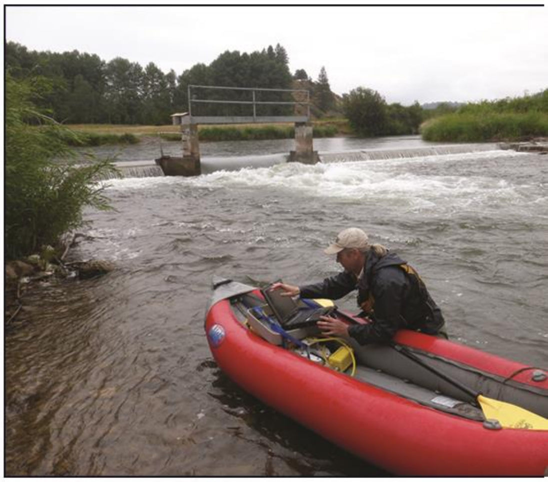
Salt River Watershed, Wyoming

E. coli Implementation Plan

Contract #00109379

September 2015

TETRA TECH



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E. coli Implementation Plan

Final Document

September 2015

Prepared for

Wyoming Department of Environmental Quality

Prepared by

Tetra Tech, Inc.
PO Box 11895
Jackson, WY 83002

Content

Tables

Figures

Abbreviations and Acronyms

BMP	best management practice
DEQ	Wyoming Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
HUC	hydrologic unit code
mL	milliliter
MST	microbial source tracking
NRCS	Natural Resources Conservation Service (U.S. Department of Agriculture)
RV	recreational vehicle
SVCD	Star Valley Conservation District
TMDL	total maximum daily load
WRP	watershed restoration plan
WWTP	wastewater treatment plant

Executive Summary

According to the Wyoming 2012 303(d) list (the most recent approved list), a 7.5 mile segment of the lower section of the Salt River does not support its designated recreation use because of high counts of the pathogen-indicator bacteria *Escherichia coli (E. coli*). Stump Creek, from the confluence with the Salt River upstream to the Idaho border, also violates the *E. coli* criteria. Total Maximum Daily Loads were prepared for the Salt River and Stump Creek and are presented in the companion document entitled: *Water Quality Restoration Plan and E. coli TMDLs Salt River Watershed, Wyoming* (Tetra Tech, 2015).

E. coli load reductions of up to 60 and 66 percent are necessary in the Salt River and Stump Creek, respectively, to achieve water quality standards. Potential sources of bacteria in the Salt River watershed include livestock, wildlife, pets, and humans. There are three primary pathways by which bacteria can reach surface waters in the Salt River watershed: direct deposition, surface water runoff, or leaching into the shallow groundwater and ultimately into the Salt River or its tributaries.

This Watershed Restoration Plan provides a framework to initiate voluntary activities within the Salt River watershed to reduce *E. coli* loading from all sources and pathways to achieve water quality standards. This plan represents the proposed activities for the first three to five years of implementation and contains the essential requirements of the United States Environmental Protection Agency (EPA) to achieve improvements in water quality. Specifically, the EPA requires that watershed plans funded by Clean Water Act Section 319 funds contain a minimum of nine critical elements (EPA, 2008). These minimum requirements are summarized and cross-walked with the content of this document in **Table ES-1**.

Table ES-1. Nine minimum elements of an EPA Watershed Restoration Plan and document cross-walk

WRP Element	Plan Summary and Cross-walk
1. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions	*E. coli* is the cause of impairment (**Section 3**) and the primary anthropogenic sources include livestock, septic systems, recreation, and pets (**Section 4**).
2. An estimate of the load reductions expected from management measures.	This WRP focuses on the initial three to five years of implementation. Achieving and maintaining the in-stream *E. coli* criteria will likely be a longer term effort and achieving the necessary watershed-scale load reductions will take longer than the duration of this first phase of implementation. Load reduction estimates are presented in **Table 6**.
3. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in item 2, and a description of the critical areas in which those measures will be needed to implement this plan.	A watershed-scale effort is proposed, addressing all of the potential source categories. This plan is heavily weighted toward education and providing technical and financial assistance for voluntary implementation. A description of the proposed management measures is provided in **Section 5**.
4. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.	Technical and financial assistance is described, and an estimate for implementation of this WRP are presented in **Section 9**.
5. An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.	Information and education is integral to the restoration strategy presented in **Section 5**.
6. Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious	Achieving water quality standards through voluntary implementation of nonpoint source best management practices (BMPs) will be a long-term effort. This WRP focuses on the first three to five years of implementation. A schedule is presented in **Section 8**.
7. A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.	Measurable milestones are presented in **Section 8** for all of the elements of the plan.
8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.	The applicable *E. coli* water quality criteria (126 organisms per 100 milliliters from May through September) are proposed as the metric for determining if loading reductions are being achieved (see **Section 7**).
9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item 8 immediately above.	A detailed monitoring strategy is presented in **Section 6**, including the following components: 1) long-term trend monitoring to determine if water quality standards have been met; 2) monitoring to address uncertainties; 3) refined source assessment monitoring, and 4) BMP effectiveness monitoring.

1 Introduction

According to the Wyoming 2012 303(d) list (the most recent approved list that was developed by the Wyoming Department of Environmental Quality [DEQ]), a 7.5 mile segment of the lower section of the Salt River does not support its designated recreation uses because of high counts of the pathogen-indicator bacteria *Escherichia coli* (*E. coli*). Stump Creek, from the confluence with the Salt River upstream to the Idaho border, also violates the *E. coli* criteria (**Table 1**).

Table 1. Impaired stream segments within the Salt River watershed

Waterbody	Waterbody ID	Location	Length (miles)	Cause of Impairment
Salt River	WYSR170401050309_01	A 7.5 mile section located 3.4 miles northwest of Etna	7.5	*E. coli*
Stump Creek	WYSR170401050203_01	From the confluence with Salt River upstream to the Idaho border		*E. coli*

The Clean Water Act and U.S. Environmental Protection Agency (EPA) regulations require that states develop Total Maximum Daily Loads (TMDLs) for waters that do not support their designated uses. All necessary TMDLs have been completed and are contained in the *Salt River Bacteria Total Maximum Daily Loads* (Tetra Tech, 2015). This document, the *Salt River Watershed Restoration Plan (WRP)*, accompanies the TMDL document and provides an implementation plan for reducing bacteria loads and attaining water quality standards in the Salt River watershed.

The WRP seeks to improve water quality in the Salt River watershed over the next three to five years. After three to five years, the Star Valley Conservation District (SVCD) and interested watershed stakeholders will review and revise the WRP. The WRP provides initial structure for interested groups and watershed stakeholders to implement a watershed restoration and enhancement effort. The intent is to engage a range of watershed stakeholders in seeking scientifically based voluntary solutions to improve water quality.

The WRP contains EPA's essential requirements to achieve improvements in water quality. Specifically, EPA requires that watershed plans funded by Clean Water Act Section 319 funds contain a minimum of nine critical elements (EPA, 2008). These minimum requirements are summarized below:

Nine Minimum Elements of an EPA Watershed Restoration Plan

1. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions
2. An estimate of the load reductions expected from management measures.
3. A description of the nonpoint source management measures that will need to be implemented to achieve load reductions in item 2, and a description of the critical areas in which those measures will be needed to implement this plan.
4. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

5. An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
6. Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.
7. A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.
9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item 8 immediately above.

2 Watershed Description

The Salt River is an 84-mile long river in Lincoln County in western Wyoming. The headwaters originate in the Salt River Range. The river flows west out of the mountains and then north along the border of Wyoming and Idaho. It passes Smoot, Wyoming, and then meanders through the mostly agricultural Star Valley, being joined by numerous creeks along the way, to its confluence with the Snake River near the town of Alpine. The Salt River watershed drains about 890 square miles of the western part of the Salt River Range in Wyoming and the eastern part of the Caribou Range of Idaho.

This WRP applies to the entire sub-basin hydrologic unit that is identified with the eight digit Hydrologic Unit Code (8-digit HUC) 17040105 (**Figure 1**). A more detailed description of the Salt River watershed, focusing on those characteristics that may have an influence on water quality, is provided in the companion TMDL document.

