background observations will exceed the largest value in the existing data set. In order to address these uncertainties, the use of a USL is recommended, provided the data set represents a single population without outliers.

3.6.1 Upper Simultaneous Limits for Normal, Lognormal and Gamma Distributions

The normal distribution based two-sided (1 – α) 100% simultaneous interval obtained using the first order Bonferroni inequality (Singh and Nocerino, 1995, 1997) is given as follows:

$$P\left(\bar{x} - sd_{\alpha}^{b} \le x_i \le \bar{x} + sd_{\alpha}^{b}; i := 1, 2, ..., n\right) = 1 - \alpha . \qquad (3\text{-}19)$$

Here, $(d_{\alpha}^{b})^2$ represents the critical value (obtained using the Bonferroni inequality) of the maximum Mahalanobis distance (Max (MDs)) for α level of significance (Singh, 1993). The details about the Mahalanobis distances and computation of the critical values, $(d_{\alpha}^{b})^2$ can be found in Singh (1993) and Singh and Nocerino (1997). These values have been programmed in ProUCL 5.0 to compute USLs for any combination of the sample size, *n*, and CC, (1 - α).

The normal distribution based, one-sided (1 – α) 100% USL providing coverage for all n sample observations is given as follows:

$$P\left(x_i \leq \bar{x} + sd_{2\alpha}^{b}; i := 1, 2, ..., n\right) = 1 - \alpha \ ;$$

$$USL = \bar{x} + s * d_{2\alpha}^{b}; \qquad (3\text{-}20)$$

Here $(d_{2\alpha}^{b})^2$ is the critical value of Max (MDs) for a 2*α level of significance.

The lognormal distribution based one-sided (1 – α) 100% USL providing coverage for all n sample observations is given by the following equation:

$$USL = \exp(\bar{x} + s * d_{2\alpha}^{b}) \qquad (3\text{-}21)$$

A gamma distribution based (using WH approximation), one-sided (1 – α) 100% USL providing coverage to all sample observations is given by:

$$USL = \max\left(0, \left(\bar{y} + d_{2\alpha}^{b} * s_y\right)^3\right)$$

A gamma distribution based (using the HW approximation), one-sided (1 – α) 100% USL providing coverage to all sample observations is given as follows:

$$USL = \left(\bar{y} + d_{2\alpha}^{b} * s_y\right)^4$$

<u>Nonparametric USL:</u> For nonparametric data sets, the largest value, $x_{(n)}$ is used to compute a nonparametric USL. Just like a nonparametric UTL, a nonparametric USL may fail to provide the specified coverage, especially when the sample size is small (e.g., <60). The confidence coefficient actually achieved by a USL can be computed using the same process as used for a nonparametric UTL described in Sections 3.4.4.2 and 3.4.4.3. Specifically, by substituting r=n in equation (3-11), the confidence coefficient achieved by a USL can be computed, and by substituting m=1 in equation (3-12), one can compute the sample size needed to achieve the desired confidence.

<u>Notes:</u> Nonparametric USLs, UTLs or UPLs should be used with caution; nonparametric upper limits are based upon order statistics and therefore do not take the variability of the data set into account. Often nonparametric BTVs estimated by order statistics do not achieve the specified CC unless the sample size is fairly large.

Some examples illustrating the computations of the various upper limits described in this chapter are discussed as follows.

Example 3-1. Consider a real Superfund site data set. The data set has several inorganic constituents of potential concern, including aluminum, arsenic, chromium (Cr), and lead. The computation of background statistics obtained using ProUCL are summarized as follows. The complete data set is given in Appendix 5 of the *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA, 2002a).

Upper Limits Based upon a Normally Distributed Data Set: The aluminum data set follows a normal distribution as shown in the following GOF Q-Q plot of Figure 3-1.

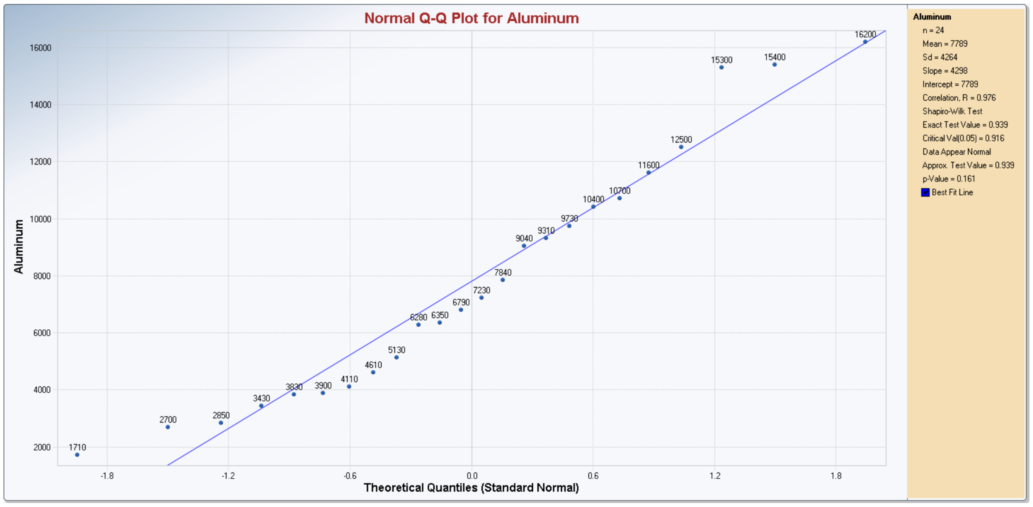

Figure 3-1. Normal Q-Q plot of aluminum with GOF Statistics

From the normal Q-Q plot shown in Figure 3-1, it is noted that the 3 largest values are higher (but not extremely high) than the rest of the 21 observations. These observations may or may not be coming from the same population as the rest of the 21 observations. The classical outlier tests (e.g., Dixon and Rosner tests) did not identify these 3 data points as outliers. Robust outlier tests (e.g., MCD [Rousseeuw and Leroy, 1987)] and PROP influence function [Singh and Nocerino, 1995] based tests) identified the 3 high values as statistical outliers. The project team should decide whether or not the 3 higher concentrations represent outliers. A brief discussion about robust outlier identification methods is given in Chapter 7. The inclusion of the 3 higher values in the data set resulted in higher upper limits. The various upper limits have been computed with (Table 3-1) and without the 3 high observations (Table 3-2).

Table 3-1. BTV Estimated Based upon All 24 Observations

Aluminum			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	24
Minimum	1710	First Quartile	4058
Second Largest	15400	Median	7010
Maximum	16200	Third Quartile	10475
Mean	7789	SD	4264
Coefficient of Variation	0.547	Skewness	0.542
Mean of logged Data	8.798	SD of logged Data	0.61
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644
Normal GOF Test			
Shapiro Wilk Test Statistic	0.939	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.109	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Background Statistics Assuming Normal Distribution			
95% UTL with 95% Coverage	17635	90% Percentile (z)	13254
95% UPL (t)	15248	95% Percentile (z)	14803
95% USL	19063	99% Percentile (z)	17708

Table 3-2. BTV Estimated Based upon 21 Observations without 3 Higher Values

Aluminum			
General Statistics			
Total Number of Observations	21	Number of Distinct Observations	21
		Number of Missing Observations	3
Minimum	1710	First Quartile	3900
Second Largest	11600	Median	6350
Maximum	12500	Third Quartile	9310
Mean	6669	SD	3215
Coefficient of Variation	0.482	Skewness	0.25
Mean of logged Data	8.676	SD of logged Data	0.549
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.371	d2max (for USL)	2.58
Normal GOF Test			
Shapiro Wilk Test Statistic	0.955	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.908	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.12	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.193	Data appear Normal at 5% Significance Level	
Data appear Normal at 5% Significance Level			
Background Statistics Assuming Normal Distribution			
95% UTL with 95% Coverage	14291	90% Percentile (z)	10789
95% UPL (t)	12344	95% Percentile (z)	11957
95% USL	14964	99% Percentile (z)	14147

The project team should make a determination of which statistics (with outliers or without outliers) should be used to estimate BTVs.

Example 3-2. Chromium concentrations of the superfund site data set used in Example 3-1 follow a lognormal distribution. The computation of background statistics using a lognormal model are shown in -3 3. Figure 3-2 is the lognormal Q-Q plot with GOF statistics.

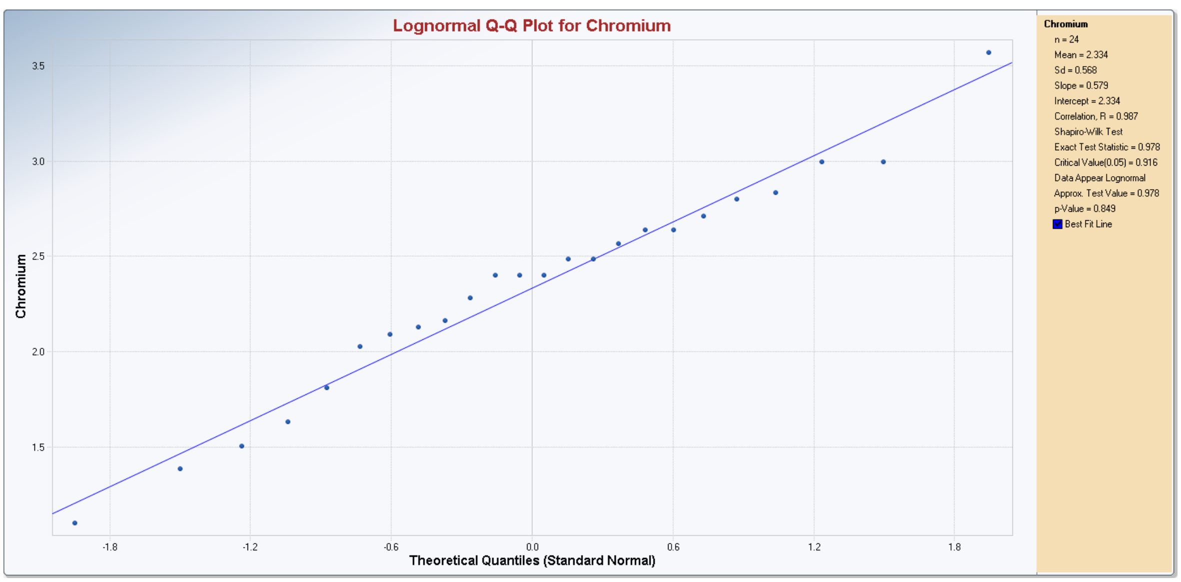

Figure 3-2. Lognormal Q-Q plot of Chromium with GOF Statistics

Table 3-3. Lognormal Distribution Based UPLs, UTLs, and USLs

Chromium			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	19
Minimum	3	First Quartile	7.975
Second Largest	20	Median	11
Maximum	35.5	Third Quartile	14.25
Mean	11.97	SD	6.892
Coefficient of Variation	0.576	Skewness	1.728
Mean of logged Data	2.334	SD of logged Data	0.568
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.978	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.128	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.181	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Background Statistics assuming Lognormal Distribution			
95% UTL with 95% Coverage	38.3	90% Percentile (z)	21.37
95% UPL (t)	27.87	95% Percentile (z)	26.27
95% UPL for Next 5 Observations	43.96	99% Percentile (z)	38.68
95% UPL for Mean of 5 Observations	16.66	95% USL	46.33

Example 3-3. Arsenic concentrations of the superfund site data set used in Example 3-1 follow a gamma distribution. The background statistics, obtained using a gamma model, are shown in Table 3-4. Figure 3-3 is the gamma Q-Q plot with GOF statistics.

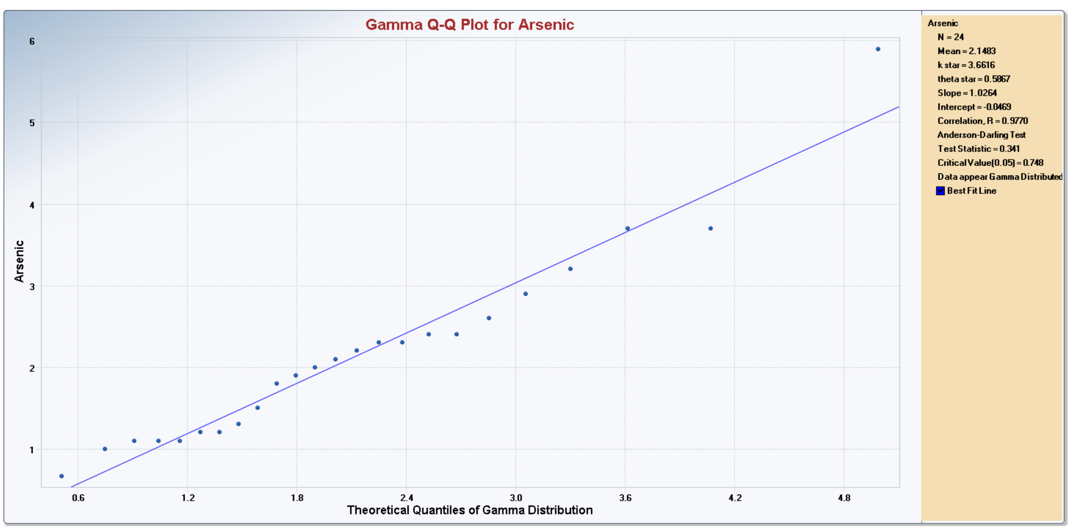

Figure 3-3. Gamma Q-Q plot of Arsenic with GOF Statistics

Table 3-4. Gamma Distribution Based UPLs, UTLs, and USLs

Arsenic			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	18
Minimum	0.66	First Quartile	1.2
Second Largest	3.7	Median	2.05
Maximum	5.9	Third Quartile	2.45
Mean	2.148	SD	1.159
Coefficient of Variation	0.54	Skewness	1.554
Mean of logged Data	0.639	SD of logged Data	0.51
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644
Gamma GOF Test			
A-D Test Statistic	0.341	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.748	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.114	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.179	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.153	k star (bias corrected MLE)	3.662
Theta hat (MLE)	0.517	Theta star (bias corrected MLE)	0.587
nu hat (MLE)	199.3	nu star (bias corrected)	175.8
MLE Mean (bias corrected)	2.148	MLE Sd (bias corrected)	1.123
Background Statistics Assuming Gamma Distribution			
95% Wilson Hilferty (WH) Approx. Gamma UPL	4.345	90% Percentile	3.654
95% Hawkins Wixley (HW) Approx. Gamma UPL	4.397	95% Percentile	4.264
95% WH Approx. Gamma UTL with 95% Coverage	5.382	99% Percentile	5.574
95% HW Approx. Gamma UTL with 95% Coverage	5.524		
95% WH USL	6.074	95% HW USL	6.294

Example 3-4. Lead concentrations of the superfund site data set used in Example 3-1 do not follow a discernible distribution. The various nonparametric background statistics for lead are shown in Table 3-5.

Table 3-5. Nonparametric UPLs, UTLs, and USLs for Lead in Soils

Lead			
General Statistics			
Total Number of Observations	24	Number of Distinct Observations	18
Minimum	4.9	First Quartile	10.43
Second Largest	98.5	Median	14
Maximum	109	Third Quartile	19.25
Mean	22.49	SD	26.83
Coefficient of Variation	1.193	Skewness	2.665
Mean of logged Data	2.743	SD of logged Data	0.771
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.309	d2max (for USL)	2.644
Nonparametric Distribution Free Background Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Upper Limits for Background Threshold Values			
Order of Statistic, r	24	95% UTL with 95% Coverage	109
Approximate f	1.263	Confidence Coefficient (CC) achieved by UTL	0.708
95% Percentile Bootstrap UTL with 95% Coverage	109	95% BCA Bootstrap UTL with 95% Coverage	109
95% UPL	106.4	90% Percentile	44.81
90% Chebyshev UPL	104.6	95% Percentile	91.72
95% Chebyshev UPL	141.8	99% Percentile	106.6
95% USL	109		

Notes: As mentioned before, nonparametric upper limits are computed by higher order statistics, or by some value in between (based upon linear interpolation) the higher order statistics. In practice, nonparametric upper limits do not provide the desired coverage to the population parameter (upper threshold) unless the sample size is large. From Table 3-5, it is noted that a UTL95-95 is estimated by the maximum value in the data set of size 24. However, the CC actually achieved by UTL95-95 (and also by USL95) is only 0.708. *Therefore, one may want to use other upper limits such as 95% Chebyshev UPL = 141.8 to estimate a BTV.*

Example 3-5: Why Use a Gamma Distribution to Model Positively Skewed Data Sets?

The data set considered in Example 2-2 of Chapter 2 is used to illustrate the deficiencies and problems associated with the use of a lognormal distribution to compute UCL95 of the mean. As noted earlier, the data set follows a lognormal as well as a gamma model; the various upper limits, based upon a lognormal and a gamma model, are summarized as follows. The largest value in the data set is 169.8, the UTL95-95 and UPL95 based upon a lognormal model are 799.7 and 319 both of which are significantly higher than the maximum value of 169.8. A UPL95 (UTL95-95) based upon a gamma model are 245.3(or 285.6) and 163.5 (or 178.2) which appear to represent more reasonable estimates of the BTV. These statistics are summarized in Table 3-6 (lognormal) and Table 3-7 (gamma) below.

Table 3-6. Background Statistics Based Upon a Lognormal Model

X			
General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
Minimum	0.349	First Quartile	5.093
Second Largest	164.3	Median	18.77
Maximum	169.8	Third Quartile	72.62
Mean	44.09	SD	51.34
Coefficient of Variation	1.164	Skewness	1.294
Mean of logged Data	2.835	SD of logged Data	1.68
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.292	d2max (for USL)	2.663
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.135	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.177	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Background Statistics assuming Lognormal Distribution			
95% UTL with 95% Coverage	799.7	90% Percentile (z)	146.5
95% UPL (t)	319	95% Percentile (z)	269.7

Table 3-7. Background Statistics Based Upon a Gamma Model

X			
General Statistics			
Total Number of Observations	25	Number of Distinct Observations	25
Minimum	0.349	First Quartile	5.093
Second Largest	164.3	Median	18.77
Maximum	169.8	Third Quartile	72.62
Mean	44.09	SD	51.34
Coefficient of Variation	1.164	Skewness	1.294
Mean of logged Data	2.835	SD of logged Data	1.68
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	2.292	d2max (for USL)	2.663
Gamma GOF Test			
A-D Test Statistic	0.374	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.794	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.113	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.183	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.643	k star (bias corrected MLE)	0.592
Theta hat (MLE)	68.58	Theta star (bias corrected MLE)	74.42
nu hat (MLE)	32.15	nu star (bias corrected)	29.62
MLE Mean (bias corrected)	44.09	MLE Sd (bias corrected)	57.28
Background Statistics Assuming Gamma Distribution			
95% Wilson Hilferty (WH) Approx. Gamma UPL	163.5	90% Percentile	115
95% Hawkins Wixley (HW) Approx. Gamma UPL	178.2	95% Percentile	159.4
95% WH Approx. Gamma UTL with 95% Coverage	245.3	99% Percentile	266.8
95% HW Approx. Gamma UTL with 95% Coverage	285.6		

CRITERIA SUPPORT DOCUMENT

Site-Specific Standard for Total Dissolved Solids

Blue Creek Reservoir and Blue Creek, Box Elder County, Utah

Utah Division of Water Quality

September 3, 2015 Draft

EXECUTIVE SUMMARY

New site-specific total dissolved solids (TDS) criteria that are higher than the statewide criteria of 1,200 mg/l are proposed for Blue Creek in Box Elder County, Utah. The site-specific criteria for Blue Creek are based on natural conditions influenced by the irreversible influences of the dam and subsequent management of the water in Blue Creek Reservoir. The criterion for Blue Creek Reservoir is based on natural conditions although the reservoir itself is not natural.

