Utah Division of Water Quality

Elements to Utah's Monitoring and Assessment Program

2020-2030

Version 2.1

Utah Department of Environmental Quality
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Salt Lake City, UT 84116

Revision Tracking

Date	Revision #	Summary of Changes	Sections	Other Comments
12/2020	1	Revised 10 year plan	All	
05/2021	2	Updated content based on EPA comments	All	
07/2021	2.1	Internal updates/edits	All	

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Acronyms/Abbreviations

ABR	Authorization by Rule
AFFFs	Aqueous Fire Fighting Foams
ALU	Aquatic Life Use
AMP	Ambient Monitoring Program
ATTAINS	Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System
BACI	Before-After-Control-Impact
BCG	Biological Condition Gradient
BLM	Bureau of Land Management
BMP	Best Management Practices
BOD	Biological Oxygen Demand
BOR	Bureau of Reclamation
CEC	Contaminants of Emerging Concern
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DER	Data Evaluation Reports
DMR	Discharge Monitoring Reports
DO	Dissolved oxygen
DOC	Demonstration of Capability
DOH	Department of Health
DPM	Designated Program Manager
DQO	Data Quality Objectives
DWQ	Division of Water Quality (Utah)
DWR	Division of Wildlife Resources (Utah)
EDD	Electronic Data Deliverables
EMAP	Environmental Monitoring Assessment Program
EPA	Environmental Protection Agency
fDOM	Fluorescent Dissolved Organic Matter
GIS	Geographic Information System
GSL	Great Salt Lake
GWP	Groundwater Program
HABs	Harmful Algal Blooms
IDS	Information and Data Services Section
IMS	Internet Map Server
IR	Integrated Report
LHA	Lifetime Health Advisory
LHD	Local Health Department
MCL	Maximum Contaminant Level
NARS	National Aquatic Resource Surveys
NCCA	National Coastal Condition Assessment
NLA	National Lakes Assessment
NOV	Notice of Violation
NPS	National Park Service
NPS	Non-Point Source
NRSA	National Rivers and Stream Assessment
NWCA	National Wetlands Condition Assessment
ORD	Office of Research and Development (EPA)

ORP	Oxidation Reduction Potential
PAR	Photosynthetically Active Radiation
PBR	Permit by Rule
PCB	Polychlorinated Biphenyls
PFAS	Per- and polyfluoroalkyl substances
PIP	Project Implementation Plan
POTW	Publicly Owned Treatment Works
PPCPs	Pharmaceuticals and Personal Care Products
RIVPACS	River Invertebrate Prediction and Classification System
QAPP	Quality Assurance Project Plan
QAQC	Quality Assurance and Quality Control
QMP	Quality Management Plan
UAC R317-2	Standards of Quality for Waters of the State – Utah Administrative Code
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedures
SRP	Strategic Research Plan
STEPL	Spreadsheet Tool for Estimating Pollutant Loads
TALU	Tiered Aquatic Life Uses
TDS	Total Dissolved Solids
TIN	Total Inorganic Nitrogen
TMDL	Total Maximum Daily Load
TSI	Trophic State Index
TSS	Total Suspended Solids
TVS	Total Volatile Solids
UAA	Use Attainability Analysis
UCASE	Utah Comprehensive Assessment of Stream Ecosystems
UGS	Utah Geological Survey
UIC	Underground Injection Control
ULWQS	Utah Lake Water Quality Study
UPDES	Utah Pollution Discharge Elimination System
USDW	Underground Sources of Drinking Water
UTFTIS	Utah Fish Tissue Contamination Program
USFS	United States Forest Service
USGS	United States Geological Survey
USDW	Underground Source of Drinking Water
WLA	Waste-load Allocation
WQB	Water Quality Board
WQX	Water Quality Exchange
WWTP	Wastewater Treatment Plant
WY	Water year
305(b)	Clean Water Act requirement that requires states to submit a report on the status of waterbodies within its jurisdiction
303(c)	Classification of water quality Standards under the Clean Water Act
303(d)	List of impaired waterbodies within the state

Summary

The Utah Division of Water Quality (DWQ, or the Division), is tasked with implementing rules and regulations as set by the federal Clean Water Act (CWA) administered by the Environmental Protection Agency (EPA). The primary goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. DWQ assesses the quality of its surface water resources (streams, lakes/reservoirs, wetlands) to protect the uses of surface water for drinking, recreation, irrigation, stock watering, and to support aquatic life. DWQ has a distinct section dedicated to coordinating and implementing water quality monitoring programs throughout the state. This monitoring plan serves as the foundation for DWQ's monitoring strategy for the next 10 years and ultimately how data will support DWQ's decision making processes to protect and improve water quality. This document is a revision to Utah's 2010-2020 Strategic Monitoring Plan and will guide how monitoring occurs over the next ten years. While this document serves as a broad perspective of Utah's monitoring programs, it will be accompanied by more detailed program summaries on an annual basis. This plan was designed in a manner to provide data users with credible data to make decisions while adhering to an adaptive and efficient system of collecting data.