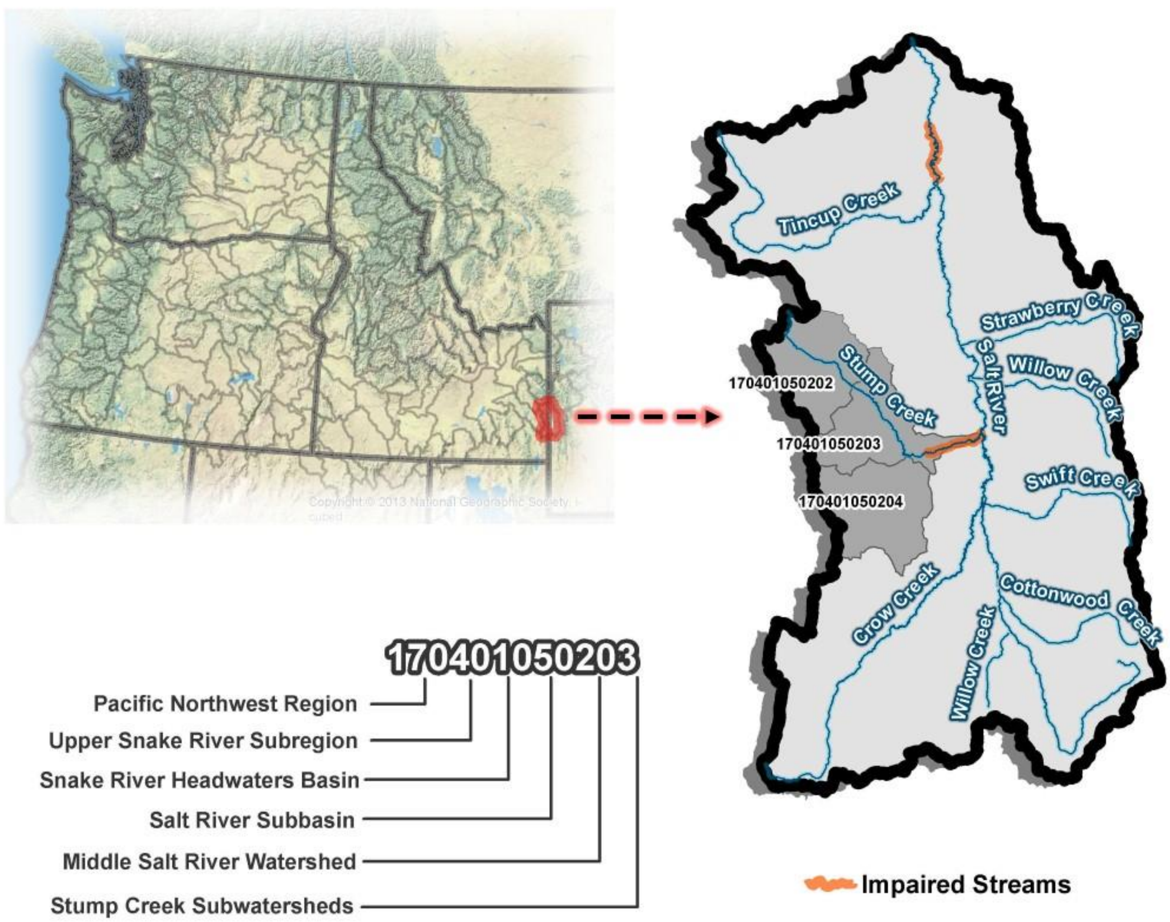


Figure 1. Salt River watershed and 303(d) listed reaches.

3 The Water Quality Problem and Current Water Quality Conditions

The TMDL targets (or water quality goals) are described above in Section 3 of the TMDL report and are based upon the summer geometric mean criterion for primary contact recreation. Only the SVCD dataset provided sufficient numbers of samples to calculate geometric means that could be compared with Wyoming's bacteria standards. Rolling geometric means of five or more samples collected within a contiguous 60-day period between May 1 and September 30 were calculated for the Salt River (**Table 2**) and Stump Creek and its tributaries (**Table 3**). The geometric means were compared with Wyoming's summer season primary contact recreation criterion of 126 counts per 100 milliliter (mL). No spatial trends are readily apparent with the number of geometric means that exceed the standard along the Salt River (**Figure 2**). However, the number of geometric means that exceed the standards is considerably higher in Stump, Tygee, and Webster creeks than in the Salt River (**Table 3**).

Table 2. Geometric means of SVCD *E. coli* data from the Salt River

Sample site	No. of samples	No. of geometric means [a]	No. of geometric mean exceedances [b]	Percent of geometric mean exceedances	Geometric mean range (counts/100 mL)
Forest Dell	110	76	12	16%	12 - 419
CR-150	110	76	21	28%	15 - 226
Smoot Bridge	110	76	20	26%	10 - 269
Burton Springs	110	76	2	3%	26 - 205
Narrows	110	76	27	36%	30 - 186
East Side Canal	110	76	30	39%	43 - 235
Freedom Bridge	110	76	6	8%	30 - 179
Etna Gauging	110	76	13	17%	49 - 207
McCoy Creek	110	76	16	21%	53 - 161

Notes

a. Number of rolling 60-day geometric means with five or more samples collected during the summer recreation season (May 1 - September 30).

b. Number of these geometric means that exceed the primary contact recreation standard of 126 counts/100 mL.

Table 3. Geometric means of SVCD *E. coli* data from Stump, Tygee, and Webster creeks

Sample site	No. of samples	No. of geometric means [a]	No. of geometric mean exceedances [b]	Percent of geometric mean exceedances	Geometric mean range (counts/100 mL)
Stump Creek	110	76	64	84%	46 - 861
Stump Creek at Tygee	20	16	9	56%	42 - 269
Webster Creek	20	16	15	94%	79 - 2,172
Tygee Creek	20	16	14	88%	112 - 657

Notes

a. Number of rolling 60-day geometric means with five or more samples collected during the summer recreation season (May 1 - September 30).

b. Number of these geometric means that exceed the primary contact recreation standard of 126 counts/100 mL.