For the summer season (March through October), a maximum criterion of 4,900 mg/l and an average criterion of 3,800 mg/l TDS are recommended. For the winter season (November through February), a maximum criterion of 6,300 mg/l and an average criterion of 4,700 mg/l TDS are recommended.

For water quality assessment purposes, the maximum criteria were derived assuming that up to 10% of the assessment samples may exceed the site-specific TDS criteria (R317-2-7). For water quality assessment for the average criteria, the data and methods used should be consistent with the methods used to derive the criteria. Specifically, the assessment methods should consider the variability and uncertainty of the data supporting the criteria as well as the assessment data. As an example, the mean of 10 summer assessment samples could be compared to 4,100 mg/l, the 95% upper prediction limit of the mean assuming k=10 future samples. For the winter, the 95% upper prediction limit for k=10 future samples is 5,300 mg/l. **Assessment sample means should not be directly compared to the average criteria.**

Applying the same methodologies for deriving the maximum criteria to Blue Creek Reservoir, a maximum criterion of 2,100 mg/ is recommended.

Site-specific Total Dissolved Criteria for Blue Creek and Blue Creek Reservoir (mg/l)				
Blue Creek Summer (March through October)		Blue Creek Winter (November through February)		Blue Creek Reservoir
Maximum	Average	Maximum	Average	Maximum
4,900	3,800	6,300	4,700	2,100

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APPENDICES

FORWARD

Site-specific criteria for total dissolved solids (TDS) were adopted in 2014 for Blue Creek and Blue Creek Reservoir (Table 1). Prior to USEPA action on the standards change, a more detailed review of the historical data demonstrated that the newly adopted criteria were too low for Blue Creek. Specifically, individual and average concentrations in the historical data for Blue Creek exceeded the new criteria. Concerns identified during the comment period include that the maximum criteria proposed in the March 3, 2015 draft would be prone to not identifying impairments when the 10% exceedance allowed by R317-2-7 was applied.

This document is an update of the *Proposed Site-Specific Standard for Total Dissolved Solid, Blue Creek, Box Elder County, Utah,* September 24, 2013 and March 3, 2015 Drafts. The methodology was revised for both Blue Creek and Blue Creek Reservoir resulting in different recommendations for the criteria as presented herein.

The methodology used represents one way of deriving these criteria. Previous derivations of site-specific criteria in Utah used different methods and other methods may be used to support site-specific criteria in the future. Many factors, such as the quantity and quality of the available data, hydrology, variability, and uncertainty, influence how site-specific criteria are developed. The methods used for Blue Creek and Blue Creek Reservoir may or may not be optimal for other site-specific standards.

1.1 INTRODUCTION

ATK Launch Systems-Promontory (ATK), Promontory, UT, recommended that the Utah Division of Water Quality revise the total dissolved solids (TDS) criterion for Blue Creek in Box Elder County, Utah. This document summarizes the technical and regulatory bases to support this change.

This document is an update of the *Proposed Site-Specific Standard for Total Dissolved Solid, Blue Creek, Box Elder County, Utah, September 24, 2013 Draft* (DWQ, 2013) and the March 3, 2015 Draft.

Additional supporting data and analyses are incorporated by reference and are included as Appendices A and B:

- June 2011 ATK *Work Plan for the Development of a New Site-Specific TDS Criterion for Blue Creek*. (ATK, 2011)
- July 11, 2013 ATK *Blue Creek Site-Specific Standard for Total Dissolved Solids (TDS) Criterion Monitoring Report* (ATK, 2013)

1.1.1 Watershed Summary

Blue Creek Reservoir has no perennial source streams. The water in Blue Creek Reservoir is collected from Blue Springs, a saline warm springs adjacent to the reservoir supplemented by storm runoff. Water control structures allow the reservoir water to be discharged to Blue Creek or to irrigation canals on the east and west sides of the valley. The irrigation canals provide water for flood irrigation and stock watering. Direct conveyances for irrigation return flows to Blue Creek are not apparent and unused water likely returns to Blue Creek via sheet flow, shallow groundwater, and roadside ditches.

Downstream of the dam, Blue Creek has flowing water (except when frozen) even absent any intentional releases from the dam. The source of this water appears to be shallow groundwater (springs) and seepage from the reservoir. As documented in previous studies by USGS, groundwater studies at the ATK facility, and common knowledge amongst locals, most of the groundwater in the area is too salty for agricultural or domestic use without treatment.

Blue Creek flows for approximately 8 miles from the dam to the northern boundary of ATK's property. From there, Blue Creeks continues in a defined channel for approximately 9 miles before becoming sheet flow (assuming water is present) on the Bear River Bay playa. Bear River

Bay Class 5E Transitional Waters/Class 5C Bear River Bay are approximately an additional 9 miles to the south of the ATK facility. Based on satellite photos, it appears that water from Blue Creek does not make it to 4208' before infiltrating or evaporating. The photos show a ubiquitous white crust on the playa characteristic of mineralization after water evaporates.

ATK discharges to Blue Creek under UDPES Permit 0024805 and this is the only permitted discharge in the Blue Creek watershed. The locations of the discharges are downstream of sample locations used to derive the site-specific criteria. The majority of agricultural use of the water occurs upstream of the ATK facility.

1.1.2 Uses

UAC R317-2-12 lists the designated uses of Blue Creek as:

- Class 2B, infrequent primary and secondary contact recreation,
- Class 3B warm water aquatic life,
- and Class 4 agriculture.

Only the Class 4 agricultural use has a numeric criterion for TDS,1,200 mg/l. Waters downstream of Blue Creek (Bear River Bay, Great Salt Lake) do not have the agricultural designated use.

As shown on Figure 1 and Figures 1 and 2 in ATK (2013), agricultural uses for water from Blue Creek Reservoir include stock watering and crop irrigation. Crops that are irrigated by flooding are: grass pasture, alfalfa, barley, wheat, and less than 40 acres of corn (USDA, 2012).

Agricultural uses of the water downstream of the ATK facility include stock watering, wildlife propagation, and limited irrigation for salt tolerant crops such as wheat grass and salt grass. Non-farming land uses included grazing and open range.

The Utah Division of Water Rights water right's database was searched and the results are presented in the Appendix E. Water Rights beneficial uses (different than water quality uses) include stock watering, crop irrigation, and wildlife propagation.

The original dam was constructed in 1904 (ATK, 2011). Blue Creek was an intermittent stream until 1975 when an earthquake changed the creek to perennial (ATK, 2011). The TDS criteria proposed in this document are based primarily on natural conditions as irreversibly modified by Blue Creek Reservoir. Existing uses will be protected because the site-specific standards are based on natural conditions.

1.1.3 Regulatory Bases

Site-specific criteria are permitted in the following situations in accordance with UAC R317-2-7.1:

> "Site-specific criterion may be adopted by rulemaking where biomonitoring data, bioassays, or other scientific analyses indicate that the statewide criterion is over or under protective of the designated uses or where natural or un-alterable conditions or other factors as defined in 40 CFR 131.10(g) prevent the attainment of the statewide criterion."

In 2013, Utah adopted a site-specific TDS criterion of a 2,200 mg/l (maximum) for Blue Creek Reservoir and higher TDS standards for Blue Creek based on natural conditions. During a subsequent review, the site-specific standards for Blue Creek were determined to be too low based on historical data not previously used to derive the standards and the methodologies and data were reviewed and new criteria proposed. Site-specific TDS criteria are appropriate for Blue Creek because based on the analyses presented in this document because of the factors of naturally occurring pollutant concentrations (CFR 131.10 (g)1.) and the irreversible conditions created by the dam (CFR 131.10 (g)4.).

1.2 METHODS

1.2.1 Data

TDS data for STORET 4960740 were available from 1989 to 2010. These data were downloaded from the DWQ AWQMS database. These data were supplemented by the data collected for the ATK (2013) study (Appendix B).

The ATK (2013) data were collected by ATK in accordance with the work plan in Appendix A. In summary, TDS monthly water samples were collected from 3 locations on Blue Creek for two years. The 3 sample locations are shown on Figure 3 of ATK (2013) in Appendix B. Sample location Blue Creek Upper is the same as STORET 4960740. The Blue Creek Below Dam site is considered representative of Blue Creek Reservoir TDS concentrations.

Initially for the ATK (2013) study, metals and major ions were quantified in addition to TDS concentrations. Representatives from ATK and DWQ met periodically to review the results and flow measurements were added for the second year and the metals and major ion analyses were discontinued. In addition to TDS concentrations and flow, the irrigation status of the reservoir diversions were recorded on the days that samples were collected.

To obtain additional data to identify the causes of the variation in TDS concentrations between the sites, DWQ and ATK staff investigated the TDS concentrations in surface waters entering Blue Creek in 2013 from other sources such as unnamed springs and drainages upstream of the ATK facility. Potential sources to Blue Creek were initially located using satellite imagery from Google Earth®. The creek was walked and a conductivity meter was used to estimate TDS concentrations by conversion using a site-specific calibration (ATK, 2013).

1.2.2. Data Analyses

The data were summarized, plotted, and reviewed. The data were explored for correlations. Statistical analyses were conducted using either Systat (v. 13) or the USEPA ProUCL (v. 5.0) software. Both exploratory and confirmatory analyses were used. *A priori* assumptions investigated include that TDS concentrations could be influenced by irrigation and/or season and that TDS concentrations from Blue Creek Reservoir were a different population than TDS concentrations for Blue Creek.

The initial evaluations were focused on the ATK (2013) data because data were collected monthly, irrigation status was recorded, and 2 additional sample locations were sampled. These data were specifically used to evaluate potential trends in TDS concentrations between sites and changes attributable to dam and/or irrigation activities. The results of these analyses were used to guide the analyses of the AWQMS data for STORET 4960740.

1.2.3. Criteria Derivation Central Tendency

The existing TDS criteria in Utah's water quality standards are presumed to be maximum criteria because no durations are specified. However, a single maximum-based criterion to represent an ambient-based criterion has a major limitation when determining discharge permit limits. Discharge concentrations that are consistently greater than the mean but less than the maximum would be allowed but this would allow an unintended increase in concentrations above the ambient concentrations. To control for this potential, an average criterion was derived for Blue Creek in addition to maximum criterion. When implemented, the two criteria approach will be much more rigorous than a single criterion approach because long-term variability is characterized by average criterion and short term variability is characterized by the maximum criterion.

USEPA does not provide specific guidance on how ambient-based criteria should be derived. USEPA (2015) guidance is available regarding when ambient-based criteria are appropriate. The USEPA (2013) ProUCL Technical Guidance does provide recommendations for estimating both central tendencies, such as averages, and upper percentile values (UPVs), such as maximums, for environmental datasets. Although this guidance was developed primarily for supporting risk assessments for the RCRA and CERCLA programs, the statistical applications are similar. Chapter 3 from USEPA (2013) that discusses the statistical characterization of background concentrations is excerpted in Appendix G for the convenience of the reader.

The primary focus of USEPA (2013) for central tendency values is on calculating the most appropriate 95% upper confidence limit of the mean to comply with USEPA risk assessment guidance for calculating an exposure point concentration. For this application, the data quality objective is to minimize the potential that the exposure point concentration will be underestimated and hence the recommendation to use the upper confidence limit of the mean.

The data quality objectives for a central tendency TDS criterion based on ambient concentrations are different. The central tendency criterion has two major applications: assessment and permitting. For assessment, future TDS concentrations will be compared to the criterion to determine if Blue Creek is impaired. False positives (erroneously concluding that TDS concentrations exceed ambient concentrations) have potentially costly implications because resources would be expended on an unnecessary TMDL (total maximum daily load). False negatives (erroneously concluding that TDS concentrations are within ambient concentrations) are also undesirable because the water quality would unknowingly impaired. The potential for false positives and negatives must be balanced because without collecting additional data, the false positive and false negative rates are inversely proportional where decreasing one will increase the other.

For permitting applications, a central tendency value that was too low would unnecessarily require more stringent effluent limits which could be costly. A central tendency value that was too high could potentially allowed unintended degradation of water quality above the natural conditions. To balance the potential for decision errors for permitting applications, the central tendency value recommended is the arithmetic mean without upper or lower confidence limits.

The unadjusted mean however is not viable for assessments. Water quality assessments are conducted every 2 years using the available data. If assessments were conducted by comparing the sample means to the average criterion, the decision error rate would be 0.50, i.e., there is a 50% chance that the sample mean will be greater than the average criterion when the underlying TDS concentrations are actually not different from the ambient concentrations. An appropriate statistical test (e.g., t-test or prediction limits) that controls for these potential decision errors is recommended.

USEPA (2013) provides recommendations for setting comparison values *a priori* that are statistically based. The 95% upper confidence limit of the mean was considered but this parameter only considers the variability in the ambient concentrations without considering the variability of the future samples collected for the assessment. The 95% upper prediction limits for the mean consider both the variability in ambient concentrations and variability in the future assessment samples (USEPA, 2013). With an upper prediction limit, the number of future samples used to estimate the mean must be specified. USEPA (2009) recommends that a minimum of 8 samples be used to construct prediction limits. This requirement is one of the limitations of this approach because the resulting comparison value is sensitive to the number of samples. For these reasons, specific comparison values for assessing compliance with the average are not specified in the site-specific standard but examples are provided in this document.

In cases where a sufficient number of samples were collected to assess the average criterion, water quality can still be assessed by comparisons to the maximum criterion described in Section 1.2.4.

1.2.4. Criteria Derivation Maximum

The maximum criteria are derived using estimates of upper percentile values (UPVs). The maximum criteria have the same applications as the average criteria for assessment and permitting. Also similar to the average criterion, the maximum criterion includes the potential for decision errors with similar consequences when implementing the maximum criterion.

USEPA (2013) includes many more choices/approaches for estimating a UPV than for the central tendency (see Appendix G). The ideal UPV would be the true maximum TDS concentration (along with the frequency and duration) but this concentration is unknown and must be estimated from the sample data.

Statistical methods can be used to estimate percentiles such as the 90^{th}, 95^{th}, and 99^{th}. A 90^{th} percentile would reduce the potential for false negative decisions during assessment but the potential for false positives would be increased because 10 percent of the ambient TDS concentrations are greater than the 90^{th} percentile by definition. This could result in false positives (the actual probability would be higher because 10 percent assumes that true 90^{th} percentile is known).

The nonparametric options were not preferred for estimating the maximum criterion because distributional testing indicated that the data could be modeled using either a lognormal or normal distribution. The parametric methods are preferred for this application when supported by the data (USEPA, 2009). Upper prediction limits were not preferred because of their sensitivity to the number of future observations and that upper prediction limits with their limitations were already being used for assessing the average criterion.

Previous derivations of the maximum TDS criteria for Blue Creek were based on 95^{th} or 99^{th}

percentile estimates. In comments, USEPA Region 8 questioned whether these percentiles were appropriate because when assessing water quality, Utah's water quality standards allow for up 10% of the sample results to exceed the TDS criterion and the water quality would be concluded to meet the criterion. As a compromise to reduce the potential for disapproval of the standard by USEPA Region 8, the 90% upper tolerance limit was selected for the maximum criteria. The 90th percentile has a higher probability of resulting in false positives during assessment but is more protective than higher percentiles.

1.3 RESULTS AND DISCUSSION

1.3.1 Results and Discussion of ATK (2013) Study

The results for TDS and Flow for each sample site from the ATK (2013) study are summarized in Table 1. Box plots of TDS and flow are provided on Figures 2 and 3, respectively. Table 2 summarizes the same data based on whether irrigation was occurring. Box plots based on irrigation status are also included in Figures 2 and 3.

As shown by the flow data on Table 2 and Figure 3, Blue Creek is a gaining stream that increases with volume as it moves down gradient. No tributaries are present which supports that groundwater is the significant source of water. For the Below Dam site, TDS concentrations were higher when irrigation water is being diverted and a low negative correlation with flow was observed with a Pearson Correlation Coefficient of -0.21. TDS concentrations showed relatively little variance with a range of 1,890 to 2,110 mg/l (Table 1). A poor correlation was expected at this site because flow is controlled by dam releases in response to irrigation demands and not water inputs to the reservoir.

At the sample site at the upstream boundary of the ATK property, Blue Creek Upper, a positive correlation between TDS and flow was observed with a Pearson's Correlation Coefficient of 0.29. While the correlation was stronger than observed at the other sites, flow explained less than 10% of the variation in TDS concentrations. TDS concentrations were variable, ranging from 2,260 to 6,270 mg/l at the Blue Creek Upper sample site. TDS concentrations increased when no irrigation was occurring which the opposite of this trend was observed at the Crossing site (Table 1, Figure 2). The mean difference in TDS concentrations between irrigating and not irrigating was a modest 600 mg/l at the Upper site.

TDS concentrations increase moving downstream between the dam and the Blue Creek Upper site as shown by the differences in median concentrations at the dam of 1,990 mg/l, to 3,180 mg/l at the Blue Creek Crossing site, to 4,220 mg/l at the Blue Creek Upper site. These reaches were further investigated to locate and measure specific sources of incoming TDS waters. Several sources of saline inputs that appear to originate from springs were identified (Table 1 in

ATK, 2013). The maximum concentration measured in these sources was 31,300 mg/l. The local ranchers report that groundwater in the area was generally unsuitable for irrigation or potable uses.

The precise irreversible impacts of the dam on TDS concentrations in Blue Creek were difficult to discern. Without the dam, the lower TDS water from Blue Springs would flow down Blue Creek instead of being stored. Other inputs to Blue Creek from springs are generally higher in TDS, so the TDS concentrations in Blue Creek should be lower at those times when water from the dam discharges to Blue Creek. However, the changes in TDS concentrations under the different dam operating scenarios (Figure 6 in Appendix B) don't appear to support this hypothesis. Additional analyses to normalize for seasonality or a more robust data set and hydrologic modeling might identify a trend but the existing data suggests that the effect of the dam is small.

The data supports that irrigation return flows are not a significant source of TDS because TDS concentrations in Blue Creek are lower during the irrigation season. Therefore, additional best management practices for irrigation would not result in the compliance with the statewide TDS standard.