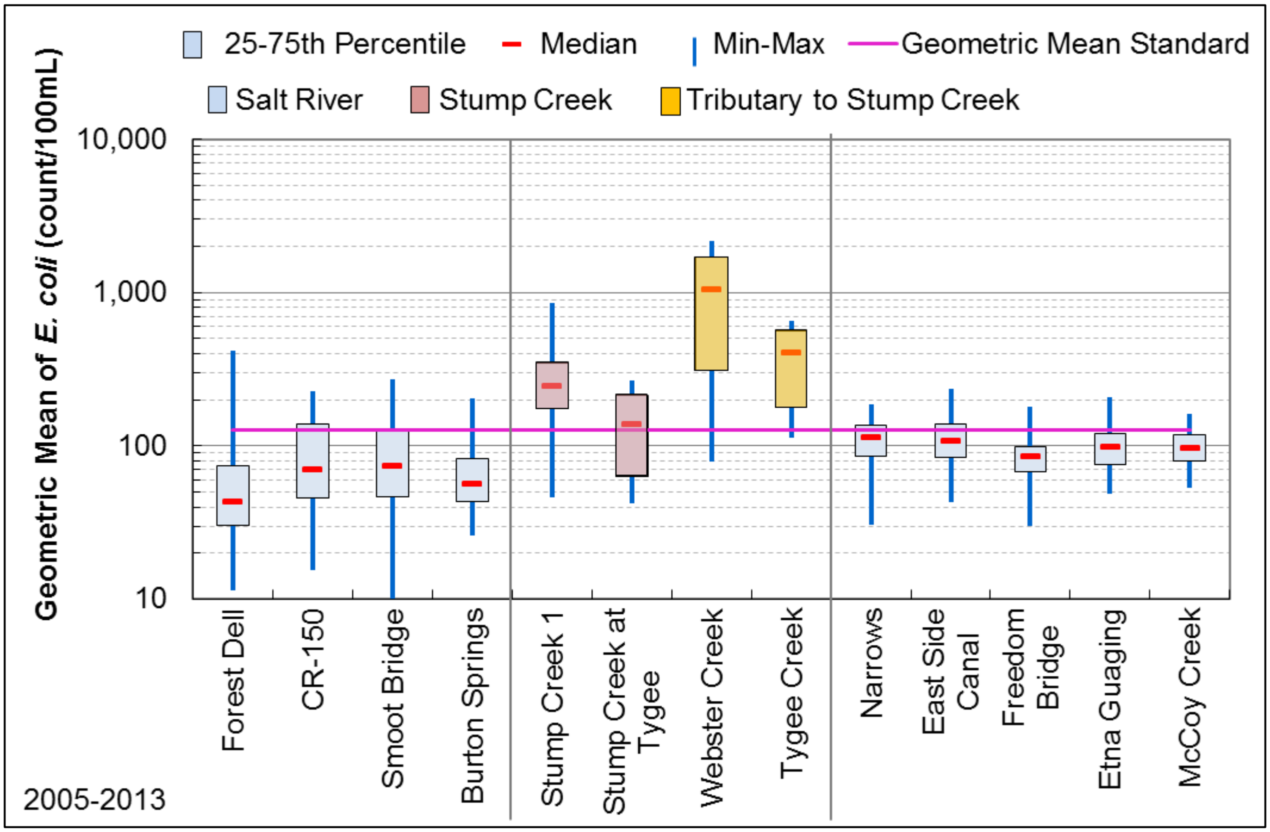


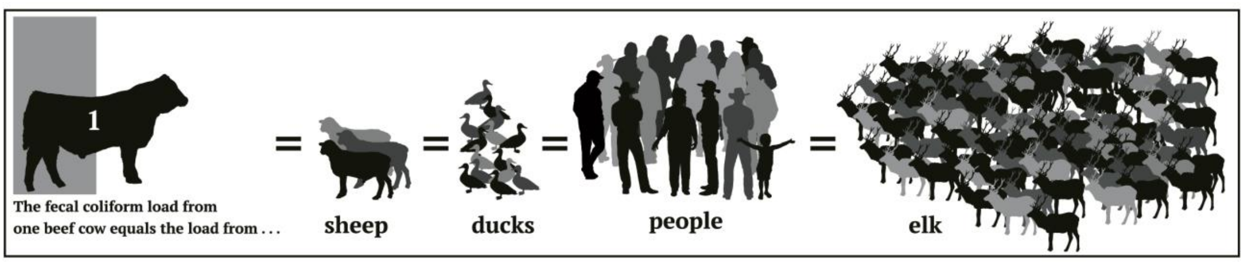
Figure 2. Summary of geometric means of *E. coli* data collected by SVCD.

4 Sources and Pathways

A detailed source assessment is provided in the companion TMDL document (Tetra Tech, 2015). The following provides a summary.

Potential sources of bacteria in the Salt River watershed include livestock, wildlife, pets, and humans. Bacteria in animal and human waste can become a significant problem when the waste is transported to streams and rivers. For example, most human waste is either discharged into and treated by a municipal waste water treatment facility (WWTP), or discharged into a septic system where it is treated. Properly functioning WWTPs and properly sited and functioning septic systems are not generally considered significant sources of bacteria. However, failing septic systems and/or septic leach fields that either become flooded or are in contact with shallow groundwater can be a source of bacteria. Similarly, well managed livestock are not necessarily a significant source of bacteria. However, when livestock, such as cattle or sheep, are allowed uncontrolled and long-term access to streams, and manure containing bacteria is deposited near the stream bank or directly in the stream, livestock can become a significant source of bacteria loading.

The rates at which the various warm-blooded animals produce bacteria varies depending upon a number of factors including the anatomy and physiology of their digestive systems, eating habits, diets, and the amount of waste they produce (i.e., larger animals typically produce more waste). For example, cattle produce more bacteria on a daily basis than sheep, sheep more bacteria than ducks, ducks more than humans and so on (Zeckoski, et. al., 2005) (**Figure 3**).



Based upon: Table 1 in Zeckoski, et. al., 2005.

Figure 3. Relative bacteria load production rates.

There are three primary pathways by which bacteria can reach surface waters in the Salt River watershed from the various sources discussed above: direct deposition, surface water runoff, or leaching into the shallow groundwater and ultimately into the Salt River or its tributaries (**Figure 4**). Given both the large numbers and the relative high rate at which they produce bacteria, and the fact that many are provided direct access to flowing water throughout the watershed, livestock are likely the most significant source of bacteria in the Salt River watershed.

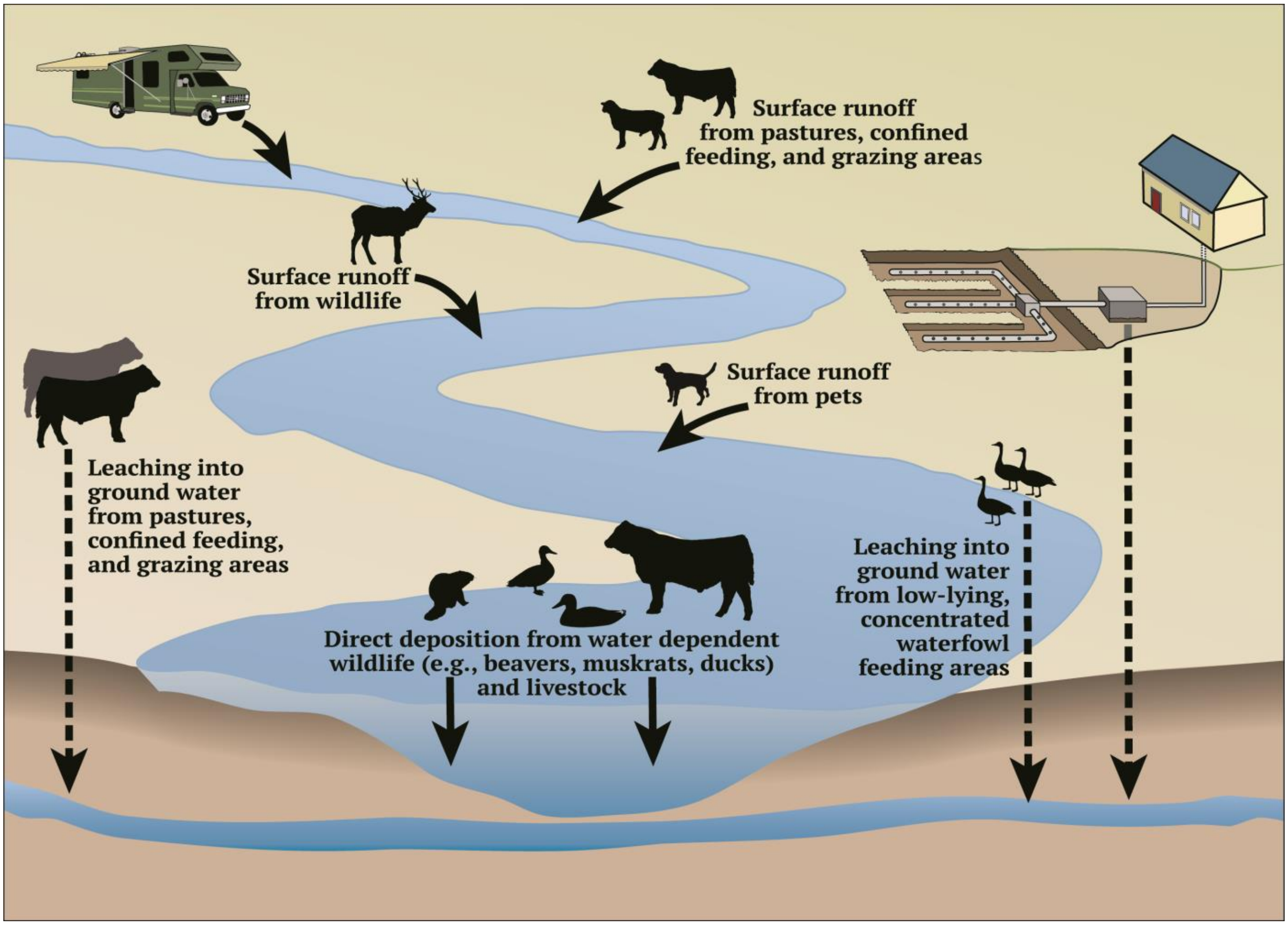


Figure 4. Bacteria transport pathways.

All sources that have the potential to deliver bacteria to the Salt River and Stump Creek need to be considered to solve this problem.

5 Restoration Strategies (3-5 year outlook)

This WRP focuses on the initial three to five years of implementation (2015 – 2020). This is considered a reasonable timeframe to establish the structure and obtain grant funding for interested groups and watershed stakeholders to implement an initial watershed restoration and enhancement effort. It is acknowledged that achieving and maintaining the in-stream *E. coli* criteria will likely be a longer term effort. After three to five years, the Star Valley Conservation District and interested watershed stakeholders will review and revise the WRP. All potential human-derived sources and pathways are considered in this plan. Strategies for each of the source categories are provide below.

5.1 Human Sources

The potential human sources of bacteria include failing and/or improperly sited septic systems, discharges from wastewater treatment facilities, and recreation.

5.1.1 Septic Systems

As described in the companion TMDL document, there are approximately 4,000 septic systems in the Salt River watershed. Properly installed and maintained septic systems are designed to treat waste and are not considered a source of bacteria (Zeckoski et al., 2005). However, improperly installed, poorly maintained, or failing systems represent potential sources of human bacteria in a watershed. Benham et al. (2004) estimates that between 3 and 40 percent of septic systems may fail, based on age[1]. The older the system, the more likely it is to fail.

The primary objective of this component of the plan is to identify and repair or replace the poorly functioning and/or failing septic systems in the watershed. This will be accomplished through implementation of:

- an educational program,
- a septic tank pumping cost share program (including required inspections), and
- a cost share program for septic system repair/replacement.

Additionally, groundwater monitoring is proposed in an effort to identify potential priority/problem areas (see **Section 6.4.2**).

5.1.1.1 Septic System Education

Since implementation of this plan is non-regulatory, the objective is to facilitate voluntary participation (i.e., get the owners of failing or improperly sited septic systems to volunteer to make improvements) through implementation of an educational program. Education will be provided via SVCD’s website, through septic system workshops, and self-assessment. Both the website and workshops will provide general information on septic systems design, installation, maintenance and repair, environmental concerns, and land planning issues. Workshops will be held twice, annually.

The self-assessment is intended to provide owners/operators of septic systems with a non-threatening way to evaluate the potential risk factors of their septic system. An example Septic System Self-

[1] Benham et al. (2004) estimates failure rates as follows: 40% for systems installed pre-1966, 20% for systems installed between 1966 and 1985, and 3% for systems installed post 1985.

Assessment[2] form (**Table 4**) will be available on SVCD's website and will also be discussed at the workshops. If, after completing the self-assessment, the majority of the responses fall into a high risk category or the answers are unknown, owner/operators will be urged to contact the SVCD to explore options to address potential impacts.

[2] The Septic System Self-Appraisal form and concept has been adapted from ongoing work by the Sheridan County Wyoming Conservation District (http://www.sccdwy.org/#).

Table 4. Septic System Self-Assessment

Septic System Features	Low Risk	High Risk	
REGULATORY CONSIDERATIONS			
Is the system permitted by the County?	Yes	No	Unknown
Does the location of the septic tank meet all of the following minimum distance requirements? →50' away from water wells (including neighbor's) →10' away from property lines →5' away from building foundations →25' away from potable water pipes →50' away from surface waterbodies	Yes	No	Unknown
Does the location of the leachfield meet all of the following minimum distance requirements? →100' away from water wells (including neighbor's) →10' away from property lines →5' away from building foundations without drains →25' away from building foundations with drains →25' away from potable water pipes →10' away from the septic tank →50' away from surface waterbodies	Yes	No	Unknown
What is the construction material of the septic tank?	Concrete, Fiberglass	Metal, Other	Unknown
Is there a clean out between the house and the septic tank?	Yes	No	Unknown
Is the leachfield located under an impermeable or compacted surface such as concrete, asphalt, brick, parking areas, or buildings?	No	Yes	Unknown
Is the septic tank capacity at least 1000 gallons (for ALL residences up to 4 bedrooms)?	Yes	No	Unknown
For residences with over 4 bedrooms, is the relationship between the septic tank and the size of the household less than 250 gallons per BEDROOM (septic tank size in gallons divided by the number of bedrooms)?	Yes	No	Unknown
ENVIRONMENTAL AND HEALTH CONSIDERATIONS			
Is wastewater discharged directly to any surface waterbody (stream/river, irrigation ditch, pond/reservoir etc.)?	No	Yes	Unknown
Is there ponding or wastewater breakout at the ground surface?	No	Yes	Unknown
Is the distance from the septic system (tank or leachfield) to any surface waterbody less than 50 feet?	No	Yes	Unknown
Does terrain slope towards or away from any surface waterbody?	Away	Toward	Unknown
Is the depth to the seasonal high groundwater table less than 4 feet?	No	Yes	Unknown
Are soils characterized by one of the following? →gravelly rocky soils that water passes through easily →very tight, clayey soils that water cannot penetrate	No	Yes	Unknown
Are there any signs of system malfunction present? →Septic Odors →Burnt out grass or ground staining over the leach field →Patches of lush green grass over the leach field →Pipes exposed or apparent cave-ins →Cracks or signs of leakage in risers and lids	No	Yes	Unknown
FUNCTION AND MAINTENANCE CONSIDERATIONS			
Is run-off from storm water, sump pumps, foundation drains or roofs diverted to flow into the septic system?	No	Yes	Unknown
Are trees, large shrubs or other plants with extensive root systems in the vicinity (10 feet) of the leach field?	No	Yes	Unknown
Has the tank been inspected and/or pumped in the last three years?	Yes	No	Unknown
Is the system less than 25 years old?	Yes	No	Unknown

5.1.1.2 Septic Pumping Cost Share and Inspection

SVCD proposes to coordinate a septic system pumping and inspection cost share program for residents of Star Valley, Wyoming. The objectives of this program are two-fold: 1) to encourage homeowners to maintain their septic systems, and; 2) to identify septic systems in need of repair. Eligibility criteria and priorities will be developed prior to initiation of the program. At a minimum, however, the homeowner must agree to completion of an inspection to be eligible for cost share assistance with pumping. SVCD proposes to coordinate with the two septic tank pumping contractors serving the Salt River watershed. The pumping and inspections will be conducted by these contractors. SVCD proposes to purchase two inspection cameras, one for each contractor, to conduct tank inspections at the time of pumping[3]. Tank inspection will include measuring septic and solids levels, drainage of the system and visual check for root infiltration, cracks or damage to the tank. SVCD and program participants will be given a copy of the inspection report.

5.1.1.3 Septic System Repair/Replacement/Hook-up Cost Share

The ultimate goal of this component of the plan it to repair or replace those septic systems within the Salt River watershed that are contributing bacteria to the Salt River or Stump Creek. SVCD proposes to obtain grant funding to implement a technical assistance and cost-share program for repair and replacement of failing or poorly sited septic systems. Technical and financial assistance may also be provided to connect failing or poorly sited septic systems to wastewater treatment facilities in cases where this may be feasible. Eligibility criteria and priorities will be developed prior to implementation of this program and will likely, at least partially, be driven by the source(s) of grant funding obtained.

5.1.2 Wastewater Treatment Plants

Available data do not suggest that discharges from waste water treatment plants are a significant source of bacteria in the Salt River watershed. However, in-stream data are limited in the vicinity of the Thayne WWTP. To address this uncertainty, paired bacteria and flow samples will be collected upstream and downstream of the Thayne lagoons in Flat Creek during summer low flow conditions (see **Section 6.2**).

5.2 Recreation

Recreation is not generally considered a significant source of bacteria, but, recreational use is relatively high in the Salt River watershed (e.g., fishing, hunting, tubing, swimming, and camping). If waste from recreational vehicles (RVs; e.g., campers, motorhomes) and campsites is not disposed of properly, these activities can result in localized discharges of bacteria.

5.2.1 Education

SVCD proposes to increase public awareness through education on their website, informing the recreational community about the importance of proper waste disposal at campsites. Brochures will be developed showing the locations of RV dump stations throughout the watershed. Additionally, signs will be posted at known high-use RV camping areas identifying BMPs and locations of nearby waste dump sites.

[3] SVCD will retain ownership of cameras but will lend them out to contractors.

5.2.2 Temporary RV Dumping Facilities

During the peak recreation season (e.g., 4th of July, Pioneer Days, hunting season), local RV dump stations are often very busy and it is difficult for them to keep up. SVCD will coordinate with local septic waste pumpers/haulers to provide a pump truck to go to key undeveloped camp grounds and heavily used Forest Service camp grounds to pump RV tanks during peak recreation times.

5.3 Livestock

> *The primary objective of the livestock element of this plan is to reduce the amount of manure that is deposited in, or near streams within the Salt River watershed.*

Livestock, such as cattle, horses, and sheep, can be a major source of bacteria to surface waters. Bacteria within manure can be transported:

- through direct deposition, where access is provided to streams or hydrologically connected conveyances;
- by becoming entrained in surface water runoff over areas with manure, and;
- leaching from livestock waste on the soil surface into the shallow groundwater and ultimately being transported to surface waters.

The greatest threat from this source category occurs when manure is deposited in, or stored near, streams during times of heavy rainfall or snowmelt, and when manure is deposited in streams during the dry season when water levels are low.