Other than the reservoir, no specific hydrological features (e.g., confluence) or marked changes in TDS were observed. The reservoir has relatively consistent TDS concentrations that are greater than the statewide TDS criterion of 1,200 mg/l. Below the dam, TDS concentrations increase rapidly with a larger increase between the dam and the Blue Creek Crossing site than between the Blue Creek Crossing site and the Blue Creek Upper. The distance from ATK's property to the dam is approximately 8 miles. A single site-specific criterion is proposed for this reach, including extending downstream to Great Salt Lake. Although no specific data are available for the reach between ATK and the Great Salt Lake, salinity typically increases as creeks approach the lake and are influenced by saline sediments and future investigations may determine that additional site-specific criteria are appropriate.

1.3.2 Data Summary STORET 4960740/Blue Creek Upper

The Blue Creek Upper sample site is the location of STORET 4960740, the only sample site used by DWQ to assess the water quality of Blue Creek. This site will likely to remain the primary sample site for assessing the future water quality of Blue Creek and the site-specific standards are based on the data from only this location. Assessments to determine if Blue Creek is meeting the standard should also be based on the total dissolved solids concentrations observed at this location.

Table 1. Summary Statistics for Total Dissolved Solids and Flow for Blue Creek Reservoir and Blue Creek, Box Elder County, Utah						
	BCBD_TDS (mg/l)	BCCR_TDS (mg/l)	BCU_TDS (mg/l)	BCBD_FLOW (gal/min)	BCCR_FLOW (gal/min)	BCU_FLOW (gal/min)
N of Cases	29	32	32	28	27	24
Minimum	1,890	2,470	2,260	0	0	0
Maximum	2,110	5,060	6,270	11,162	8,079	11,438
Median	1,990	3,180	4,220	374	1,434	2,428
Arithmetic Mean	2,007	3,297	4,261	774	1,847	2,712
Geometric Mean	2,006	3,254	4,184	.	.	.
Standard Deviation	63.6	572.4	802.7	2094	1,776	2,548
Notes						
BC_BD	Blue Creek below Dam (Representative of Reservoir)					
BCCR	Blue Creek Crossing					
BC_U	Blue Creek Upper					

Table 2. Summary Statistics for Total Dissolved Solids During Irrigation and No Irrigation in Blue Creek Box Elder County, Utah						
	Irrigation	Not Irrigating	Irrigation	Not Irrigating	Irrigation	Not Irrigating
	BCBD_TDS (mg/l)		BCCR_TDS (mg/l)		BCU_TDS (mg/l)	
N of Cases	19	10	19	13	19	13
Minimum	1890	1940	2600	2470	2260	4050
Maximum	2110	2100	4670	5060	5630	6270
Arithmetic Mean	1998	2025	3443	3085	4011	4626
Geometric Mean	1997	2024	3410	3039	3928	4589
Standard Deviation	69.6	48.8	492.4	632.9	818.3	645.5
Notes BC_BD BCCR BC_U	 Blue Creek below Dam Blue Creek Crossing Blue Creek Upper					

The ATK (2013) and DWQ datasets were combined to derive the site-specific standards for Blue Creek. As shown in the statistical summary Table 3 and Appendix C, TDS data are available for the Blue Creek Upper for 349 days from 1989 to 2013. The following evaluations were based on this data set.

1.3.3. Site-Specific Criteria for Blue Creek

TDS concentrations at the Blue Creek Upper (STORET 4960740) sample location varied much more than the reservoir. The Blue Creek Upper data were plotted, investigated for statistical outliers, and compared to known distributions. No outliers were identified initially using the ProUCL software (Appendix D). Monthly box plots of TDS concentrations were constructed for the Blue Creek Upper sample site (Figure 4). Based on a visual grouping, TDS concentrations from November through February (winter) appear to be more similar to each other than the TDS concentrations in the other months. TDS concentrations in the winter may be higher because of the lack of irrigation return flows in addition to reduced surface runoff due to temperatures below freezing.

In addition to season, the potential influences of irrigation activities on TDS concentrations were explored. The irrigation season was assumed to be from April 15 to December 15 based on the 2-year study conducted by ATK (2013). Figure 5 shows box plots for TDS concentrations at Blue Creek Upper when irrigation is occurring versus when no irrigation is occurring.

Average TDS concentrations are higher in the winter or when irrigation is not occurring. When the data was explored using a parametric analysis of variance (ANOVA) with irrigation and season as factors, season had a much stronger influence (Appendix E). The difference in mean TDS concentrations between irrigating and not-irrigating is only 351 mg/l. The difference in means between seasons was about 900 mg/l ($p<0.0001$).

Based on the low magnitude of differences in TDS concentrations based on irrigation status, subsequent analyses were conducted for seasonal differences in TDS concentrations with November, through February comprising the winter season and March through October comprising the summer season. The datasets were again analyzed for outliers and the October 30, 1992 value of 7,180 mg/l was identified as an outlier. This was the highest TDS concentration observed with the next highest concentration being 6,724 mg/l. This data point (7,180 mg/l) was concluded to be a statistical outlier and was not included in further statistical analyses for the summer season.

Table 3. Summary Statistics for Sample Site Blue Creek Upper

Number	Minimum TDS Concentration (mg/L)	Maximum TDS Concentration (mg/L)	Mean TDS Concentration (mg/L)	Standard Deviation TDS Concentration (mg/L)
349	1,649	7,180	4,121	943.7
Notes: TDS = total dissolved solids				

Table 4. Summary Statistics for Sample Site Blue Creek Upper by Season					
Season	Number	Minimum TDS Concentration (mg/L)	Maximum TDS Concentration (mg/L)	Mean TDS Concentration (mg/L)	Standard Deviation TDS Concentration (mg/L)
Summer	235	2,250	6,270	3,822	716
Winter	113	1,649	6,724	4,714	1,035
Notes:					
TDS	total dissolved solids				

Summary statistics based on seasons are summarized in Table 4 and the box plots shown on Figure 6. Distributional testing suggests that the summer TDS concentrations are lognormally or gamma distributed. TDS concentrations for the winter season appear to be normally distributed (Appendix D).

1.3.3.1 Blue Creek Summer Season Criteria

For the summer season, the mean TDS concentration of 3,800 mg/l is recommended for the average criterion (Table 4). This value is based on a log transformation of the data and then converting back to an untransformed value (USEPA, 2009 p. 18-5).

When assessing water quality for meeting the average criterion, **the mean of the assessment samples should not be directly compared to average criterion.** Instead, a statistical method that is consistent with the derivation of the average criteria should be used. Table 5 summarizes example comparison values (CVs) to assess if TDS concentrations are meeting the average criteria. As discussed in Section 1.2.3., the UPL is generally preferred and at least 10 samples are recommended based on the results of hypothetical water quality assessments using the existing TDS data.

Potential UPVs for the maximum criterion were predicted for the summer season assuming a lognormal distribution and nonparametric assumptions are shown in Table 6 and range from 4,900 to 7,200 mg/l. For Blue Creek in the summer season, the 95% upper tolerance limit (UTL) with 90% coverage of 4,100 mg/l is selected for the maximum criterion. The 90th percentile of the summer TDS dataset is 4,900 suggesting that false positive water quality impairments may occur but if they are false positives, they should be able to be resolved with additional sample results.

Figure 7 shows a histogram of the summer season TDS data with both the proposed average and the maximum criteria.

Table 5. Example Comparison Values (CVs) for Assessing the Summer Season TDS Average Criterion of 3,800 (mg/l)	
95% Adjusted-CLT UCL (Adjusted for Skewness, Chen-1995)	3,900
95% Modified-t UCL (Adjusted for Skewness, Johnson-1978))	3,900
95% Hall's Bootstrap UCL	3,900
95% Bootstrap t UCL	3,900
95% BCA Bootstrap UCL	3,900
95% Chebyshev (Mean, Sd) UCL	4,000
97.5% Chebyshev (Mean, Sd) UCL	4,100
99% Chebyshev (Mean, Sd) UCL	4,300
95% H-UCL	3,900
95% Chebyshev (MVUE) UCL	4,000
97.5% Chebyshev (MVUE) UCL	4,100
99% Chebyshev (MVUE) UCL	4,300
95% UPL for Mean of Next 6 Observations	4,300
95% UPL for Mean of Next 10 Observations	4,100
Notes: UCL = upper confidence limit UPL = upper prediction limit	

Table 6. Potential Upper Percentile Values (UPVs) for a Summer Season TDS Maximum Criterion (mg/l)	
Lognormal 95% UTL with 99% Coverage	6,000
Lognormal 95% UTL with 95% Coverage	5,300
Lognormal 95% UPL(t)	5100
Lognormal 95% UPL for Next 10 Observations	6,100
Lognormal 95% USL	7,200
Nonparametric 95% Percentile Bootstrap UTL with 99% Coverage	6,100
Nonparametric 95% UPL	5,200
Nonparametric 95% Chebyshev UPL	6,900
Nonparametric 95% USL	6,300
Nonparametric 95% UTL with 99% Coverage	5,900
95% BCA Bootstrap UTL with 99% Coverage	6,100
Lognormal 95% UTL with 90% Coverage	**4,900**
Notes: UPL = Upper Prediction Limit UTL = Upper Tolerance Limit USL = Upper Simultaneous Limit	

1.3.3.2. Derivation of Winter Season Criteria

For the winter season, the mean TDS concentration of 4,700 mg/l is recommended for the average criterion (Table 4). As with the summer season average criterion, **the mean of the assessment samples should not be directly compared to average criterion.** Instead, a statistical method that is consistent with the derivation of the average criteria should be used. Table 7 summarizes example comparison values (CVs) to assess if TDS concentrations are meeting the average criteria. As discussed in Section 1.2.3., the UPL is generally preferred and at least 10 samples are recommended based on the results of hypothetical water quality assessments using the existing TDS data.

UPVs for a potential maximum criterion for the winter season were predicted assuming a normal distribution. As for summer, only parametric UPVs were considered. The 95 upper tolerance limits of the 90th, 95th and 99th percentiles and the 95% USL range from 6,300 to 8,100 mg/l (Table 8). The 6,300 mg/l 95% UTL with 90% coverage is selected as the maximum criterion. The 90th percentile of the winter TDS dataset is 6,000 and a comparison with the existing TDS data suggests a lower potential for false positive water quality impairments than when assessing the summer season maximum. False positive water quality impairment decisions should be able to be resolved with additional sample results if they occur. Figure 7 shows a histogram of the winter season TDS data with both the proposed average and maximum criteria.

1.3.3.3. Duration and Frequency

Both the winter and summer criteria were derived using the same methods and the same duration and frequency are recommended for both. The duration for the maximum criterion is recommended to be daily because the derivation was based on daily measurements. The frequency of exceedance is recommended to be no more than 10 percent in accordance with UAC R317-2-7.1. The methods used to derive the average criteria support an averaging time (duration) of 23 years. However, a 23 year averaging time is impractical and one year, or shorter, is recommended. One year or shorter averaging times will be protective of longer averaging times.

1.3.3.4. Trends

The criteria were based on the TDS spanning a 24 year period. When this data is graphed, the slope of the trend line is positive and statistically significant. The trend observed over this time period suggests that TDS concentrations may have increased on average by over 700 mg/l over the 24 year period. If this trend continues, the site-specific standards will have to be recalculated in the future.

Table 7. Example Comparison Values (CVs) for Assessing the Winter Season Average TDS Criterion of 4,700 (mg/l)	
95% UCL(t)	4,900
95% UPL for Mean of Next 6 Observations	5,400
95% UPL for Mean of Next 10 Observations	**5,300**

1.3.4. Site-Specific Criteria for Blue Creek Reservoir

For the reservoir, a single maximum criterion of 2,100 mg/l TDS based on a 95% UTL with 90% coverage is recommended. TDS concentrations showed little variation in the reservoir, and the other upper-percentile estimates were all similar. For instance, 2,100 mg/l based on the 90th percentile and 95% UTL with 90% coverage were the lowest upper bound estimates.

Table 8. Potential Upper Percentile Values (UPVs) for Winter Season TDS Maximum Criterion (mg/l)	
Normal 95% UTL with 99% Coverage	7,500
Normal 95% UTL with 95% Coverage	6,700
Normal 95% UPL(t)	6,400
Normal 95% UPL for Next 10 Observations	7,400
Normal 95% USL	8,100
Nonparametric 95% Percentile Bootstrap UTL with 99% Coverage	6,700
Nonparametric 95% UPL	6,200
Nonparametric 95% Chebyshev UPL	9,200
Nonparametric 95% USL	6,700
Nonparametric 95% UTL with 99% Coverage	6,700
95% BCA Bootstrap UTL with 99% Coverage	6,700
95% UTL with 90% Coverage	**6,300**
Notes: UPL = Upper Prediction Limit UTL = Upper Tolerance Limit USL = Upper Simultaneous Limit	

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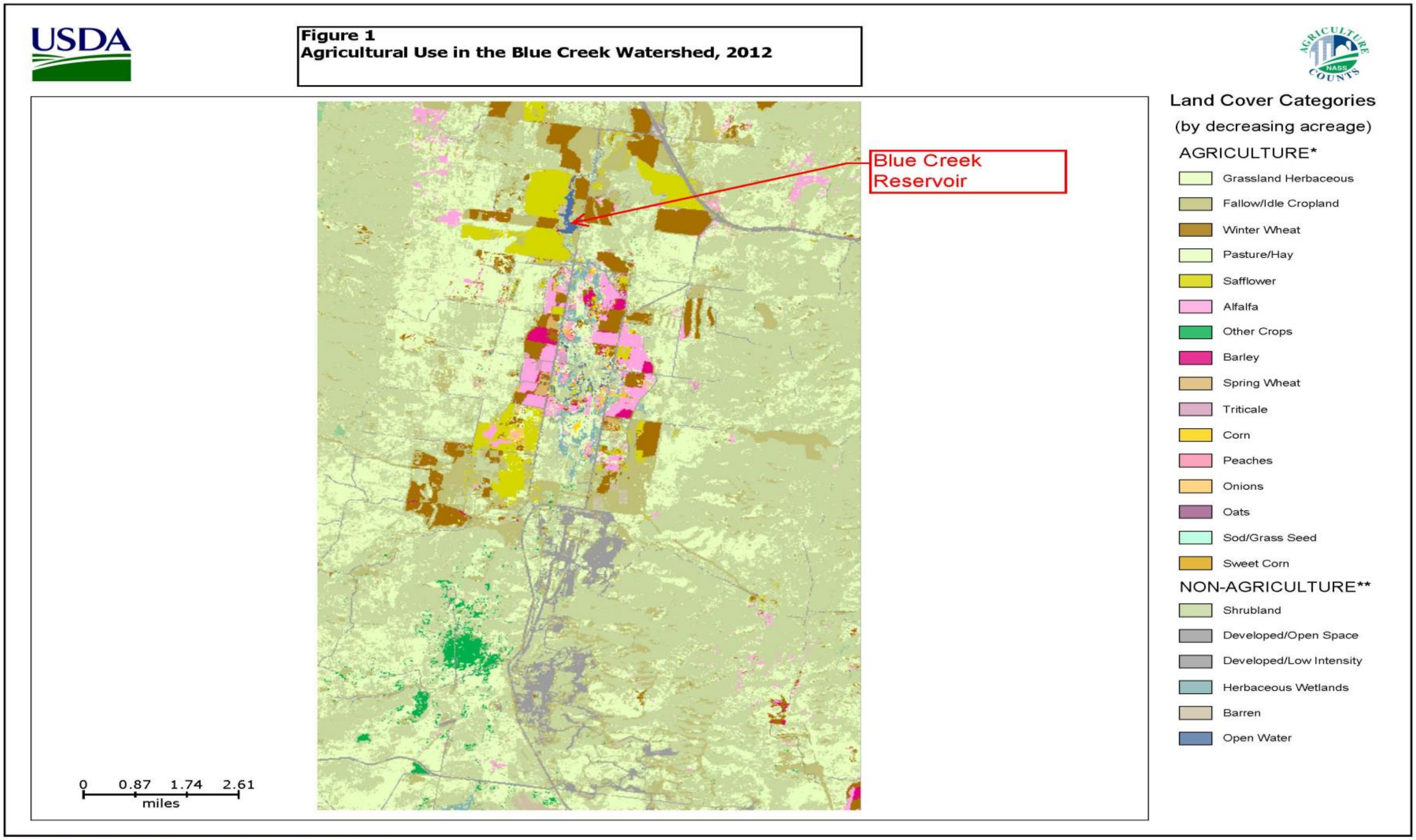
Figures



Produced by CropScape - http://nassgeodata.gmu.edu/CropScape

* Only top 16 agriculture categroies are listed. ** Only top 6 non-agriculture categroies are listed.