The objective of the livestock element of the plan is to reduce the amount of manure that is deposited in, or stored near streams. A brief list of suggested BMPs that may assist in achieving this objective is provided in **Table 5**. A thorough description of BMPs for livestock management is provided in DEQ's 2013 Livestock/Wildlife Best Management Practice Manual.

Table 5. BMPs that may reduce bacteria transport to streams

Best Management Practice	Description
General Livestock Grazing Management	The management of livestock grazing to sustainably achieve desired production and conservation objectives.
Alternative Water Sources and Shade	Help producers and land managers limit the amount of time livestock and wildlife spend in or near surface waters to protect water quality and riparian areas.
Stream Crossings	Establishing stable stream access points and crossings to prevent excess damage from trampling and to protect water quality and riparian areas.
Manure Management	Handling, utilizing, composting, and storing animal waste in a way such that nutrients and pathogens are not introduced into water resources.
Fencing	Controlling and limiting access to an area of land with constructed structures, such as fences, that act as barriers to animals.
Riparian Buffers	Established areas of dense vegetation adjacent to natural water bodies, which maintain the integrity of waterways and reduce pollution by preventing stream bank erosion and treating polluted runoff.

Source: Livestock/Wildlife Best Management Practice Manual (DEQ, 2013).

The overall strategy is to facilitate voluntary implementation of BMPs by implementing an educational program, a demonstration project, and making technical and financial assistance available.

5.3.1 Education

The objective of the educational element of the livestock component of the plan is to facilitate voluntary implementation of water quality improvements. Education will be provided via SVCD's website, through an educational workshop, and self-assessment.

The SVCD plans to add a webpage to their website focusing on livestock and pastured animals including links to educational materials regarding best management practices, sources for obtaining technical and financial assistance, and a link to a self-appraisal that livestock managers can use to assess the potential of their operations to contribute pollutants (including bacterial) to the stream network. Much like the septic system self-appraisal (see **Section 5.1.1.1**), the livestock self-assessment[4] is intended to provide ranchers/farmers with a non-threatening way to evaluate their operations. An example self-appraisal form is provided in **Table 6.** This form is intended to be used by livestock/domestic animal owners to evaluate the potential risk factors of their operation. If after completing the self-assessment the majority of the responses fall into a high risk category, owners/operators will be urged to contact the SVCD to explore options to address potential impacts.

Table 6. Example livestock and pastured animals self-appraisal form

Features of the Operation	High Risk	Low Risk
LOCATION CONSIDERATIONS		
Does the area of confinement or feeding impact a surface waterbody that is designated as impaired by the State of Wyoming (see below)?	Yes	No
Do livestock/domestic animals have direct and constant access to a stream or other surface waterbody (irrigation ditch, pond/reservoir etc.)?	Yes	No
Is the distance from the area of confinement or feeding to a stream or other surface waterbody less than 100 feet?	Yes	No
Is the area of confinement or feeding located within a floodplain?	Yes	No
Does the terrain slope towards a stream or other surface waterbody?	Yes	No
SITE/CONDITION CONSIDERATIONS		
Does the area of confinement or feeding support perennial vegetation?	No	Yes
If present, is the buffer between the area of confinement or feeding and the stream or surface waterbody well-vegetated with a mixture of perennial grasses, forbes, and woody species?	No	Yes
Does run-off from within the area of confinement or feeding discharge into a stream or other surface waterbody?	Yes	No
Is there run-off from upslope areas, building roofs, or other sources that passes through the area of confinement or feeding prior to entering a stream or other surface waterbody?	Yes	No
OPERATION/MANAGEMENT CONSIDERATIONS		
Is the entire acreage used as an area of confinement and/or feeding on a continuous, season-long basis?	Yes	No
Is manure/animal waste stockpiled in or near a stream or other surface waterbody?	Yes	No
Is the riparian area/floodplain fenced so that it can be managed separately from the area of confinement or feeding?	No	Yes
Does the operation have a grazing plan that considers the frequency and intensity of grazing and provides a rest opportunity during the growing season?	No	Yes

[4] The Livestock and Pastured Animals Self-Appraisal form and concept has been adapted from ongoing work by the Sheridan County Wyoming Conservation District (http://www.sccdwy.org/#).

5.3.2 Grazing Management and Stockmanship Workshop

One method to reduce the amount of manure that is deposited in or near streams is to reduce the amount of time that livestock graze and loaf in riparian areas, and to enhance the condition of vegetation communities in riparian areas so they provide an effective buffer. A number of methods are available to limit the amount of time that livestock remain in riparian areas ranging from fencing, to development of off-stream water sources, to application of riding/handling techniques to achieve more control of the herd.

The SVCD proposes to sponsor a one-day seminar for ranchers and livestock managers on grazing management and stockmanship techniques to minimize the impacts of riparian grazing. Steve Cote from the National Resources Conservation Service (NRCS) in Arco, Idaho will be a featured speaker discussing methods that enable ranchers to quietly move cattle in pasture rotation systems to keep them out of fragile riparian areas along streams. In addition, local and regional experts on BMPs for livestock management in riparian areas will be invited to speak.

5.3.3 Livestock Demonstration Project

The Bridger Teton National Forest has identified three spring developments located on the Grover-Blaney Grazing Allotment within the Salt River watershed that are likely sources of bacteria given their current condition: White Pine Spring, Church House Hollow Spring, and Spruce Hollow WD#1 (**Figure 5**). These springs currently are not functioning at their optimal levels due to damaged fencing, compaction of the spring sources from livestock and wildlife, broken/damaged lines to the troughs, and troughs not holding water due to age. Livestock and wildlife currently have direct access to the springs resulting in the potential for both direct deposition of bacteria and runoff entering the hydrologic network. All three are in need of complete refurbishment including; new spring boxes, pipelines to the troughs, and fencing around the spring sources.

Livestock water developments such as these are ubiquitous throughout the watershed. As a demonstration project, the SVCD, in cooperation with the Bridger Teton National Forest, proposes to obtain grant funding to refurbish these three springs. Additionally, SVCD will work with the Forest Service to develop an inventory of springs that need to be addressed and will continue to repair as needed and as funding is available.

5.3.4 Portable Solar Powered Off-Stream Watering Equipment

In 2013, the SVCD purchased and supplied equipment for one portable, solar powered, off-stream water system to remediate a riparian water quality issue within Little Greys Cattle Allotment in the Greys River watershed. During the summer grazing season, this system was used to redistribute cattle away from a degraded riparian area. During the remainder of the year, the system was used to address similar issues on private lands. The equipment was successfully used for the entire grazing season.

Given the previous success, the SVCD proposes to purchase and make available the equipment for one additional portable, solar powered off-stream watering system. The unit would be made available for use on both the national forest and private lands within the Salt River watershed.

5.3.5 Livestock and Pastured Animals Improvement Program

The SVCD, in coordination with the NRCS, proposes to develop and obtain grant funds for the implementation of a technical assistance and cost share program for the implementation of BMPs for livestock and pastured animals. The program will provide incentives to landowners for the rearrangement or relocation of corrals and feeding areas that have the potential to negatively impact water quality. Run-off from corrals often contain bacteria (many of which are human pathogens), nutrients, sediment, and organic materials which are delivered to local streams.

It is envisioned that Livestock and Other Pastured Animals Improvement Program will be voluntary, locally-directed, with financial and technical assistance provided to producers wishing to minimize the impact of a livestock operation on adjacent waterways.

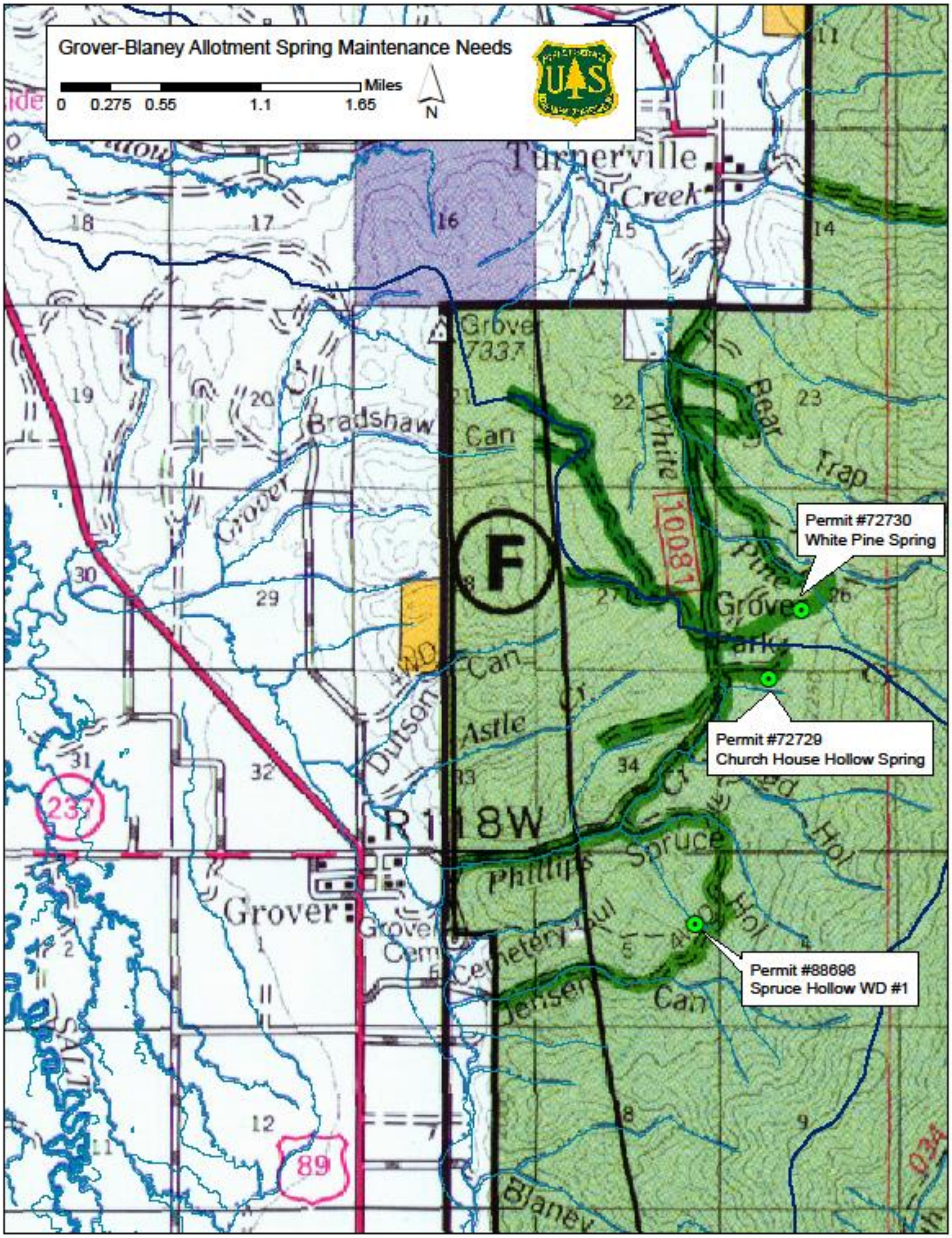


Figure 5. Location of proposed spring refurbishment projects.

5.4 Pets

When pet waste is improperly disposed of, it can be picked up by stormwater runoff and washed into nearby waterbodies. Pet waste carries bacteria, viruses, and parasites that can threaten the health of humans and wildlife. Although pet waste is not likely a significant source of bacteria in the Salt River watershed, every effort should be taken to minimize the potential. The focus of the WRP to address pet waste will be to increase public awareness through education on SVCD's website, informing pet owners about the importance of cleaning up after their pets and encouraging proper waste disposal. Additionally, SVCD will work with the municipalities and Forest Service to install mutt mitt stations in key areas.

5.5 Summary of Potential BMPs and Estimated Load Reductions

Necessary median *E. coli* load reductions reported in the companion TMDL document for the Salt River and Stump Creek range up to 60 and 66 percent, respectively, depending upon flow condition.
As described previously, this WRP focuses on the initial three to five years of implementation. It is acknowledged that achieving and maintaining the in-stream *E. coli* criteria will likely be a longer term effort and achieving the necessary watershed scale *E. coli* load reductions will take longer than the duration of this first phase of implementation proposed in this plan.

The proposed suite of BMPs for this first phase of implementation and associated load reduction estimates are presented in **Table 7**. The greatest reductions in *E. coli* loading will likely be realized through implementation of the proposed BMPs for septic systems and livestock.

Table 7. BMP summary and estimated load reductions.

Source Category	Education	BMPs	Estimated Combined Reductions [a]
Septic Systems	Website, septic workshops, self-appraisal	Pumping, inspections, repair, replacement	Up to 100% for repair/replacement
WWTP Discharge	n/a	n/a	n/a
Recreation	Website, brochures, posting signs, temporary RV dump stations	Education, temporary RV dump stations	50%
Livestock	Website, stockmanship workshop, self-appraisal	Grazing management, alternative water sources and shade, stream crossings, manure management, fencing, riparian buffers	50-90%
Pets	Website	Education	50%

Notes
BMP = best management practice; n/a = not applicable; RV = recreational vehicle; WWTP = wastewater treatment plant.
a. Estimated based on best professional judgement.

6 Water Quality and Water Quantity Monitoring

The SVCD has been collecting bacteria concentration samples at nine stations on the mainstem of the Salt River and one station on Stump Creek since 2005. The primary purpose of this monitoring effort has been to characterize existing conditions. In a typical year, about fifteen samples are taken at each site. Most of the samples have been collected during the primary recreation season (May 1 – September 30), but a few samples have been collected during the secondary recreation season (October 1-April 30). With completion of the TMDL and the Salt River Watershed Water Quality Improvement Plan (Tetra Tech, 2015), however, the monitoring goals and objectives will transition from characterizing the water quality problem to:

- Long-term trend monitoring to determine if water quality standards have been met.
- Monitoring to address uncertainties.
- Refining the understanding of sources
- BMP effectiveness monitoring

A summary of the strategy is provided below.

6.1 Long-Term Trend Monitoring

The primary goal of the long-term trend monitoring strategy is to assess trends in bacteria concentration over time and to determine if the water quality standards have been attained. The SVCD proposes to collect a minimum of five bacteria (*E. coli*) concentration samples annually at the seven sites listed in **Table 8** and shown on **Figure 6**.

The Salt River often runs dry downstream of the Smoot Bridge. An 8th site has been added to begin to develop a record of this occurrence. When *E. coli* samples are collected at the other sites, a visual flow estimate will also be made at the Salt River at Fairview North Road site.

Table 8. Proposed long-term trend monitoring sites

Site	Latitude	Longitude	Parameter
Salt River at Smoot Bridge	42.620389°	-110.940009°	*E. coli*
Salt River at Fairview North Road	42.692677°	-110.963752°	Flow (visual estimate)
Crow Creek	TBD	TBD	*E. coli*
Stump Creek near State Line	42.786662°	-111.034140°	*E. coli*
Stump Creek Auburn	42.795210°	-110.997937°	*E. coli*
Salt River at Narrows Bridge	42.841435°	-110.981063°	*E. coli*
Salt River at Freedom Bridge	42.982212°	-111.031236°	*E. coli*
Salt River at Etna Gage	43.076125°	-111.035390°	*E. coli*

Notes
Latitudes and longitudes are in the North American Datum 1983.
TBD = to be determined.