Figure 1. Agricultural Use in the Blue Creek Watershed

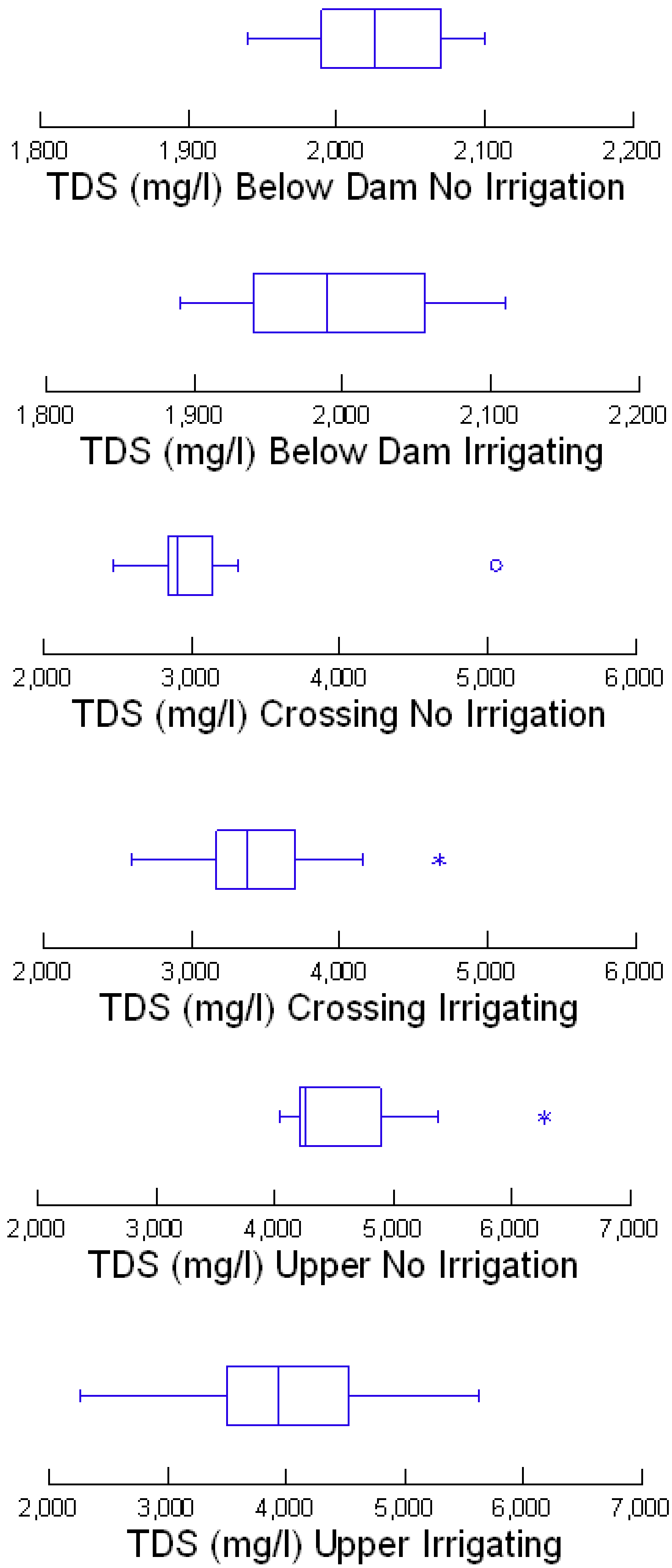


Figure 2. Box Plots for Total Dissolved Solids, Blue Creek, Box Elder County, Utah

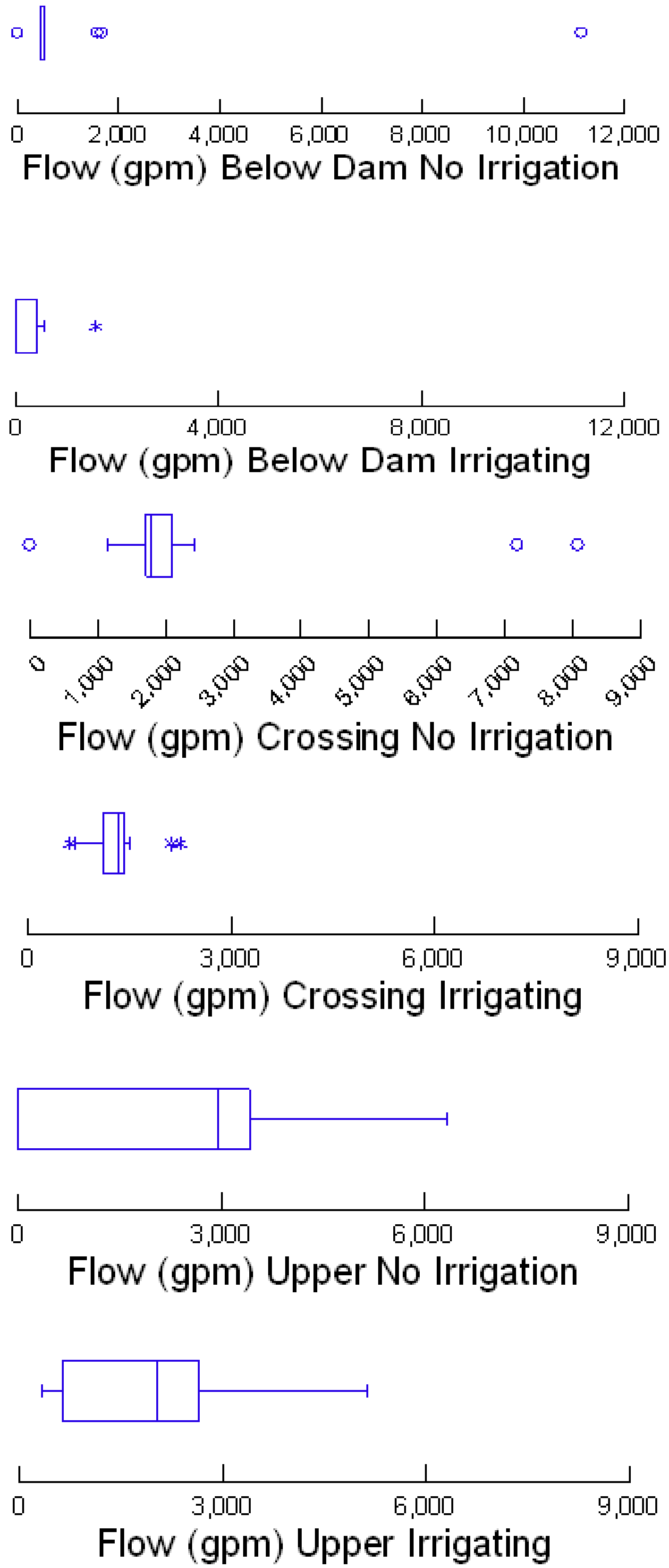


Figure 3. Box Plots for Flow, Blue Creek, Box Elder County, Utah

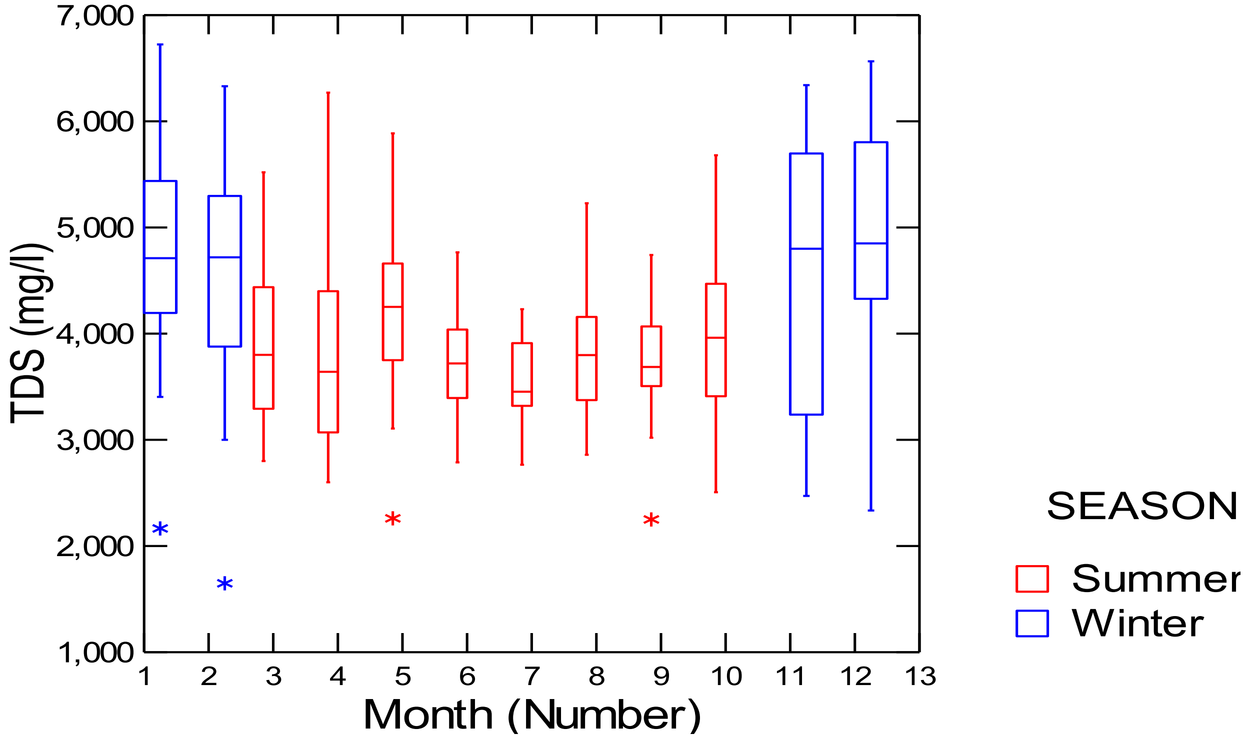


Figure 4. Box Plots of total dissolved solids (TDS) at the Blue Creek Upper Site by Month and Season

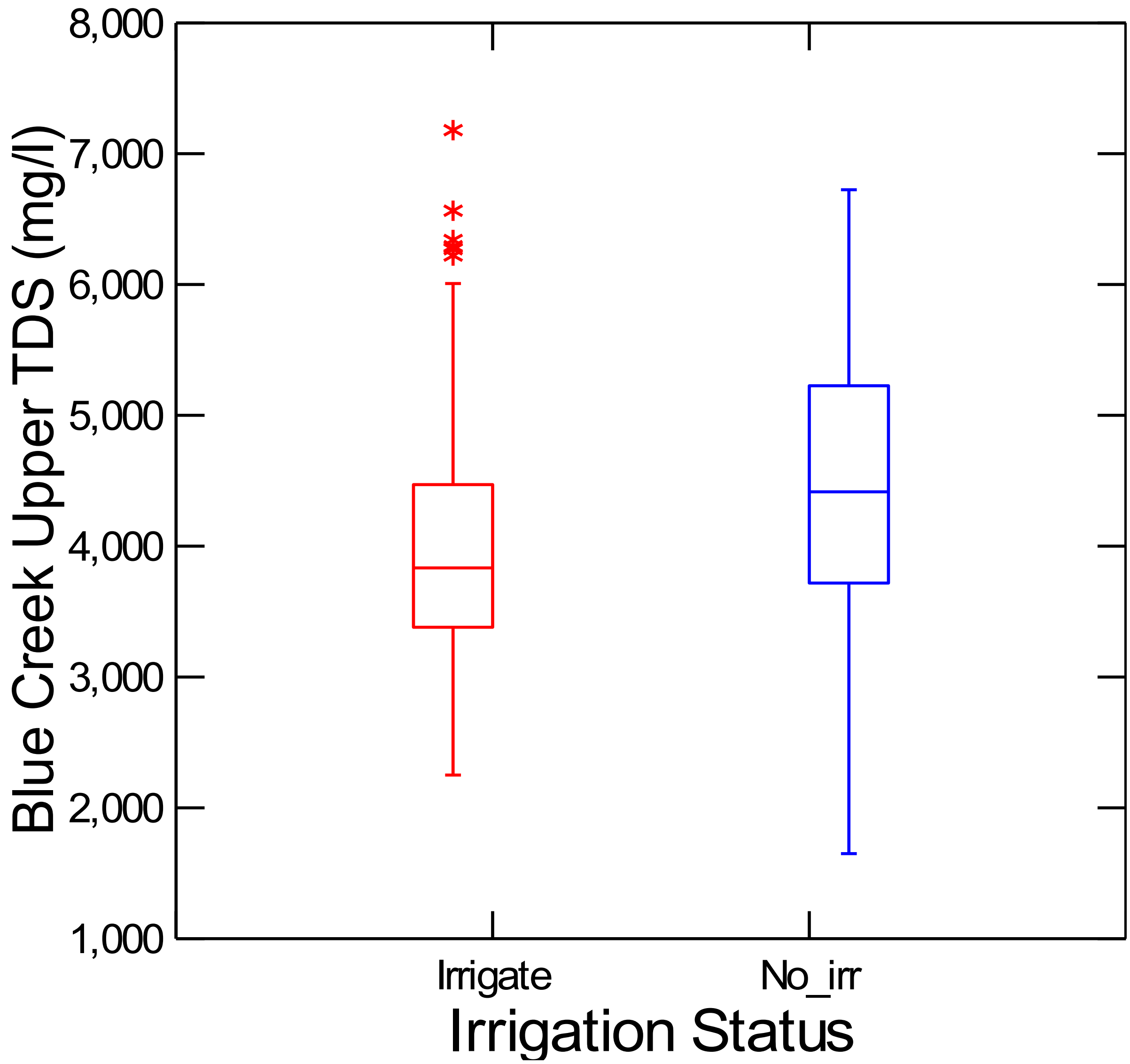


Figure 5. Box Plots of total dissolved solids (TDS) at the Blue Creek Upper Site by Irrigation Season

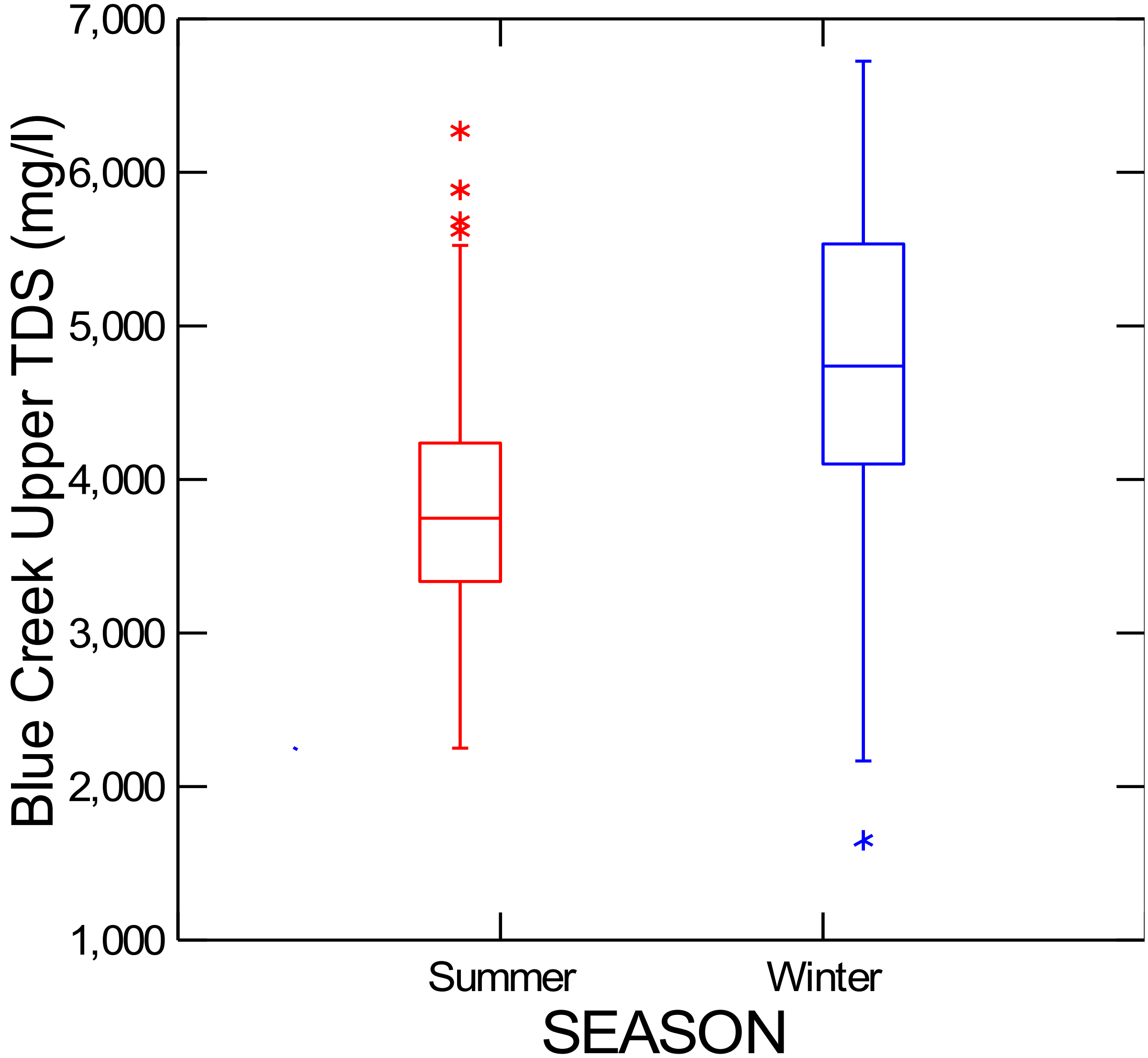


Figure 6. Box Plots of total dissolved solids (mg/l) at the Blue Creek Upper Site by Season

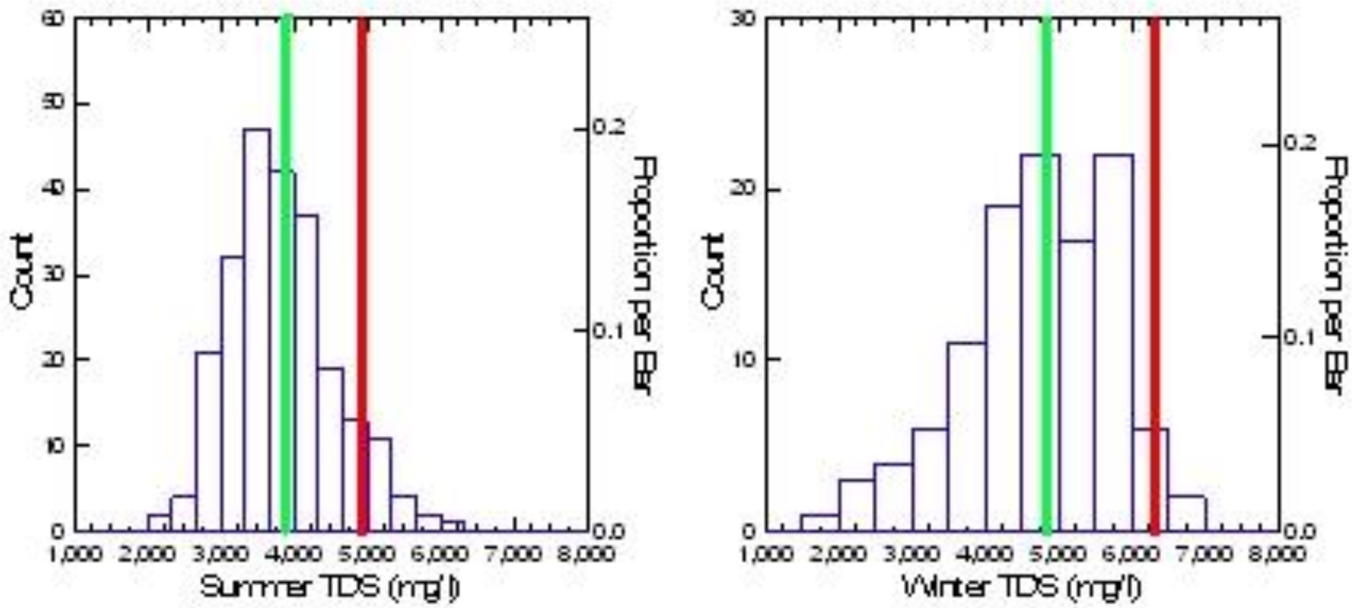


Figure 7. Histograms of Blue Creek summer and winter seasons total dissolved solids concentrations with proposed average (green lines) and maximum (red lines) criteria

APPENDIX A WORK PLAN FOR THE DEVELOPMENT OF A NEW SITE-SPECIFIC TDS CRITERION FOR BLUE CREEK, JUNE, 2011

APPENDIX B BLUE CREEK SITE-SPECIFIC STANDARD FOR TOTAL DISSOLVED SOLIDS (TDS) CRITERION MONITORING REPORT, ATK LAUNCH SYSTEMS PROMONTORY, JULY 11, 2013

APPENDIX C TOTAL DISSOLVED SOLIDS DATA

- Blue Creek Upper ATK and DWQ STORET 4960740 Data

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
6/2/1989	4038	Irrigate	1989	4038	Summer	June
6/16/1989	3348	Irrigate	1989	3348	Summer	June
6/29/1989	3536	Irrigate	1989	3536	Summer	June
7/7/1989	3910	Irrigate	1989	3910	Summer	July
7/21/1989	4200	Irrigate	1989	4200	Summer	July
8/11/1989	3726	Irrigate	1989	3726	Summer	Aug
8/25/1989	4864	Irrigate	1989	4864	Summer	Aug
9/8/1989	3130	Irrigate	1989	3130	Summer	Sept
9/22/1989	3020	Irrigate	1989	3020	Summer	Sept
10/6/1989	3022	Irrigate	1989	3022	Summer	Oct
10/20/1989	3066	Irrigate	1989	3066	Summer	Oct
11/3/1989	2916	Irrigate	1989	2916	Winter	Nov
11/16/1989	2472	Irrigate	1989	2472	Winter	Nov
12/1/1989	2334	Irrigate	1989	2334	Winter	Dec
12/12/1989	3824	Irrigate	1989	3824	Winter	Dec
1/5/1990	3404	No_irr	1990	3404	Winter	Jan