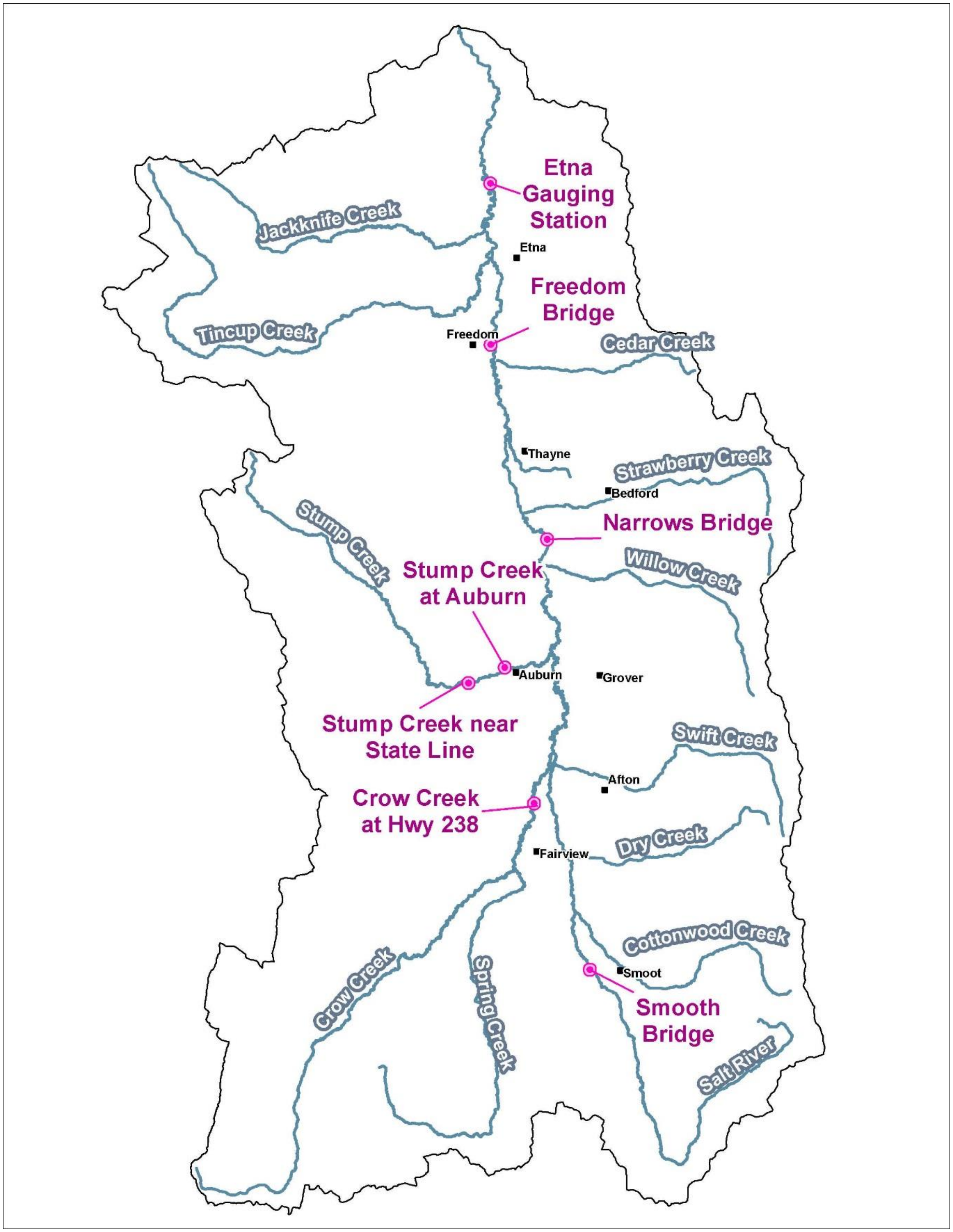


Figure 6. Proposed long-term monitoring sites.

6.2 Monitoring to Address Uncertainties

The primary uncertainty that needs to be addressed is the extent to which the Thayne WWTP may be contributing bacteria to Flat Creek and the Salt River. SVCD will work with the Town of Thayne, review any data that may have been collected, and determine if additional monitoring needs to happen. If additional data are needed, paired bacteria and flow samples will be collected upstream and downstream of the Thayne lagoons in Flat Creek during summer low flow conditions.

Additionally, given limited recent data, there are uncertainties regarding flow in Stump Creek. Although collection of additional flow data in Stump Creek will not change the ultimate goal of this plan (i.e., attain water quality standards in both Stump Creek and the Salt River), it may provide additional insight into the magnitude of bacteria loading to the Salt River from the Stump Creek watershed. At a minimum, monthly flow measurements should be collected at (or in close proximity to depending upon access) the Stump Creek at State Line and Stump Creek at Mouth locations.

6.3 BMP Effectiveness Monitoring

A number of BMPs may be employed within the Salt River watershed to reduce bacteria loading. There are two primary purposes for BMP effectiveness monitoring: 1) to determine if, where, and when, BMPs have been implemented, and 2) to determine if they are, in fact, reducing bacteria loads. A tracking system is proposed to record/document implementation activities in the watershed that may reduce bacteria levels. The long-term trend monitoring described above will be relied upon to determine if BMPs (at the watershed-scale) have been effective, but, the collection of in-stream bacteria concentration samples to assess the effectiveness of individual BMPs may be considered on a case-by-case basis.

6.4 Source Identification Monitoring

6.4.1 Synoptic Surveys

A single synoptic survey of the Salt River watershed was conducted by Tetra Tech in July 2014. The results were useful in identifying potential contributing areas and also identifying those areas that were likely not contributing significant bacteria loads. However, those samples only represented a single point in time. Two additional synoptic sampling events are proposed between May 1st and September 30th at the sites listed in **Table 9** and shown on **Figure 7**.

Table 9. Proposed synoptic survey sites.

Site	Latitude	Longitude	Parameter
Salt River at Forest Dell	42.543077°	-110.894365°	Flow and *E. coli*
Salt River at Smoot Bridge	42.620389°	-110.940009°	Flow and *E. coli*
Salt River at Fairview North Road	42.692677°	-110.963752°	Flow and *E. coli*
Crow Creek	TBD	TBD	Flow and *E. coli*
Cottonwood Creek	42.621960°	-110.913975°	Flow
Dry Creek	42.681949°	-110.924632°	Flow
Swift Creek	42.732384°	-110.933294°	Flow
Salt River at Burton Springs	42.756969°	-110.971551°	Flow and *E. coli*
Stump Creek at gage	42.786662°	-111.034140°	Flow and *E. coli*
Stump Creek Auburn	42.795210°	-110.997937°	Flow and *E. coli*
Salt River at Narrows Bridge	42.841435°	-110.981063°	Flow and *E. coli*
Willow at mouth	42.856057°	-110.989268°	Flow and *E. coli*
Salt River upstream of East Side Canal	42.881768°	-110.998652°	Flow and *E. coli*
Salt River downstream of East Side Canal	42.881768°	-110.998652°	Flow and *E. coli*
Flat Creek near mouth	TBD	TBD	Flow and *E. coli*
Freedom Bridge	42.982212°	-111.031236°	Flow and *E. coli*
Tincup Creek at State Line Road	43.010480°	-111.044144°	Flow and *E. coli*
Jack Knife Creek at State Line Road	43.046060°	-111.044091°	Flow and *E. coli*
Etna Gage Station	43.076125°	-111.035390°	Flow and *E. coli*
McCoy Creek	43.127124°	-111.031414°	Flow and *E. coli*

Notes
Latitudes and longitudes are in the North American Datum 1983.
TBD = to be determined.