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
1/19/1990	4408	No_irr	1990	4408	Winter	Jan
2/2/1990	3876	No_irr	1990	3876	Winter	Feb
2/16/1990	3752	No_irr	1990	3752	Winter	Feb
3/2/1990	2800	No_irr	1990	2800	Summer	March
3/16/1990	2850	No_irr	1990	2850	Summer	March
3/30/1990	4068	No_irr	1990	4068	Summer	March
4/13/1990	3112	Irrigate	1990	3112	Summer	April
4/27/1990	3308	Irrigate	1990	3308	Summer	April
5/11/1990	3768	Irrigate	1990	3768	Summer	May
5/25/1990	4588	Irrigate	1990	4588	Summer	May
6/7/1990	4030	Irrigate	1990	4030	Summer	June
6/22/1990	3172	Irrigate	1990	3172	Summer	June
7/6/1990	3744	Irrigate	1990	3744	Summer	July
7/20/1990	3664	Irrigate	1990	3664	Summer	July
8/3/1990	4202	Irrigate	1990	4202	Summer	Aug
8/17/1990	3880	Irrigate	1990	3880	Summer	Aug

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
8/31/1990	3660	Irrigate	1990	3660	Summer	Aug
9/14/1990	3672	Irrigate	1990	3672	Summer	Sept
9/28/1990	2250	Irrigate	1990	2250	Summer	Sept
10/12/1990	2572	Irrigate	1990	2572	Summer	Oct
10/26/1990	2624	Irrigate	1990	2624	Summer	Oct
11/9/1990	2536	Irrigate	1990	2536	Winter	Nov
11/21/1990	5596	Irrigate	1990	5596	Winter	Nov
12/7/1990	4328	Irrigate	1990	4328	Winter	Dec
12/21/1990	4286	No_irr	1990	4286	Winter	Dec
1/4/1991	4744	No_irr	1991	4744	Winter	Jan
1/18/1991	3700	No_irr	1991	3700	Winter	Jan
2/12/1991	3558	No_irr	1991	3558	Winter	Feb
2/22/1991	3320	No_irr	1991	3320	Winter	Feb
3/8/1991	3212	No_irr	1991	3212	Summer	March
3/22/1991	4222	No_irr	1991	4222	Summer	March
4/5/1991	2868	No_irr	1991	2868	Summer	April

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
4/19/1991	3742	Irrigate	1991	3742	Summer	April
5/3/1991	4364	Irrigate	1991	4364	Summer	May
5/17/1991	3380	Irrigate	1991	3380	Summer	May
5/31/1991	5620	Irrigate	1991	5620	Summer	May
6/12/1991	3394	Irrigate	1991	3394	Summer	June
6/18/1991	3172	Irrigate	1991	3172	Summer	June
6/21/1991	3842	Irrigate	1991	3842	Summer	June
6/25/1991	4766	Irrigate	1991	4766	Summer	June
7/12/1991	3038	Irrigate	1991	3038	Summer	July
7/26/1991	3698	Irrigate	1991	3698	Summer	July
8/6/1991	3800	Irrigate	1991	3800	Summer	Aug
8/23/1991	4200	Irrigate	1991	4200	Summer	Aug
9/6/1991	3700	Irrigate	1991	3700	Summer	Sept
9/20/1991	3500	Irrigate	1991	3500	Summer	Sept
9/24/1991	3550	Irrigate	1991	3550	Summer	Sept
10/1/1991	3500	Irrigate	1991	3500	Summer	Oct

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
10/16/1991	3400	Irrigate	1991	3400	Summer	Oct
11/1/1991	4400	Irrigate	1991	4400	Winter	Nov
11/12/1991	4084	Irrigate	1991	4084	Winter	Nov
11/13/1991	4200	Irrigate	1991	4200	Winter	Nov
11/27/1991	5300	Irrigate	1991	5300	Winter	Nov
12/13/1991	4700	Irrigate	1991	4700	Winter	Dec
12/23/1991	3900	No_irr	1991	3900	Winter	Dec
1/10/1992	4600	No_irr	1992	4600	Winter	Jan
1/16/1992	4120	No_irr	1992	4120	Winter	Jan
1/24/1992	3800	No_irr	1992	3800	Winter	Jan
2/7/1992	3000	No_irr	1992	3000	Winter	Feb
2/21/1992	4100	No_irr	1992	4100	Winter	Feb
2/25/1992	3832	No_irr	1992	3832	Winter	Feb
3/6/1992	3600	No_irr	1992	3600	Summer	March
3/20/1992	3000	No_irr	1992	3000	Summer	March
4/3/1992	2600	No_irr	1992	2600	Summer	April

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
4/14/1992	2718	Irrigate	1992	2718	Summer	April
4/17/1992	2800	Irrigate	1992	2800	Summer	April
4/29/1992	4500	Irrigate	1992	4500	Summer	April
5/15/1992	3800	Irrigate	1992	3800	Summer	May
5/29/1992	4400	Irrigate	1992	4400	Summer	May
6/2/1992	4702	Irrigate	1992	4702	Summer	June
6/12/1992	3400	Irrigate	1992	3400	Summer	June
6/25/1992	4000	Irrigate	1992	4000	Summer	June
7/9/1992	4000	Irrigate	1992	4000	Summer	July
7/21/1992	3924	Irrigate	1992	3924	Summer	July
7/22/1992	3600	Irrigate	1992	3600	Summer	July
8/6/1992	3930	Irrigate	1992	3930	Summer	Aug
8/21/1992	4490	Irrigate	1992	4490	Summer	Aug
9/2/1992	3530	Irrigate	1992	3530	Summer	Sept
9/9/1992	3686	Irrigate	1992	3686	Summer	Sept
10/2/1992	4020	Irrigate	1992	4020	Summer	Oct

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
10/13/1992	5020	Irrigate	1992	5020	Summer	Oct
10/20/1992	5242	Irrigate	1992	5242	Summer	Oct
10/30/1992	7180	Irrigate	1992		Summer	Oct
11/13/1992	5916	Irrigate	1992	5916	Winter	Nov
11/25/1992	3094	Irrigate	1992	3094	Winter	Nov
12/8/1992	4468	Irrigate	1992	4468	Winter	Dec
12/10/1992	5812	Irrigate	1992	5812	Winter	Dec
12/23/1992	4736	No_irr	1992	4736	Winter	Dec
1/13/1993	4749	No_irr	1993	4749	Winter	Jan
1/29/1993	5534	No_irr	1993	5534	Winter	Jan
2/11/1993	5116	No_irr	1993	5116	Winter	Feb
2/23/1993	5280	No_irr	1993	5280	Winter	Feb
2/26/1993	4296	No_irr	1993	4296	Winter	Feb
3/12/1993	4437	No_irr	1993	4437	Summer	March
3/26/1993	3293	No_irr	1993	3293	Summer	March
4/9/1993	4488	No_irr	1993	4488	Summer	April

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
4/28/1993	3264	Irrigate	1993	3264	Summer	April
5/4/1993	3750	Irrigate	1993	3750	Summer	May
5/13/1993	3106	Irrigate	1993	3106	Summer	May
5/27/1993	4136	Irrigate	1993	4136	Summer	May
6/4/1993	4231	Irrigate	1993	4231	Summer	June
6/15/1993	4124	Irrigate	1993	4124	Summer	June
6/18/1993	4528	Irrigate	1993	4528	Summer	June
6/30/1993	3668	Irrigate	1993	3668	Summer	June
7/9/1993	3536	Irrigate	1993	3536	Summer	July
7/20/1993	3116	Irrigate	1993	3116	Summer	July
8/6/1993	3652	Irrigate	1993	3652	Summer	Aug
8/20/1993	4115	Irrigate	1993	4115	Summer	Aug
8/24/1993	4728	Irrigate	1993	4728	Summer	Aug
9/2/1993	3853	Irrigate	1993	3853	Summer	Sept
9/16/1993	4233	Irrigate	1993	4233	Summer	Sept
9/30/1993	4561	Irrigate	1993	4561	Summer	Sept

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
10/12/1993	3556	Irrigate	1993	3556	Summer	Oct
10/15/1993	3522	Irrigate	1993	3522	Summer	Oct
10/29/1993	2918	Irrigate	1993	2918	Summer	Oct
11/11/1993	2783	Irrigate	1993	2783	Winter	Nov
11/23/1993	5702	Irrigate	1993	5702	Winter	Nov
12/10/1993	5803	Irrigate	1993	5803	Winter	Dec
12/22/1993	5592	No_irr	1993	5592	Winter	Dec
1/7/1994	5385	No_irr	1994	5385	Winter	Jan
1/21/1994	5334	No_irr	1994	5334	Winter	Jan
2/4/1994	4737	No_irr	1994	4737	Winter	Feb
2/18/1994	3881	No_irr	1994	3881	Winter	Feb
3/9/1994	3735	No_irr	1994	3735	Summer	March
3/23/1994	4933	No_irr	1994	4933	Summer	March
4/13/1994	3336	No_irr	1994	3336	Summer	April
4/19/1994	2986	Irrigate	1994	2986	Summer	April
4/29/1994	3456	Irrigate	1994	3456	Summer	April

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
5/11/1994	5042	Irrigate	1994	5042	Summer	May
5/26/1994	3333	Irrigate	1994	3333	Summer	May
6/9/1994	3935	Irrigate	1994	3935	Summer	June
6/24/1994	3710	Irrigate	1994	3710	Summer	June
7/8/1994	3419	Irrigate	1994	3419	Summer	July
7/19/1994	3321	Irrigate	1994	3321	Summer	July
7/20/1994	3890	Irrigate	1994	3890	Summer	July
8/4/1994	3934	Irrigate	1994	3934	Summer	Aug
8/18/1994	3820	Irrigate	1994	3820	Summer	Aug
9/1/1994	3846	Irrigate	1994	3846	Summer	Sept
9/16/1994	3394	Irrigate	1994	3394	Summer	Sept
9/26/1994	3512	Irrigate	1994	3512	Summer	Sept
10/12/1994	3961	Irrigate	1994	3961	Summer	Oct
10/28/1994	4048	Irrigate	1994	4048	Summer	Oct
11/10/1994	4775	Irrigate	1994	4775	Winter	Nov
11/23/1994	2983	Irrigate	1994	2983	Winter	Nov

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
12/6/1994	4227	Irrigate	1994	4227	Winter	Dec
12/23/1994	4849	No_irr	1994	4849	Winter	Dec
1/12/1995	2166	No_irr	1995	2166	Winter	Jan
1/17/1995	4592	No_irr	1995	4592	Winter	Jan
1/26/1995	4031	No_irr	1995	4031	Winter	Jan
2/7/1995	5423	No_irr	1995	5423	Winter	Feb
2/20/1995	5437	No_irr	1995	5437	Winter	Feb
3/8/1995	4803	No_irr	1995	4803	Summer	March
3/22/1995	4003	No_irr	1995	4003	Summer	March
4/13/1995	3122	Irrigate	1995	3122	Summer	April
4/28/1995	5016	Irrigate	1995	5016	Summer	April
5/4/1995	4567	Irrigate	1995	4567	Summer	May
5/22/1995	5047	Irrigate	1995	5047	Summer	May
5/24/1995	5264	Irrigate	1995	5264	Summer	May
6/8/1995	3491	Irrigate	1995	3491	Summer	June
6/21/1995	2787	Irrigate	1995	2787	Summer	June

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
7/6/1995	3380	Irrigate	1995	3380	Summer	July
7/13/1995	3081	Irrigate	1995	3081	Summer	July
7/28/1995	3455	Irrigate	1995	3455	Summer	July
8/10/1995	2859	Irrigate	1995	2859	Summer	Aug
8/21/1995	3796	Irrigate	1995	3796	Summer	Aug
9/7/1995	3315	Irrigate	1995	3315	Summer	Sept
9/20/1995	4589	Irrigate	1995	4589	Summer	Sept
10/4/1995	5097	Irrigate	1995	5097	Summer	Oct
10/20/1995	4196	Irrigate	1995	4196	Summer	Oct
10/27/1995	5016	Irrigate	1995	5016	Summer	Oct
11/2/1995	5997	Irrigate	1995	5997	Winter	Nov
11/13/1995	6293	Irrigate	1995	6293	Winter	Nov
11/28/1995	4824	Irrigate	1995	4824	Winter	Nov
12/13/1995	6007	Irrigate	1995	6007	Winter	Dec
12/20/1995	5433	No_irr	1995	5433	Winter	Dec
1/11/1996	5468	No_irr	1996	5468	Winter	Jan

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
1/23/1996	5652	No_irr	1996	5652	Winter	Jan
1/26/1996	5407	No_irr	1996	5407	Winter	Jan
2/6/1996	4263	No_irr	1996	4263	Winter	Feb
2/20/1996	1649	No_irr	1996	1649	Winter	Feb
3/7/1996	3800	No_irr	1996	3800	Summer	March
3/20/1996	3070	No_irr	1996	3070	Summer	March
4/1/1996	2950	No_irr	1996	2950	Summer	April
4/17/1996	4240	Irrigate	1996	4240	Summer	April
5/8/1996	4074	Irrigate	1996	4074	Summer	May
5/22/1996	4660	Irrigate	1996	4660	Summer	May
6/7/1996	4240	Irrigate	1996	4240	Summer	June
6/19/1996	3040	Irrigate	1996	3040	Summer	June
7/16/1996	3780	Irrigate	1996	3780	Summer	July
7/30/1996	3352	Irrigate	1996	3352	Summer	July
7/31/1996	4170	Irrigate	1996	4170	Summer	July
8/7/1996	3310	Irrigate	1996	3310	Summer	Aug

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
8/22/1996	2970	Irrigate	1996	2970	Summer	Aug
9/10/1996	4270	Irrigate	1996	4270	Summer	Sept
9/25/1996	4740	Irrigate	1996	4740	Summer	Sept
10/9/1996	4070	Irrigate	1996	4070	Summer	Oct
10/24/1996	4824	Irrigate	1996	4824	Summer	Oct
11/8/1996	5770	Irrigate	1996	5770	Winter	Nov
11/20/1996	6340	Irrigate	1996	6340	Winter	Nov
12/3/1996	5980	Irrigate	1996	5980	Winter	Dec
12/18/1996	5590	No_irr	1996	5590	Winter	Dec
1/15/1997	4710	No_irr	1997	4710	Winter	Jan
1/30/1997	5170	No_irr	1997	5170	Winter	Jan
2/6/1997	5314	No_irr	1997	5314	Winter	Feb
2/10/1997	4940	No_irr	1997	4940	Winter	Feb
2/26/1997	3380	No_irr	1997	3380	Winter	Feb
3/12/1997	3570	No_irr	1997	3570	Summer	March
3/26/1997	3420	No_irr	1997	3420	Summer	March

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
4/8/1997	3070	No_irr	1997	3070	Summer	April
4/29/1997	3640	Irrigate	1997	3640	Summer	April
5/8/1997	4728	Irrigate	1997	4728	Summer	May
8/7/1997	3086	Irrigate	1997	3086	Summer	Aug
10/22/1997	2506	Irrigate	1997	2506	Summer	Oct
1/28/1998	4738	No_irr	1998	4738	Winter	Jan
5/14/1998	4254	Irrigate	1998	4254	Summer	May
7/14/1998	2766	Irrigate	1998	2766	Summer	July
10/27/1998	3182	Irrigate	1998	3182	Summer	Oct
1/20/1999	4422	No_irr	1999	4422	Winter	Jan
4/13/1999	2794	No_irr	1999	2794	Summer	April
8/18/1999	3662	Irrigate	1999	3662	Summer	Aug
4/3/2000	3136	No_irr	2000	3136	Summer	April
4/12/2000	2802	No_irr	2000	2802	Summer	April
6/22/2000	3372	Irrigate	2000	3372	Summer	June
7/12/2000	2977	Irrigate	2000	2977	Summer	July

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
8/9/2000	3548	Irrigate	2000	3548	Summer	Aug
10/6/2000	4485	Irrigate	2000	4485	Summer	Oct
1/25/2001	3638	No_irr	2001	3638	Winter	Jan
4/5/2001	3814	No_irr	2001	3814	Summer	April
7/2/2001	2952	Irrigate	2001	2952	Summer	July
7/26/2001	3958	Irrigate	2001	3958	Summer	July
10/2/2001	3436	Irrigate	2001	3436	Summer	Oct
11/6/2001	5192	Irrigate	2001	5192	Winter	Nov
11/7/2001	5692	Irrigate	2001	5692	Winter	Nov
1/11/2002	5765	No_irr	2002	5765	Winter	Jan
1/15/2002	5740	No_irr	2002	5740	Winter	Jan
4/2/2002	3812	No_irr	2002	3812	Summer	April
7/11/2002	2968	Irrigate	2002	2968	Summer	July
8/13/2002	4338	Irrigate	2002	4338	Summer	Aug
10/29/2002	4910	Irrigate	2002	4910	Summer	Oct
11/11/2002	5138	Irrigate	2002	5138	Winter	Nov

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
1/8/2003	5324	No_irr	2003	5324	Winter	Jan
2/4/2003	5526	No_irr	2003	5526	Winter	Feb
4/4/2003	4121	No_irr	2003	4121	Summer	April
5/15/2003	5886	Irrigate	2003	5886	Summer	May
7/8/2003	4147	Irrigate	2003	4147	Summer	July
7/15/2003	4198	Irrigate	2003	4198	Summer	July
8/19/2003	5228	Irrigate	2003	5228	Summer	Aug
9/23/2003	3996	Irrigate	2003	3996	Summer	Sept
10/2/2003	3965	Irrigate	2003	3965	Summer	Oct
10/28/2003	5524	Irrigate	2003	5524	Summer	Oct
12/2/2003	6222	Irrigate	2003	6222	Winter	Dec
1/13/2004	6724	No_irr	2004	6724	Winter	Jan
2/3/2004	5990	No_irr	2004	5990	Winter	Feb
2/17/2004	5250	No_irr	2004	5250	Winter	Feb
3/16/2004	5520	No_irr	2004	5520	Summer	March
4/7/2004	4590	Irrigate	2004	4590	Summer	April

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
7/2/2004	3450	Irrigate	2004	3450	Summer	July
10/12/2004	4470	Irrigate	2004	4470	Summer	Oct
1/13/2005	4700	No_irr	2005	4700	Winter	Jan
4/4/2005	4400	No_irr	2005	4400	Summer	April
4/20/2005	4942	Irrigate	2005	4942	Summer	April
8/2/2005	3044	Irrigate	2005	3044	Summer	Aug
8/3/2005	3860	Irrigate	2005	3860	Summer	Aug
10/7/2005	3640	Irrigate	2005	3640	Summer	Oct
10/18/2005	3716	Irrigate	2005	3716	Summer	Oct
1/13/2006	6140	No_irr	2006	6140	Winter	Jan
2/21/2006	4772	No_irr	2006	4772	Winter	Feb
4/6/2006	3660	No_irr	2006	3660	Summer	April
7/5/2006	3336	Irrigate	2006	3336	Summer	July
7/10/2006	3560	Irrigate	2006	3560	Summer	July
10/11/2006	2939	Irrigate	2006	2939	Summer	Oct
1/10/2007	4710	No_irr	2007	4710	Winter	Jan

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
1/12/2007	5960	No_irr	2007	5960	Winter	Jan
4/3/2007	3440	No_irr	2007	3440	Summer	April
5/14/2007	3180	Irrigate	2007	3180	Summer	May
7/2/2007	2792	Irrigate	2007	2792	Summer	July
7/10/2007	3160	Irrigate	2007	3160	Summer	July
10/9/2007	3754	Irrigate	2007	3754	Summer	Oct
10/11/2007	4260	Irrigate	2007	4260	Summer	Oct
12/11/2007	6564	Irrigate	2007	6564	Winter	Dec
4/9/2008	2996	No_irr	2008	2996	Summer	April
5/5/2008	3570	Irrigate	2008	3570	Summer	May
7/2/2008	3450	Irrigate	2008	3450	Summer	July
7/15/2008	3386	Irrigate	2008	3386	Summer	July
8/4/2008	3438	Irrigate	2008	3438	Summer	Aug
9/22/2008	3544	Irrigate	2008	3544	Summer	Sept
10/12/2008	4470	Irrigate	2008	4470	Summer	Oct
12/3/2008	4486	Irrigate	2008	4486	Winter	Dec

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
1/26/2009	5804	No_irr	2009	5804	Winter	Jan
2/10/2009	4700	No_irr	2009	4700	Winter	Feb
3/2/2009	5202	No_irr	2009	5202	Summer	March
4/8/2009	4140	No_irr	2009	4140	Summer	April
7/1/2009	3320	Irrigate	2009	3320	Summer	July
10/6/2009	3410	Irrigate	2009	3410	Summer	Oct
2/4/2010	5700	No_irr	2010	5700	Winter	Feb
2/17/2010	6330	No_irr	2010	6330	Winter	Feb
2/25/2010	5620	No_irr	2010	5620	Winter	Feb
5/10/2010	4010	Irrigate	2010	4010	Summer	May
7/14/2010	3970	Irrigate	2010	3970	Summer	July
10/6/2010	5680	Irrigate	2010	5680	Summer	Oct
2/8/2011	4580	No_irr	2011	4580	Winter	Feb
4/14/2011	5270	No_irr	2011	5270	Summer	April
5/26/2011	2260	Irrigate	2011	2260	Summer	May
6/8/2011	3930	Irrigate	2011	3930	Summer	June

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
7/26/2011	3380	Irrigate	2011	3380	Summer	July
8/29/2011	3230	Irrigate	2011	3230	Summer	Aug
9/29/2011	3780	Irrigate	2011	3780	Summer	Sept
10/21/2011	4260	Irrigate	2011	4260	Summer	Oct
11/17/2011	3380	Irrigate	2011	3380	Winter	Nov
12/20/2011	4850	No_irr	2011	4850	Winter	Dec
1/2/2012	4570	No_irr	2012	4570	Winter	Jan
2/1/2012	4550	No_irr	2012	4550	Winter	Feb
2/9/2012	4210	No_irr	2012	4210	Winter	Feb
2/16/2012	4890	No_irr	2012	4890	Winter	Feb
3/19/2012	4160	No_irr	2012	4160	Summer	March
4/16/2012	6270	Irrigate	2012	6270	Summer	April
4/23/2012	4710	Irrigate	2012	4710	Summer	April
4/30/2012	4730	Irrigate	2012	4730	Summer	April
5/7/2012	4350	Irrigate	2012	4350	Summer	May
6/4/2012	3720	Irrigate	2012	3720	Summer	June

Date	BC_Upper_ TDS (mg/l)	Irr_Season	Year	BC_Upper_ NoOutlier TDS mg/l	Season	Month
7/10/2012	4230	Irrigate	2012	4230	Summer	July
8/8/2012	2980	Irrigate	2012	2980	Summer	Aug
9/5/2012	4140	Irrigate	2012	4140	Summer	Sept
10/5/2012	3760	Irrigate	2012	3760	Summer	Oct
11/5/2012	3620	Irrigate	2012	3620	Winter	Nov
12/6/2012	5630	Irrigate	2012	5630	Winter	Dec
1/14/2013	4210	No_irr	2013	4210	Winter	Jan
1/22/2013	4050	No_irr	2013	4050	Winter	Jan
1/30/2013	4180	No_irr	2013	4180	Winter	Jan
2/7/2013	5170	No_irr	2013	5170	Winter	Feb
3/4/2013	5370	No_irr	2013	5370	Summer	March
4/1/2013	4260	No_irr	2013	4260	Summer	April
5/7/2013	4250	Irrigate	2013	4250	Summer	May

APPENDIX D GOODNESS OF FIT AND OUTLIER STATISTICS

- Blue Creek Below Dam Site, Blue Creek Crossing, and Blue Creek Upper ATK (2013)
- Blue Creek Upper all ATK and DWQ Data
- Blue Creek Upper all data by irrigation status (outlier out)
- Blue Creek Upper all data by season (outlier out)
- Outlier all Blue Creek Upper data
- Outlier all Blue Creek Upper data by irrigation status
- Outlier all Blue Creek Upper data by season
- Outlier Blue Creek Upper data by season with 7,180 dropped as outlier

APPENDIX E HYPOTHESIS TESTING RESULTS AND PROUCL OUTPUTS

- Blue Creek Upper TDS Concentration ANOVA with season and irrigation status as Factors

- Blue Creek Upper TDS Concentrations in Winter versus Summer SeasonsProUCL output for Background Threshold Values for Blue Creek
- ProUCL output for Background Threshold Values for Blue Creek Reservoir

APPENDIX F UTAH WATER RIGHTS DATABASE FOR BLUE CREEK

APPENDIX G SUPPLEMENTARY INFORMATION ON CALCULATING UPPER PERCENTILE VALUES FROM USEPA (2013)

State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

MEMORANDUM

TO: Utah Water Quality Board

THROUGH: Walter L. Baker, P.E.

FROM: Johnathan P. Cook, PE

DATE: September 1, 2015

SUBJECT: Request to Adopt Rule R317-101, Utah Wastewater Project Assistance Program

On June 10, 2014 President Obama signed into law the Water Resources Reform and Development Act of 2014 (WRRDA). Among its provisions are amendments to Titles I, II, V, and VI of the Federal Water Pollution Control Act (FWPCA). Several of the provisions of WRRDA affect the Clean Water State Revolving Fund (CWSRF) program. An amendment to R317-101 was proposed to the Board in June 2015.

The public comment period for the amended rule began on August 1, 2015 and ended on August 31, 2015. No comments were received.

It is recommended that the Water Quality Board adopt the amended R317-101, Utah Wastewater Project Assistance Program. It is recommended that the rule become effective immediately, as proposed.

Attachments: Summary of the Proposed repeal and reenactment of R317-101
Text of the amended R317-101 *"Utah Wastewater Project Assistance Program"*

File:Administrative Rule \ Utah Wastewater Project Assistance Program
F:U:\ENG_WQ\JPCOOK\PROJECTS\0 RULES\R317-101 FUNDING\2015-09-01 REQUEST TO ADOPT RULE R317-101.DOCX

195 North 1950 West • Salt Lake City, UT
Mailing Address: P.O. Box 144870 • Salt Lake City, UT 84114-4870
Telephone (801) 536-4300 • Fax (801) 536-4301 • T.D.D. (801) 536-4414
www.deq.utah.gov

SUMMARY OF THE PROPOSED AMENDMENT OF R317-101

The following changes are made:

- R317-101-2: Alphabetizing the definitions section to be consistent with Division of Administrative Rules guidelines.
- R317-101-2: Defining a "Cost Effective Analysis". Subsection D is added to address WRRDA requirements.
- R317-101-3.I: Revising "Water Conservation and Management Plan" to "Water Conservation Plan" to be consistent with Utah Code and Division of Water Resources administrative rules.
- R317-101-3.N: Issuing Construction Permits is now a duty of the Director.
- R317-101-3.P: Resolutions to amend sewer ordinance and user fee rate structures are also acceptable forms of these documents.
- R317-101-3.Q: Plans of operations relate to hiring qualified staff and asset management needed to properly operate treatment works and sewerage systems. It is necessary that new facilities have a plan of operation. Existing facilities that are merely expanding, repairing, or replacing systems, already have such management systems in place.
- R317-101-3.R: In practice, it is not necessary for the applicant to develop an entirely new O&M Manual if the new facilities are merely expanding, repairing, or replacing existing systems. Amendments to existing O&M manuals may be an acceptable alternative.
- R317-101-4.B.1: The WRRDA specifically requires the consideration of income, unemployment data, and population trends in determining the affordability of a project for a community.
- R317-101-5.A.7: Requiring applicants for financial assistance for OWS to obtain bids is a best practice.
- R317-101-9.A: Making the sentence more readable.
- R317-101-10.A: Making the sentence more readable.
- R317-101-14: The definition of a "Cost Effective Analysis" has been moved to R317-101-2.

The following general changes have also been made at various locations throughout the document:

- Correcting references to sections and subsections of State rules.
- Correcting references to the United States Code.
- Correcting references to the Utah Annotated Code
- Correcting references to definitions, programs, acronyms, and entities.
- General improvement of readability.

The Director may allow water hauling for Non-Community Public Water Systems by special approval if:

(a) consumers can not otherwise be supplied with good quality drinking water; or,

(b) the nature of the development, or ground conditions, are such that the placement of a pipe distribution system is not justified.

[Proposals for water hauling shall be submitted to, and approved by, the Director.

] (3) Emergencies.

Water hauling may be a temporary means of providing drinking water in an emergency. Water systems shall notify the Division as soon as possible of such emergencies.

KEY: drinking water, transmission and distribution pipelines, connections, water hauling
Date of Enactment or Last Substantive Amendment: [November 10, 2014]2015
Notice of Continuation: March 13, 2015
Authorizing, and Implemented or Interpreted Law: 19-4-104

Environmental Quality, Water Quality
R317-101
Utah Wastewater Project Assistance Program

NOTICE OF PROPOSED RULE
(Amendment)
DAR FILE NO.: 39512
FILED: 07/15/2015

RULE ANALYSIS

PURPOSE OF THE RULE OR REASON FOR THE CHANGE: Maintain compliance with Titles I, II, V, and VI of the Federal Water Pollution Control Act (FWPCA) as it was amended by the Water Resources Reform and Development Act of 2014 (WRRDA). Additional changes are to make the rule similar in format to other division rules, correct citations, and to improve the readability of the rule.

SUMMARY OF THE RULE OR CHANGE: The changes consist of: 1) including the maximization of the potential for efficient use, reuse, recapture, and conservation of water and for energy conservation to the maximum extent practicable in the cost effective analysis; 2) including consideration of unemployment data and population growth in determining an affordable sewer rate for a community; 3) alphabetizing the definitions section; 4) removal of "Board" from the definitions section because it is defined in Rule R317-1; 5) addition of "Executive Secretary" to the definitions section; 6) moving the definition of "Cost Effective Analysis" to the definitions section; 7) revising the name "Water Conservation and Management Plan" to "Water Conservation Plan" to be consistent with Utah Code and Division of Water Resources administrative rules; 8) issuing construction permits is now a duty of the director; 9) resolutions to amend sewer ordinance and user fee rate structures are also acceptable forms of these documents; 10) improve the description of how plans of operations relate to hiring qualified staff and the asset management needed to properly operate treatment works and sewerage systems; 11) it is necessary that new facilities have a plan of operation, but existing facilities that are merely expanding, repairing, or replacing systems, already have such management systems in place, but it is not necessary to develop an entirely new manual if the new facilities are merely expanding, repairing, or replacing existing systems when amendments to existing manuals may be an acceptable alternative; 12) requiring applicants for financial assistance for onsite wastewater systems to obtain bids is a best practice; 13) correcting references to sections and subsections of state rules; 14) correcting references to the United States Code; 15) correcting references to the Utah Code; 16) correcting references to definitions, programs, acronyms, and entities; and 17) general improvement of readability.

STATUTORY OR CONSTITUTIONAL AUTHORIZATION FOR THIS RULE: FWPCA of 2014, 6 U.S.C. Section 5002 and FWPCA of 2014, 6 U.S.C. Section 602(b)(13) and Section 11-8-2 and Title 19, Chapter 5 and Title 73, Chapter 10C

ANTICIPATED COST OR SAVINGS TO:

♦ THE STATE BUDGET: The change that affects the definition of "Cost Effective Analysis" is not anticipated to affect the amount of money that the Water Quality Board (WQB) will either loan or grant to a project. Maximization of efficient use, reuse, recapture, and conservation of water and of energy conservation was already a best engineering practice for the water industry and hence, an implied requirement in the consideration of alternatives for projects. This change makes it an explicit requirement for consideration. The change that requires the inclusion of unemployment data and population growth trends is not anticipated to affect the amount of money that the WQB will either loan or grant to a project. Currently, the WQB considers a community's median adjusted gross household income (MAGI) as the primary metric of an affordable sewer rate, which is used to establish project financing terms. If a community has high unemployment, it is likely that community will also have a low MAGI such that under the proposed rule amendment the community would receive equally favorable financing terms as before. Negative, low, and rapid population growth projections from GOMB data are already considered in the financial models for bonding that the WQB uses. Other changes to the rule have no monetary effect on the state budget.

♦ LOCAL GOVERNMENTS: The change that affects the definition of "Cost Effective Analysis" is not anticipated to affect the amount of money that the WQB will either loan or grant to a project. Maximization of efficient use, reuse, recapture, and conservation of water and of energy conservation was already a best engineering practice for the water industry and hence, an implied requirement in the consideration of alternatives for projects. This change makes it an explicit requirement for consideration. The change that requires the inclusion of unemployment data and population growth trends is not anticipated to affect the amount of money that the WQB will either loan or grant to a project. Currently, the WQB considers a community's MAGI as the primary metric of an affordable sewer rate, which is used to establish project financing terms. If a community has high unemployment, it is likely that community will also have a low MAGI such that under the proposed rule amendment the community would receive equally favorable financing terms as before. Negative, low, and rapid population growth projections from GOMB data are already considered in the financial models for bonding that the WQB uses. Other changes to the rule have no monetary effect on local government.

♦ SMALL BUSINESSES: The WRRDA changes do not affect small businesses because SRF funds are limited to use for assistance of bodies politic. The only change that could affect small business is the change that requires applicants for financial assistance for onsite wastewater systems to obtain bids. If a small business applying for this type assistance had not received bids for the work, requiring them to solicit for bids could potentially save the small business money. This change ensures the best value and use of state funds for those small businesses receiving financial assistance through this program.

♦ PERSONS OTHER THAN SMALL BUSINESSES, BUSINESSES, OR LOCAL GOVERNMENTAL ENTITIES: The WRRDA changes do not affect persons other than small businesses, businesses, or local government entities because SRF funds are limited to use for assistance of bodies politic. The only change that could affect persons other than small businesses, businesses, or local government entities is the change that requires applicants for financial assistance for onsite wastewater systems to obtain bids. If these other persons applying for this type assistance had not received bids for the work, requiring them to solicit for bids could potentially save them money. This change ensures the best value and use of state funds for those other persons receiving assistance through this program.

COMPLIANCE COSTS FOR AFFECTED PERSONS: There are no anticipated additional compliance costs for the affected persons.

COMMENTS BY THE DEPARTMENT HEAD ON THE FISCAL IMPACT THE RULE MAY HAVE ON BUSINESSES: The changes to Rule R317-101 are not anticipated to have any fiscal impacts on businesses.

THE FULL TEXT OF THIS RULE MAY BE INSPECTED, DURING REGULAR BUSINESS HOURS, AT:

ENVIRONMENTAL QUALITY
WATER QUALITY
THIRD FLOOR
195 N 1950 W
SALT LAKE CITY, UT 84116
or at the Division of Administrative Rules.

DIRECT QUESTIONS REGARDING THIS RULE TO:

♦ Judy Etherington by phone at 801-536-4344, by FAX at 801-536-4301, or by Internet E-mail at jetherington@utah.gov

INTERESTED PERSONS MAY PRESENT THEIR VIEWS ON THIS RULE BY SUBMITTING WRITTEN COMMENTS NO LATER THAN AT 5:00 PM ON 08/31/2015

THIS RULE MAY BECOME EFFECTIVE ON: 09/07/2015

AUTHORIZED BY: Walter Baker, Director

R317. Environmental Quality, Water Quality.
R317-101. Utah Wastewater Project Assistance Program.
R317-101-1. Statutory Authority.

The authority for the Department of Environmental Quality acting through the Utah Water Quality Board to issue loans to political subdivisions to finance all or part of wastewater project costs and to enter into ["]credit enhancement agreements["], ["]interest buy-down agreements["], and Hardship Grants is provided in Sections 11-8-2 and 73-10c-4[~~Title 73, Chapter 10b and Title 73, 10c~~].

R317-101-2. Definitions[~~ and Eligibility~~].

"Cost Effective Analysis" means an analysis of feasible project alternatives capable of meeting state and federal water quality and public health requirements. The cost effective analysis shall be certified by the political subdivision and it shall include:

A. monetary costs including the present worth or equivalent annual value of all capital costs;

B. operation, maintenance, and replacement costs;

C. fiscal sustainability, e.g., the cost of replacement of the project; and

D. maximizes the potential for efficient use, reuse, recapture, and conservation of water and for energy conservation to the maximum extent practicable.

"Credit Enhancement Agreement" means any agreement entered into between the Board, on behalf of the State, and a political subdivision, for the purpose of providing methods and assistance to political subdivisions to improve the security for and marketability of wastewater project obligations.

"Eligible Project Costs" means project costs that meet the financial assistance requirements established by the Board.

"Executive Secretary" means the Executive Secretary of the Water Quality Board.

"Financial Assistance" means a project loan, bond purchase, credit enhancement agreement, interest buy-down agreement or hardship grant.

"Hardship Grant" means a grant of monies to a political subdivision, individual, corporation, association, state of federal agency or other private entity that meets the wastewater project loan considerations or nonpoint source eligibility criteria whose project is determined by the Board to not be economically feasible unless grant assistance is provided. A hardship grant may be authorized in the following forms:

A. A Planning Advance is required to be repaid at a later date, unless deemed otherwise by the Board, to help meet project costs incident to planning to determine the economic, engineering and financial feasibility of a proposed project.