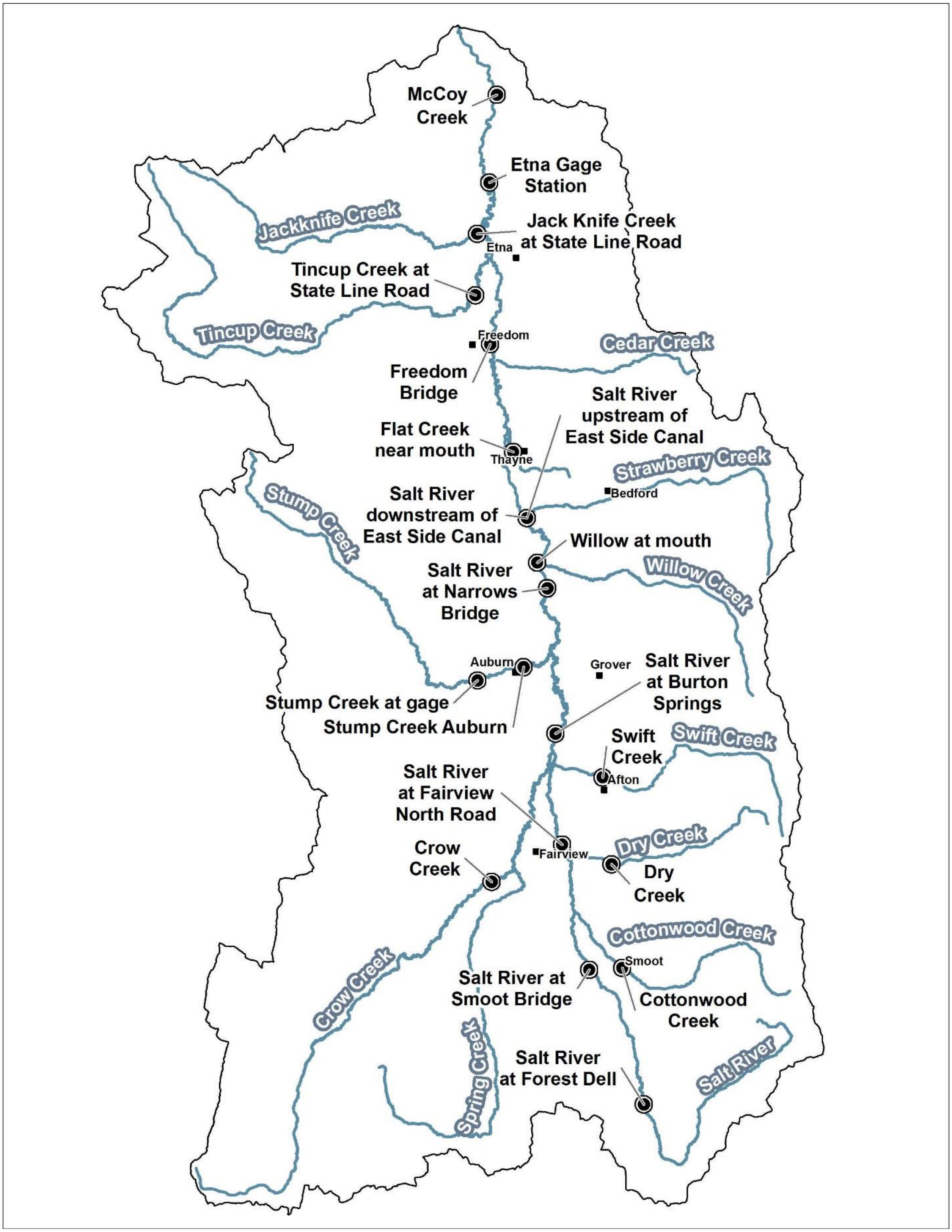


Figure 7. Proposed synoptic sample sites.

6.4.2 Groundwater Sampling

Based on the July 2014 synoptic survey, a large load of bacteria were delivered to the Salt River between Burton Springs and the Narrows Bridge. Stump Creek is the primary tributary along this reach of the Salt River. However, the load from Stump Creek accounted for less than two percent of the total load measured at the Narrows Bridge. This suggests that other pathways (i.e., groundwater and direct deposition) may be important in this portion of the watershed. It is hypothesized that septic systems and dairy operations in the town of Auburn, Wyoming are producing a groundwater bacteria load that is being transported to the Salt River. To test this hypothesis, a total of five shallow wells are proposed for installation near the town of Auburn, Wyoming to evaluate the presence of bacteria in groundwater. The groundwater gradient is assumed to be generally eastward; therefore, one or two background wells are proposed for installation west of Auburn in an area of agricultural fields east of Stump Creek (up-gradient), and three to four wells are proposed to be installed east (down-gradient) of State highway 238 in an area of agricultural fields west of the Salt River. Well locations can be adjusted as necessary if groundwater gradient is determined to differ from the assumed direction. To minimize site impacts and project costs, wells will be installed using direct-push rigs such as Geoprobe® or Power Probe®.

6.4.3 Optional Microbial Source Tracking

The term “Microbial Source Tracking” (MST) refers to procedures that use host-specific (i.e., found only in one host species or group) or host-associated (i.e., largely confined to one host species or group) microbial indicators to establish the origin of fecal pollution in water. MST is based on the principles that some microorganisms have an exclusive or preferential association with a particular host, and that these host-associated microorganisms are shed in feces and can be detected in water bodies (Hagedorn et al. 2011, EPA 2005).

Microbial source tracking can be expensive and time-consuming in comparison to traditional monitoring. And sometimes MST results that conflict with pre-conceived notions of pollution sources are not trusted by the public. As a result, MST is only recommended if implementation of this plan has not successfully resulted in achieving the water quality goals. In this case, MST may be useful in identifying a previously overlooked source or may confirm that all sources over which humans have control have been addressed (e.g., the only remaining sources are wildlife).

7 Criteria to Determine Achievement of Load Reductions

The water quality criterion to determine if load reductions are being achieved for the summer recreation season (May 1–September 30) states that concentrations of *E. coli* bacteria should not exceed a geometric mean of 126 counts/100 mL during any consecutive 60-day period. Necessary median *E. coli* load reductions reported in the companion TMDL document for the Salt River and Stump Creek range up to 60 and 66 percent, respectively, depending upon flow condition.

Given that the sources of bacteria in the watershed are largely nonpoint source and implementation will be voluntary, achievement of water quality standards will likely take a long time. A lag time is anticipated. First, time will be needed to obtain funding, develop the programs, and generate interest among watershed stakeholders. Then, BMPs will likely be implemented incrementally throughout the watershed as funding becomes available.

8 Implementation Schedule and Measurable Milestones

The intent is for the WRP to be fully implemented by 2020. At that time, SVCD will review the plan and revise/make additions as necessary. An implementation schedule, with measureable milestones is presented in **Table 10**.

Table 10. Watershed Restoration Plan Schedule and Measureable Milestones

Activity	2015	2016	2017	2018	2019	2020
Septic Systems						
Update SVCD website	■					
Finalize self-appraisal form	■					
Septic workshops (2x annually)		■	■	■	■	■
Septic pumping (4 annually)		■	■	■	■	■
Septic system repair (1 annually)		■	■	■	■	■
Waste Water Treatment Facilities (see Uncertainties under Water Quality Monitoring)						
Recreation						
Update SVCD website	■					
Post signs		■				
Temporary RV dump stations		■	■	■	■	■
Livestock						
Update SVCD website	■					
Finalize self-appraisal form	■					
Stockmanship Workshop		■	■			
Demonstration Project		■	■			
Livestock and Pastured Animals cost share program		■	■	■	■	■
Pets						
Update SVCD website	■					
Install and maintain “mutt mitt” stations	■	■	■	■	■	■
Water Quality Monitoring						
Long-term trends		■	■	■	■	■
Uncertainties		■				
BMP effectiveness		■	■	■	■	■
Source ID (synoptic)		■				
Source ID (groundwater)		■				
Source ID (MST - optional)						■

9 Technical and Financial Assistance

The need for technical assistance will vary depending upon the topic. The SVCD will serve as the first point of contact for technical assistance. Additional and/or more in-depth technical assistance may be provided by the resource agency representatives that previously served on the Salt River TMDL Technical Advisory Committee:

- Wyoming Department of Environmental Quality
- Bridger Teton National Forest (U.S. Forest Service)
- Caribou Targee National Forest (U.S. Forest Service)
- Caribou County Conservation District
- Wyoming State Engineers Office
- Wyoming Game and Fish Department
- Lincoln County Office of Planning and Engineering
- U.S. Geologic Survey

Interagency coordination between local, state, and federal entities will be an integral part of this implementation plan. The SVCD and NRCS will assist in coordination between the State of Wyoming and willing private landowners to address source issues on private land. For agriculture and septic system improvements, BMP implementation is a voluntary, incentive-based program. Federal cost-share incentives are available through programs such as the NRCS Environmental Quality Incentive Program (EQIP) as well as EPA 319 funding that specifically address nonpoint sources. Other sources of funding may include the Wyoming Landscape Conservation Initiative, Wyoming Wildlife and Natural Resource Trust, Ducks Unlimited, Partners for Fish and Wildlife, and Wyoming Department of Agriculture. Continued participation from private landowners, managers, and all stakeholders in the watershed is important to the successful outcome of this implementation plan.

Cost estimates for the restoration strategies identified for the first three to five years of implementation are listed in **Table 11**.

Table 11. Cost estimates for implementation of the proposed restoration strategy

Task	Expected Cost
Septic Systems	
Finalize self-appraisal form and update SVCD website	$2,000
Septic workshops (2x annually)	$1,000
Septic pumping (10x annually)	$1,500
Septic system repair (1x annually)	$8,000
Recreation	
Update SVCD website	$2,000
Post signs	$4,500
Develop brochures	$1,200
Livestock	
Finalize self-appraisal form and update SVCD website	$2,000
Stockmanship Workshop (X2)	$5,000
Demonstration Project	$15,000
Portable Solar Powered Off-Stream Watering Equipment	$15,000
Livestock and Pastured Animals cost share program	$30,000
Pets	
Update SVCD website	$2,000
Install and maintain "mutt mitt" stations	$4,000
Water Quality Monitoring	
Long-term trends	$11,600
Uncertainties	
WWTP sampling	$0
Stump Creek flow monitoring	$6,000
BMP effectiveness	$5,000
Source ID (synoptic)	$15,000
Source ID (groundwater)	$17,000
Source ID (MST - optional)	$25,000
Total	$172,800

Note: Cost estimates are approximations based on the best available data at this time. It is envisioned that these will be refined prior to seeking funding.

10 References

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