B. A Design Advance is required to be repaid at a later date, to help meet project costs incident to design including, but not limited to, surveys, preparation of plans, working drawings, specifications, investigations and studies.

C. A Project Grant is not required to be repaid.

"Interest Buy-Down Agreement" means any agreement entered into between the Board, on behalf of the State, and a political subdivision, for the purpose of reducing the cost of financing incurred by a political subdivision on bonds issued by the political subdivision for project costs.

"Nonpoint Source (NPS) Project" means a facility, system, practice, study, activity or mechanism that abates, prevents or reduces the pollution of water of this state by a nonpoint source.

"Principal Forgiveness" means a loan wherein a portion of the loan amount is forgiven (not required to be repaid) upon closing the loan.

"Project Costs" means the cost of acquiring and constructing any project and include: the cost of acquisition and construction of any facility or any modification, improvement, or extension of such facility; any cost incident to the acquisition of any necessary property, easement or right of way; engineering or architectural fees, legal fees, fiscal agent's and financial advisors' fees; any cost incurred for any preliminary planning to determine the economic and engineering feasibility of a proposed project; costs of economic investigations and studies, surveys, preparation of designs, plans, working drawings, specifications and the inspection and supervision of the construction of any facility; interest accruing on loans made under this program during acquisition and construction of the project; and any other cost incurred by the political subdivision, the Board or the Department of Environmental Quality, in connection with the issuance of obligation of the political subdivision to evidence any loan made to it under the law.

"Political Subdivision" means any county, city, town, improvement district, metropolitan water district, water conservancy district, special service district, drainage district, irrigation district, separate legal or administrative entity created under the Interlocal Co-operation Act or any other entity constituting a political subdivision under the laws of Utah.

"Wastewater Project" means a sewer, storm or sanitary sewage system, sewage treatment facility, lagoon, sewage collection facility and system and related pipelines and all similar systems, works and facilities necessary or desirable to collect, hold, cleanse or purify any sewage or other polluted waters of this State; and a study, pollution prevention activity, or pollution education activity that will protect waters of this state.

"Wastewater Project Obligation" means, as appropriate, any bond, loan, note or other obligation of a political subdivision issued to finance all or part of the cost of acquiring, constructing, expanding, upgrading or improving a wastewater project.

[~~A. Board means Utah Water Quality Board.~~

~~B. Political Subdivision means any county, city, town, improvement district, metropolitan water district, water conservancy district, special service district, drainage district, irrigation district, separate legal or administrative entity created under the Interlocal Co-operation Act or any other entity constituting a political subdivision under the laws of Utah.~~

~~C. Wastewater Project means a sewer, storm or sanitary sewage system, sewage treatment facility, lagoon, sewage collection facility and system and related pipelines and all similar systems, works and facilities necessary or desirable to collect, hold, cleanse or purify any sewage or other polluted waters of this State; and a study, pollution prevention activity, or pollution education activity that will protect waters of this state.~~

~~D. Project Costs include the cost of acquiring and constructing any project including, without limitation: the cost of acquisition and construction of any facility or any modification, improvement, or extension of such facility; any cost incident to the acquisition of any necessary property, easement or right of way; engineering or architectural fees, legal fees, fiscal agent's and financial advisors' fees; any cost incurred for any preliminary planning to determine the economic and engineering feasibility of a proposed project; costs of economic investigations and studies, surveys, preparation of designs, plans, working drawings, specifications and the inspection and supervision of the construction of any facility; interest accruing on loans made under this program during acquisition and construction of the project; and any other cost incurred by the political subdivision, the Board or the Department of Environmental Quality, in connection with the issuance of obligation of the political subdivision to evidence any loan made to it under the law.~~

~~E. Wastewater Project Obligation means, as appropriate, any bond, note or other obligation of a political subdivision issued to finance all or part of the cost of acquiring, constructing, expanding, upgrading or improving a wastewater project.~~

~~F. Credit Enhancement Agreement means any agreement entered into between the Board, on behalf of the State, and a political subdivision, for the purpose of providing methods and assistance to political subdivisions to improve the security for and marketability of wastewater project obligations.~~

~~G. Interest Buy-Down Agreement means any agreement entered into between the Board, on behalf of the State, and a political subdivision, for the purpose of reducing the cost of financing incurred by a political subdivision on bonds issued by the subdivision for project costs.~~

~~H. Financial Assistance means a project loan, credit enhancement agreement, interest buy-down agreement or hardship grant.~~

~~I. Hardship Grant means a grant of monies to a political subdivision, individual, corporation, association, state of federal agency or other private entity that meets the wastewater project loan considerations or NPS eligibility criteria whose project is determined by the Board to not be economically feasible unless grant assistance is provided. A hardship grant may be authorized in the following forms:~~

~~1. A Planning Advance which will be required to be repaid at a later date, unless deemed otherwise by the Board, to help meet project costs incident to planning to determine the economic, engineering and financial feasibility of a proposed project.~~

~~2. A Design Advance which will be required to be repaid at a later date, to help meet project costs incident to design including, but not limited to, surveys, preparation of plans, working drawings, specifications, investigations and studies.~~

~~3. A Project Grant which will not be required to be repaid.~~

~~J. Nonpoint Source Project means a facility, system, practice, study, activity or mechanism that abates, prevents or reduces the pollution of water of this state by a nonpoint source.~~

~~K. Principal Forgiveness means a loan wherein a portion of the loan amount is "forgiven" upon closing the loan.~~
]

R317-101-3. Application and Project Initiation Procedures.

The following procedures must normally be followed to obtain financial assistance from the Board:

A. It is the responsibility of the applicant to obtain the necessary financial, legal and engineering counsel to prepare an effective and appropriate financial assistance agreement, including cost effectiveness evaluations of financing methods and alternatives, for consideration by the Board.

B. A completed application form, project engineering report as appropriate, and financial capability assessment are submitted to the Board. Any comments from the local health department or association of governments should accompany the application.

C. The staff prepares an engineering and financial feasibility report on the project for presentation to the Board.

D. The Board ["A]authorizes["] financial assistance for the project on the basis of the feasibility report prepared by the staff, designates whether a loan, credit enhancement agreement, interest buy-down agreement, hardship grant or any combination thereof, is to be entered into, and approves the project schedule [(]see Section R317-101-14[)]. The Board shall authorize a hardship grant only if it determines that other financing alternatives are unavailable or unreasonably expensive to the applicant. If the applicant seeks financial assistance in the form of a loan of amounts in the security account established pursuant to Title 73, Chapter 10c, which loan is intended to provide direct financing of projects costs, then the Board shall authorize such loan only if it determines that credit enhancement agreements, interest buy-down agreements and other financing alternatives are unavailable or unreasonably expensive to the applicant or that a loan represents the financing alternative most economically advantageous to the state and the applicant; provided, that for purposes of this paragraph and for purposes of Subsection 73-10c-4(2), the term "loan" shall not include loans issued in connection with interest buy-down agreements as described in Section R317-101-12 hereof or in connection with any other interest buy-down arrangement.

E. Planning Advance Only - The applicant requesting a Planning Advance must attend a preapplication meeting, complete an application for a Planning Advance, prepare a plan of study, and submit a draft contract for planning services.

F. Design Advance Only - The applicant requesting a design advance must have completed an engineering plan which meets program requirements and submitted a draft contract for design services.

G. The project applicant must demonstrate public support for the project.

H. Political subdivisions which receive assistance for a wastewater project under these rules must agree to participate annually in the Municipal Wastewater Planning Program (MWPP).

I. Political subdivisions which receive assistance under these rules and which own a culinary water system must complete and submit a Water Conservation[~~and Management~~] Plan, per Section 73-10-32.

J. The project applicant's engineer prepares a preliminary design report, as appropriate, outlining detailed design criteria for submission to the Board.

K. Upon approval of the preliminary design report by the Board, the applicant's engineer completes the plans, specifications, and contract documents for review by the Board.

L. For financial assistance mechanisms when the applicant's bond is purchased by the Board, the project applicant's bond documentation, including an opinion from legal counsel experienced in bond matters that the wastewater project obligation is a valid and binding obligation of the political subdivision, must be submitted to the Assistant Attorney General for preliminary approval and the applicant shall publish a Notice of Intent to issue bonds in a newspaper of general circulation pursuant to Section 11-14-201[~~21~~]. For financial assistance mechanisms when the applicant's bond is not purchased by the Board, the applicant shall submit a true and correct copy of an opinion from legal counsel experienced in bond matters that the wastewater project obligation is a valid and binding obligation of the political subdivision.

M. Hardship Grant - The Board executes a grant agreement setting forth the terms and conditions of the grant.

N. The Director[~~Board~~] issues a Construction Permit[/] and Plan Approval for plans and specifications, and concurs in bid advertisement.

O. If a project is designated to be financed by a loan or an interest buy-down agreement as described in Sections R317-101-12 [~~and~~]through R317-101-[-]13, from the Board, to cover any part of project costs an account supervised by the applicant and the Board will be established by the applicant to assure that loan funds are used only for qualified project costs. If financial assistance for the project is provided by the Board in the form of a credit enhancement agreement as described in Section R317-101-11 all project funds will be maintained in a separate account and a quarterly report of project expenditures will be provided to the Board.

P. A copy of the applicant's Sewer Use Ordinance or Resolution and User Charge System[~~rate structure~~] must be submitted to the Division[~~Board~~] for review and approval to insure adequate provisions for debt retirement, [~~and/or~~]operation and maintenance, or both.

Q. A plan of operation must be submitted by the applicant to the Division for new treatment works, sewerage systems, and projects involving upgrades that add additional treatment, e.g., advanced treatment. The Plan must address:[~~, including~~] adequate staffing, with an operator certified at the appropriate level in accordance with Rule R317-10, training, and start up procedures to assure efficient operation and maintenance of the facilities. The plan must be[~~, is~~] submitted by the applicant in draft at initiation of construction and approved in final form prior to 50% of construction completion.

R. An O[~~o~~]peration and M[~~m~~]aintenance [~~(O and M)~~] M[~~m~~]anual (Manual) which provides long-term guidance for efficient facility operations and maintenance [~~O and M~~]is submitted by the applicant and approved in draft and final form prior to, respectively, 50% and 90% of project construction completion. Existing Manuals can be submitted or amended if the existing Manual is relevant to the funded project.

S. The applicant's contract with its engineer must be submitted to the Board for review to determine that there will be adequate engineering involvement, including project supervision and inspection, to successfully complete the project.

T. The applicant's attorney must provide an opinion to the Board regarding legal incorporation of the applicant, valid legal title to rights-of-way and the project site, and adequacy of bidding and contract documents.

U. Credit Enhancement Agreement and Interest Buy-Down Agreement Only - The Board issues the credit enhancement agreement or interest buy-down agreement setting forth the terms and conditions of the security or other forms of assistance provided by the agreement and notifies the applicant to sell the bonds as described in[~~(see~~] Sections R317-101-11 [~~and~~]through R317-101-12[~~)~~].

V. Credit Enhancement Agreement and Interest Buy-Down Agreement Only - The applicant sells the bonds on the open market and notifies the Board of the terms of sale. If a credit enhancement agreement is being utilized, the bonds sold on the open market shall contain the legend required by Subsection 73-10c-6(2)(a). If an interest buy-down agreement is being utilized, the bonds sold on the open market shall bear a legend which makes reference to the interest buy-down agreement and states that such agreement does not constitute a pledge of or charge against the general revenues, credit or taxing powers of the state and that the holder of any such bond may look only to the applicant and the funds and revenues pledged by the applicant for the payment of interest and principal on the bonds.

W. The applicant opens bids for the project.

X. Loan Only - The Board gives final approval to purchase the bonds and execute the loan contract[~~ (see~~] as described in Section R317-101-13[~~)~~].

Y. Loan Only - The final closing of the loan is conducted.

Z. The Board gives approval to award the contract to the low responsive and responsible bidder.

AA. A preconstruction conference is held.

BB. The applicant issues a written notice to proceed to the contractor.

R317-101-4. Loan, Credit Enhancement, Interest Buy-Down, and Hardship Grant Consideration Policy.

A. Water Quality Board Priority Determination

In determining the priority for financial assistance the Board shall consider:

1. t[~~T~~]he ability of the political subdivision to obtain funds for the wastewater project from other sources or to finance such project from its own resources;

2. t[~~T~~]he ability of the political subdivision to repay the loan or other project obligations;

3. w[~~W~~]hether a good faith effort to secure all or part of the services needed from the private sector through privatization has been made; and

4. w[~~W~~]hether the wastewater project:

a. m[~~M~~]eets a critical local or state need;

b. i[~~I~~]s cost effective;

c. w[~~W~~]ill protect against present or potential health hazards;

d. i[~~I~~]s needed to comply with minimum standards of the Federal Water Pollution Control Act Amendments of 1972, U.S.C. 1251 et. Seq.[~~, Chapter 26, Title 33, United States Code~~], or any similar or successor statute;

e. i[~~I~~]s needed to comply with the minimum standards of Title 19, Chapter 5[~~the~~] Utah Water Quality[~~Pollution Control~~] Act, [~~Chapter 5, Title 19,~~]or any similar or successor statute;

f. i[~~I~~]s designed to reduce or prevent the pollution of the waters of this state; or

g. f[~~F~~]urthers the concept of regionalized sewer service;

5. t[~~T~~]he priority point total for the project as determined by the Board from application of the current Utah State Project Priority System [~~(~~]Rule R317-100[~~)~~];

6. t[~~T~~]he overall financial impact of the proposed project on the citizens of the community including direct and overlapping indebtedness, tax levies, user charges, impact or connection fees, special assessments, etc., resulting from the project, and anticipated operation and maintenance costs versus the median adjusted gross household income of the community;

7. t[~~T~~]he readiness of the project to proceed;

8. Consistency with other funding source commitments that may have been obtained for the project; and

9. o[~~O~~]ther criteria that the Board may deem appropriate.

B. Water Quality Board Financial Assistance Determination. The amount and type of assistance offered will be based on the following considerations:

1. f[~~F~~]or loan consideration, the estimated annual cost of sewer service to the average residential user should not exceed 1.4% of the median adjusted gross household income from the most recent available State Tax Commission records. Consideration will also be given to the applicant's unemployment data, population trends, and the applicant's level of contribution to the project. For hardship grant consideration, exclusive of advances for planning and design, the estimated annual cost of sewer service for the average residential user should exceed 1.4% of the median adjusted gross household income from the most recent available State Tax Commission records. The Board will also consider the applicant's level of contribution to the project[~~.~~];

2. t[~~T~~]he estimated, average residential cost, [~~(~~]as a percent of median adjusted gross household income[~~)~~], for the proposed project should be compared to the average user charge, [~~(~~]as a percent of median adjusted gross household income[~~)~~], for recently constructed projects in the State of Utah[~~.~~];

3. maximizing[~~Optimizing~~] return on the security account while still allowing the project to proceed[~~.~~];

4. l[~~L~~]ocal political and economic conditions[~~.~~];

5. c[~~C~~]ost effectiveness evaluation of financing alternatives[~~.~~];

6. a[~~A~~]vailability of funds in the security account[~~.~~];

7. e[~~E~~]nvironmental need[~~.~~]; and

8. o[~~O~~]ther data and criteria the Board may deem appropriate.

C. The Executive Secretary may not execute financial assistance for NPS[~~Non-point Source~~] projects totaling more than $1,000,000 per fiscal year unless directed by the Board.

R317-101-5. Financial Assistance For Onsite[~~On-site~~] Wastewater Systems.

A. Replacement or repair of Onsite[~~On-site~~] Wastewater Systems (OWS), as defined in Section R317-4-2[~~1.45~~], are eligible for funding if they have malfunctioned or are in non-compliance with state administrative rules or local regulations governing the same.

1. Funding will only be made for the repair or replacement of existing malfunctioning OWS when the malfunction is not attributable to inadequate system operation and maintenance.

2. The Executive Secretary, [and/]or another whom the Board may designate, will authorize and execute OWS grant agreements and loan agreements with the applicant for a wastewater project as defined by Subsection R317-101-2.C[(C)].

3. OWS funding recipients must have a total household income no greater than 150% of the state median adjusted gross household income, as determined from the Utah Tax Commission's most recently published data or other means testing as approved by the Executive Secretary.

4. Eligible activities under the OWS Financial Assistance program include:

a. s[S]eptic tank;

b. a[A]bsorption system;

c. b[B]uilding sewer;

d. a[A]ppurtenant facilities

e. c[C]onventional or alternative OWS;

f. c[C]onnection of the residence to an existing centralized sewer system, including connection or hook-up fees, if this is determined to be the best means of resolving the failure of an OWS[.]; and

g. c[C]osts for construction, permits, legal work, engineering, and administration.

5. Ineligible project components include:

a. land;

b. interior plumbing components[include];

c. impact fees, if connecting to a centralized sewer system is determined to be the best means of resolving the failure of an OWS;

d. OWS for new homes or developments; and

e. OWS operation and maintenance.

6. The local health department will certify the completion of the project to the Division[of Water Quality].

7. To be reimbursed for project expenditures the borrower must solicit bids for the work, maintain and submit invoices, financial records, or receipts that[which] document the expenditures or costs.

B. The following procedures apply to OWS loans:

1. OWS loan applications will be received by the local health department which will evaluate the need, priority, eligibility and technical feasibility of each project. The local health department will issue a certificate of qualification (COQ) for projects which qualify for a OWS[OSW] loan. The COQ and completed loan application will be forwarded to the Division[of Water Quality] for its review[.];

2. t[T]he maximum term of the OWS[OSW] loan will be 10 years[.];

3. t[T]he interest rate of OWS[OSW] loans may be between 0%[zero percent or up to] and 60% [percent] of the interest rate on a 30-year U.S. Treasury bill[.];

4. s[S]ecurity conditions for OWS[OSW] [L]loans:

a. t[T]he borrower must adequately secure the loan with real property or other appropriate security[.]; and

b. t[T]he ratio of the loan amount to the value of the pledged security must not be greater than 70%[percent.];

5. OWS loan recipients will be billed for monthly payments of principal and interest beginning 60 days after execution of the loan agreement[.];

6. t[T]he OWS loan must be paid in full at the time the property served by the project is sold or transferred[.]; and

7. t[T]he [Utah]Division[of Water Quality], or its designee, will evaluate the financial aspects of the project and the credit worthiness of the applicant.

C. The following procedures apply to OWS grants:

OWS grants may be made to recipients that are unable to secure a loan but are otherwise eligible for funding as identified in Subsection R317-101-5.A.4[5(4)].

R317-101-6. Financial Assistance for Large Underground Wastewater Disposal Systems.

A. Large Underground Wastewater Disposal Systems (LUWDS) projects, as defined in Subsection[UAC] 73-10c-2(9), may be eligible for funding from the state revolving loan funds[SRF] and from the Hardship Grant Program. Application and project initiation procedures including loans, credit enhancement, interest buy-down and hardship grant consideration policies for LUWDS are defined in Sections R317-101-3 [and]through R317-101-4 except as otherwise stated.

B. The following procedures apply to LUWDS project loans:

1. Projects will be prioritized according to criteria established in Section R317-100-4, Utah State Project Priority System for the Utah Wastewater Project Assistance Program.

2. The maximum term of LUWDS project loans will be twenty years but not beyond a term exceeding the depreciable life of the project.

3. The interest rate on LUWDS project loans will be determined by the Board.

C. The following procedures apply to LUWDS project grants. Hardship Grants may be considered for LUWDS projects that meet criteria established in Section R317-101-4 and that:

1. address[es] a critical water quality need or health hazard;

2. would otherwise not be economically feasible; or

3. implement[s] provisions of TMDLs.

R317-101-7. Financial Assistance for NPS[Non-point Source] Projects.

A. [Non-point Source Pollution (]NPS[)] Projects, as defined in Section[UAC] 73-10c-2(9), are eligible for funding from the state revolving loan fund[SRF] and from the Hardship Grant Program.

1. Funding to [the]individuals in amounts in excess of $150,000 will be presented to and authorized funding by the Board. Funding of less than $150,000 will be considered and authorized funding by the Executive Secretary.

2. The Executive Secretary, [and/]or another whom the Board may designate, will authorize and execute NPS project loan agreements, [and/or]grant agreements, or both, with the applicant.

3. Eligible projects under the NPS project funding programs include projects that:

a. abate or reduce raw sewage discharges;

b. repair or replace failing individual on-site wastewater disposal systems;

c. reduce untreated or uncontrolled runoff;

d. improve critical aquatic habitat resources;

e. conserve soil, water, or other natural resources;

f. protect and improve ground water quality;

g. preserve and protect the beneficial uses of water of the state;

h. reduce the number of water bodies not achieving water quality standards;

i. improve watershed management;

j. prepare and implement total maximum daily load (TMDL) assessments;

k. are a study, activity, or mechanism that abates, prevents or reduces water pollution; or

l. supports educational activities that promotes water quality improvement.

B. The following procedures apply to NPS project loans:

1. Projects will be prioritized according to criteria established in Section R317-100-4, Utah State Project Priority System for the Utah Wastewater Project Assistance Program.

2. The maximum term of NPS program loans will be twenty years but not beyond a term exceeding the depreciable life of the project.

3. The interest rate on NPS project loans will be determined by the Board.

4. NPS project loans are exempt from environmental reviews under the National Environmental Policy Act (NEPA) as long as the funding of these projects is identified in Utah's NPS[Non-point Source] Pollution Management Plan.

5. Security of NPS project loans.

a. NPS project loans to individuals in amounts greater than $15,000 will be secured by the borrower with water stock or real estate. Loans less than $15,000 may be secured with other assets.

b. For NPS project loans to individuals the ratio of the loan amount to the value of the pledged security must not be greater than 70%[-percent].

c. NPS loans to political subdivisions of the state will be secured by a revenue bond, general obligation bond or some other acceptable instrument of debt.

6. The Division[-of Water Quality] will determine project eligibility and priority. Periodic payments will be made to the borrower, contractors, or consultants for work relating to the planning, design, and construction of the project. The borrower must maintain and submit the financial records that document expenditures or costs.

7. The Division[-of Water Quality], or its designee, will perform periodic project inspections. Final payment on the NPS loan project will not occur until a final inspection has occurred and an acceptance letter issued for the completed project.

8. NPS project loan recipients will be billed periodically for payments of principal and interest as agreed to in the executed loan agreements or bond documents.

9. The [Utah-]Division[-of Water Quality], or its designee, will evaluate the financial aspects of the NPS project and the credit worthiness of the applicant.

C. The following procedures apply to NPS project grants. Hardship Grants may be considered for a NPS project that:

1. addresses a critical water quality need or health hazard;

2. remediates water quality degradation resulting from natural sources damage including fires, floods, or other disasters;

3. would otherwise not be economically feasible;

4. provides financial assistance for a study, pollution prevention activity, or educational activity; or

5. implements provisions of TMDLs.

R317-101-8. Loans For Storm Water Projects.

Storm water projects are eligible for funding through the Utah Wastewater Project Assistance Program, as identified in Subsection[UCA] 73-10c-2(12). In addition to other rules identified in Rule R317-101 which may apply, the following particular rules apply to storm water project loans:

A. Loans will only be made to political subdivisions of the state.

B. The interest rate charged on storm water project loans will be equal to 60% of the interest rate on a 30-year U.S. Treasury bill.

C. Storm water project loans will be made twice per year. Projects will be prioritized so that the limited funds which are available are allocated first to the highest priority projects in accordance with Sections R317-100-3 [and]through R317-100-4, ranking systems of the Utah State Project Priority System for the Utah Wastewater Project Assistance Program.

D. Storm water projects are eligible for funding provided a significant portion of the project is for the purpose of improving water quality.

R317-101-9. Planning Advance.

A. A Planning Advance can only be made to a political subdivision which demonstrates a financial hardship[-which prevents the completion of project planning].

B. A Planning Advance is made to a political subdivision with the intent to provide interim financial assistance for project planning until the long-term project financing can be secured. Once the long-term project financing has been secured, the Planning Advance must be expeditiously repaid to the Board.

C. The applicant must demonstrate that all funds necessary to complete project planning will be available prior to commencing the planning effort. The Planning Advance will be deposited with these other funds into a supervised escrow account at the time the grant agreement between the applicant and Board is executed.

D. Failure on the part of the recipient of a Planning Advance to implement the construction project may authorize the Board to seek repayment of the Advance on such terms and conditions as it may determine.

E. The recipient of a Planning Advance must first receive written approval for any cost increases or changes to the scope of work.

R317-101-10. Design Advance.

A. A Design Advance can only be made to a political subdivision which demonstrates a financial hardship[-which prevents the completion of project design].

B. A Design Advance is made to a political subdivision with the intent to provide interim financial assistance for the completion of the project design until the long-term project financing can be secured. Once the long-term project financing has been secured, the Project Design Advance must be expeditiously repaid to the Board.

C. The applicant must demonstrate that all funds necessary to complete the project design will be available prior to commencing the design effort. The Design Advance will be deposited with these other funds into a supervised escrow account at the time the grant agreement between the applicant and Board is executed.

D. Failure on the part of the recipient of a Design Advance to implement the construction project may result in[authorize] the Board [to-]seeking repayment of the Advance on such terms and conditions as it [may-]determines.

E. The recipient of a Design Advance must first receive written approval for any cost increases or changes to the scope of work.

R317-101-11. Credit Enhancement Agreements.

The Board will determine whether a project may receive all or part of a loan, hardship grant, credit enhancement agreement or interest buy-down agreement subject to the criteria in Section R317-101-4. To provide security for project obligations the Board may agree to purchase project obligations of political subdivisions or make loans to the political subdivisions to prevent defaults in payments on project obligations. The Board may also consider making loans to the political subdivisions to pay the cost of obtaining letters of credit from various financial institutions, municipal bond insurance, or other forms of insurance or security for project obligations. In addition, the Board may consider other methods and assistance to political subdivisions to properly enhance the marketability of project obligations or enhance the security for project obligations.

R317-101-12. Interest Buy-Down Agreement.

Interest buy-down agreements may consist of:

A[1]. A financing agreement between the Board and political subdivision whereby a specified sum is loaned or granted to the political subdivision to be placed in a trust account. The trust account shall be used exclusively to reduce the cost of financing for the project.

B[2]. A financing agreement between the Board and the political subdivision whereby the proceeds of bonds purchased by the Board is combined with proceeds from publicly issued bonds to finance the project. The rate of interest on bonds purchased by the Board may carry an interest rate lower than the interest rate on the publicly issued bonds, which when blended together will provide a reduced annual debt service for the project.

C[3]. Any other legal method of financing which reduces the annual payment amount on locally issued bonds. After credit enhancement agreements have been evaluated by the Board and it is determined that this method is not feasible or additional assistance is required, interest buy-down agreements and loans may be considered. Once the level of financial assistance required to make the project financially feasible is determined, a cost effective evaluation of interest buy-down options and loans must be completed. The financing alternative chosen should be the one most economically advantageous for the state and the applicant.

R317-101-13. Loans.

The Board may make loans to finance all or part of a wastewater project only after credit enhancement agreements and interest buy-down agreements have been evaluated and found either unavailable or unreasonably expensive. The financing alternative chosen should be the one most economically advantageous for the state and its political subdivision.

R317-101-14. Project Authorization.

A project may be ["A]authorized["] for a loan, credit enhancement agreement, interest buy-down agreement or hardship grant in writing by the Board following submission and favorable review of an application form, engineering report, [(]if required[)], financial capability assessment and Staff feasibility report. The engineering report must include the preparation of a cost effective analysis according to Section R317-101-2.[of feasible project alternatives capable of meeting State and Federal water quality and public health requirements. It shall include consideration of monetary costs including the present worth or equivalent annual value of all capital costs, operation, maintenance, and replacement costs. The alternative selected must be the most economical means of meeting applicable State and Federal effluent and water quality or public health requirements over the useful life of the facility while recognizing environmental and other nonmonetary considerations.] If it is anticipated that a project will be a candidate for financial assistance from the Board, the Staff should be contacted, and the plan of study for the engineering report, [(]if required,[)] should be approved before the planning is initiated.

Once the application form, plan of study, engineering report, and financial capability assessment are reviewed, the staff will prepare a project feasibility report for the Board's consideration in [A]authorizing a project. The project feasibility report will include a detailed evaluation of the project with regard to the Board's funding priority criteria, and will contain recommendations for the type of financial assistance which may be extended, [(]i.e., [for]a loan, credit enhancement agreement, interest buy-down agreement or hardship grant[)].

Project [A]authorization is not a contractual commitment and is conditioned upon the availability of funds at the time of loan closing, or signing of the credit enhancement, interest buy-down, or grant agreement and upon adherence to the project schedule approved at that time. If the project is not proceeding according to the project schedule the Board may withdraw the project [A]authorization so that projects that[which] are ready to proceed can obtain necessary funding. Extensions to the project schedule may be considered by the Board, but any extension requested must be fully justified.

R317-101-15. Financial Evaluations.

A. The Board considers it a proper function to assist and give direction to project applicants in obtaining funding from such State, Federal or private financing sources as may be available to achieve the most effective utilization of resources in meeting the needs of the State. This may also include joint financing arrangements with several funding agencies to complete a total project.

B. Hardship Grants will be evidenced by a grant agreement.

C. Loans will be evidenced by the sale of any legal instrument which meets the legal requirements of the Title 11, Chapter 14, Local Government Bonding Act,[Utah Municipal Bond Act (Chapter 14, Title 11)] to the Board.

D. The Board will consider the financial feasibility and cost effectiveness evaluation of the project in detail. The financial capability assessment must be completed as a basis for the review. The Board will generally use these reports to determine whether a project will be [A]authorized to receive a loan, credit enhancement agreement, interest buy-down agreement or hardship grant, as described in Sections[(Reference] R317-101-5 through R317-101-9[)]. If a project is [A]authorized to receive a loan, the Board will establish the portion of the construction cost to be included in the loan and will set the terms for the loan. The Board will require the applicants to repay the loan as rapidly as is reasonably consistent with the financial capability of the applicant. It is the Board's intent to avoid repayment schedules which would exceed the design life of the project facilities.

E. In order to support costs associated with the administration of the loan program, the Board may charge a loan origination fee. A recipient may use loan proceeds to pay the loan origination fee. The loan origination fee shall be due at the recipient's scheduled loan closing.

F. The Board shall determine the date on which annual repayment will be made. In fixing this date, all possible contingencies shall be considered, and the Board may allow the system user one year of actual use of the project facilities before the first repayment is required.

G. The applicant shall furnish the Board with acceptable evidence that the applicant is capable of paying its share of the construction costs during the construction period.

H. Loans and Interest Buy-Down Agreements Only - The Board may require, as part of the loan or interest buy-down agreement, that any local funds which are to be used in financing the project be committed to construction prior to or concurrent with the committal of State funds.

I. The Board will not forgive the applicant of any payment after the payment is due.

R317-101-16. Committal of Funds and Approval of Agreements.

After the Board has approved the plans and specifications by the issuance of a Construction Permit[~~/~~]and Plan Approval, and has received the appropriate legal documents and other items listed in the authorization letter, the project will be considered by the Board for final approval. The Board will determine whether the project loan, interest buy-down agreement or grant agreement is in proper order on the basis of the Board's authorization. The Executive Secretary may then close the loan, credit enhancement or grant agreement if representations to the Board or other aspects of the project have not changed significantly since the Board's funding authorization, provided all conditions imposed by the Board have been met. If significant changes have occurred, the Board will then review the project and, if satisfied, will then commit funds, approve the signing of the contract, credit enhancement agreement, interest buy-down or grant agreement, and instruct the Executive Secretary to submit a copy of the signed contract agreement to the Division of Finance.

R317-101-17. Construction.

The Division[~~ of Water Quality~~] staff may conduct inspections and will report to the applicant. Contract change orders must be properly negotiated with the contractor and approved in writing. Change orders in excess of $10,000 must receive prior written approval by the Division[~~ of Water Quality~~] staff before execution. Upon successful completion of the project and recommendation of the applicant's engineer, the applicant will request the Division[~~ of Water Quality~~] to conduct a final inspection. When the project is complete to the satisfaction of the applicant's engineer, the Division [~~of Water Quality~~]staff, and the applicant, written approval will be issued by the Director[~~Executive Secretary~~] to commence using the project facilities.

KEY: wastewater, water quality, loans, sewage treatment
Date of Enactment or Last Substantive Amendment: [~~June 11, 2009~~]2015
Notice of Continuation: March 28, 2013
Authorizing, and Implemented or Interpreted Law: 19-5; 73-10c; 11-8-2

Governor, Economic Development
R357-14
Electronic Meetings

NOTICE OF PROPOSED RULE
(New Rule)
DAR FILE NO.: 39510
FILED: 07/14/2015

RULE ANALYSIS

PURPOSE OF THE RULE OR REASON FOR THE CHANGE: The purpose of this rule is to outline the procedures for any public body created within Title 63N to hold an electronic meeting.

SUMMARY OF THE RULE OR CHANGE: The rule explains when an electronic meeting can be held, the procedure for requesting an electronic meeting, and what is required for the anchor location, quorums, vote counts, and any other essential requirement to an electronic meeting as provided in Utah law.

STATUTORY OR CONSTITUTIONAL AUTHORIZATION FOR THIS RULE: Section 52-4-207

ANTICIPATED COST OR SAVINGS TO:
♦ THE STATE BUDGET: This will not impact the state budget because these meetings already take place and the technology to support them in an electronic format is already present and available in our office.
♦ LOCAL GOVERNMENTS: This will not impact local governments' budgets. In fact, it could save local governments travel expenses because they will be able to attend meetings held in our office electronically.
♦ SMALL BUSINESSES: This will not impact small businesses because this is an internal office rule only. Small businesses could save travel expenses because they will be able to attend meetings held in our office electronically.
♦ PERSONS OTHER THAN SMALL BUSINESSES, BUSINESSES, OR LOCAL GOVERNMENTAL ENTITIES: There are no other persons that could be affected by this rule financially because the rule places requirements only on the office itself. Again, savings on travel expenses because they will be able to attend meetings held in our office electronically.

COMPLIANCE COSTS FOR AFFECTED PERSONS: There are no anticipated compliance costs because the office already has the technology to host electronic meetings.

COMMENTS BY THE DEPARTMENT HEAD ON THE FISCAL IMPACT THE RULE MAY HAVE ON BUSINESSES: This rule will allow the office to continue work in the most efficient and cost effective way for both ourselves and our community partners.

State of Utah

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality

Alan Matheson
Executive Director

DIVISION OF WATER QUALITY
Walter L. Baker, P.E.
Director

MEMORANDUM

TO: Water Quality Board Members

THROUGH: Walter L. Baker, P.E.

FROM: Carl Adams, Watershed Protection Section

DATE: September 14, 2015

SUBJECT: 303(d) Vision Update

Utah's 303 (d) Vision is a tailored strategy to implement the Division's CWA 303(d) Program responsibilities in the context of Utah's water quality goals and priorities. The Vision includes several elements that the Division is already putting into action including **engagement** with stakeholders and the public, **integration** of water quality improvement and protection efforts with other local, state, and federal agencies, and **assessing** the extent of healthy and impaired waters through site-specific assessments. Other key elements of the vision include:

Prioritization – Review, prioritize, and report priority impaired waters for restoration and protection;

Protection – Identify protection priorities and approaches to prevent impairments in healthy waters;

Alternatives – Incorporate adaptive management principles where such approaches are better suited to implement actions that achieve water quality goals.

This update will include a summary of feedback received from the stakeholder survey the Division conducted in April, a review of priority impaired waters for TMDL development (included below), the criteria used in prioritizing them, and impaired identified for alternative restoration approaches.

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WATERBODY NAME	IMPAIRMENT	RATIONALE FOR PRIORITY DESIGNATION
Ninemile Creek	Temperature	TMDL in Progress
Huntington Creek-1	Selenium	TMDL in Progress
Fremont River-3	E. coli	Drinking water source, Recreational use
North Fork Virgin River-2	E. coli	Drinking water source, Recreational use
North Fork Virgin River-1	E. coli	Drinking water source, Recreational use
Silver Creek	Total Dissolved Solids	CERCLA
Jordan River-8	Arsenic	Drinking water source
Provo River-3	Dissolved Oxygen	Cyanobacteria
Provo River-4	E. coli	Drinking water source, Recreational use
Provo River-6	Aluminum, Zinc	Drinking water source, Recreational use
Snake Creek-1	Arsenic	Drinking water source
Jordan River-1	E. coli, Dissolved Oxygen	TMDL in Progress
Jordan River-2	E. coli, Dissolved Oxygen	TMDL in Progress
Jordan River-3	E. coli, Dissolved Oxygen	TMDL in Progress
Jordan River-4	E. coli	Recreational use
Jordan River-5	E. coli	Recreational use
City Creek-2	Cadmium	High Quality Category 1 Water
Mill Creek3-SLCity	E. coli	Trib to Jordan River E. coli impairment
Big Cottonwood Creek-1	E. coli	Trib to Jordan River E. coli impairment
Little Cottonwood Creek-1	E. coli, Total Dissolved Solids	Trib to Jordan River E. coli impairment
Butterfield Creek	E. coli	Trib to Jordan River E. coli impairment
Parleys Canyon Creek-1	E. coli	Trib to Jordan River E. coli impairment
Mill Creek1-SLCity	E. coli	Trib to Jordan River E. coli impairment
Rose Creek	E. coli	Trib to Jordan River E. coli impairment
Emigration Creek Lower	E. coli	Trib to Jordan River E. coli impairment
Starvation Reservoir	Dissolved Oxygen	Cyanobacteria dominance (HAB)
Lower Bowns Reservoir	Dissolved Oxygen, Phosphorus	High Quality Category 1 Water
Utah Lake	Phosphorus	Cyanobacteria dominance (HAB)
Red Creek Reservoir	Phosphorus	TMDL in Progress

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FILE: Memo to Board 303d Vision.docx