The framework for Utah's monitoring plan is structured off three primary components that will be described in more detail throughout this document. These include:

1. 10 elements of a monitoring program (EPA guidance)
2. 4 strategies used to design monitoring projects
3. Overview of DWQ's current monitoring programs/projects

1.0 Introduction and Background

1.1 Agency Structure

Department of Environmental Quality

Established in 1991 to protect the environment and human health, the Utah Department of Environmental Quality (DEQ) is responsible for implementing and enforcing delegated programs under the Clear Water, Safe Drinking Water, and Clear Air Acts, as well as enforcing state environmental regulations. Its mission is to safeguard and improve Utah's air, land, and water through balanced regulation. DEQ implements state and federal environmental laws and works with individuals, community groups and businesses to protect the quality of Utah's air, land, and water.

To protect the health of Utah citizens and the environment from the adverse impacts of pollution, the primary actions of DEQ involve environmental monitoring, issuing permits, conducting inspections, and affecting environmental protection through various assistance, compliance and enforcement programs activities.

- Monitoring is performed to:
    1. Identify the presence and abundance of contaminants in discharged to and occurring in the environment
    2. Determine impacts of pollution on human health and ecosystems
    3. Determine whether, how, and by whom such impacts should be prevented, mediated, and corrected
    4. Ensure compliance and support enforcement of applicable environmental regulations
- Permits are issued by DEQ to limit the amounts of wastes entering the environment and ensure that pollutant releases return to safe levels
- Inspections of potential pollutions sources are performed to ensure compliance with state and federal regulations and standards

Division of Water Quality

DWQ's mission is to safeguard and enhance Utah's water through balanced regulation. The agency maintains, restores, and enhances the quality of Utah's surface and underground waters to protect it for drinking, agricultural, recreation, and wildlife beneficial uses. The principal mechanisms used to accomplish water quality protection in Utah are:

- Regulatory approaches
- Incentive based programs
- Market based approaches

Utah DWQ is responsible for a variety of programs that monitor, assess, and protect the surface and groundwaters for the state. DWQ has been delegated responsibility from the EPA to accomplish the objectives and goals of the CWA within state boundaries.

Under the Utah Water Quality Act (Utah Title 19-5), DWQ serves as staff to the Water Quality Board in administering:

- Permitting, compliance, and enforcement of discharge and other permits
- Development of water quality standards to protect Utah's waters for their designated beneficial uses
- Monitoring and assessment of the state's waters
- Development of watershed protection plans (TMDLs) to bring impaired waters back into compliance
- Responding to environmental incidents/spills
- Provide financial assistance through the state revolving fund program for high priority capital water quality projects
- Provide financial assistance for projects to address unregulated nonpoint source pollution
- Managing and updating water quality rules and regulations of the state

Division of Water Quality – Monitoring Section

DWQ's monitoring section performs comprehensive monitoring activities throughout the state. It is a team of dedicated individuals whose primary goal is to meet the sample collection and site inspection requirements for DWQ. Data collected to support the Division's monitoring programs are used to assess the quality of the state's surface and groundwaters and document how the quality of these water resources change through time.

DWQ's monitoring team is comprised of 8 full-time staff who coordinate all field activities for the various programs DWQ manages. Seasonal technicians (Water Quality Technicians) are hired annually to assist the monitoring team as increased field demands occur during the busy field season.

1.2 General Background

There are three major river basins in Utah: Great Basin, the Colorado Plateau, and a small portion of Columbia River Basin. The state is divided into six sub-basins, or watershed units, that DWQ uses to manage monitoring resources (more on the management of these sub-basins can be found in Section 2.3.1). These six sub-basins (Figure 1) are as follows:

- Colorado Basin
- Sevier-Beaver-Cedar-West Desert-Columbia Basins
- Bear River Watershed
- Weber River Watershed
- Uinta Basin
- Jordan River-Utah Lake Watershed

Utah's surface water resources include 14,250 perennial miles of rivers and streams and over 2000 lakes and reservoirs. Utah is the second driest state in the country and these waters play a major role in the private, commercial, and industrial development of the state. They are sources of drinking water, provide enormous recreational opportunities, sustain a variety of wildlife, and provide water for agriculture production. An overview of Utah's waterbody characteristics are listed in Table 1.

Table 1 - Atlas of Utah's Waterbody Characteristics

Atlas of Utah's Waterbody Characteristics	
Total miles of rivers/streams	85,916
- Miles of perennial rivers/streams	14,250
- Miles of intermittent rivers and streams	66,649
- Miles of ditches and canals	4,017
Number of lakes/reservoirs/ponds	2,085
- Acres of lakes/reservoirs/ponds	461,717
Wetlands	
- Acres of freshwater wetlands	510,359
- Linear miles of wetlands	1,902

Source: Draft 2010 Utah Integrated Report

More information on this topic can be found at DWQ's Watershed Management Program.

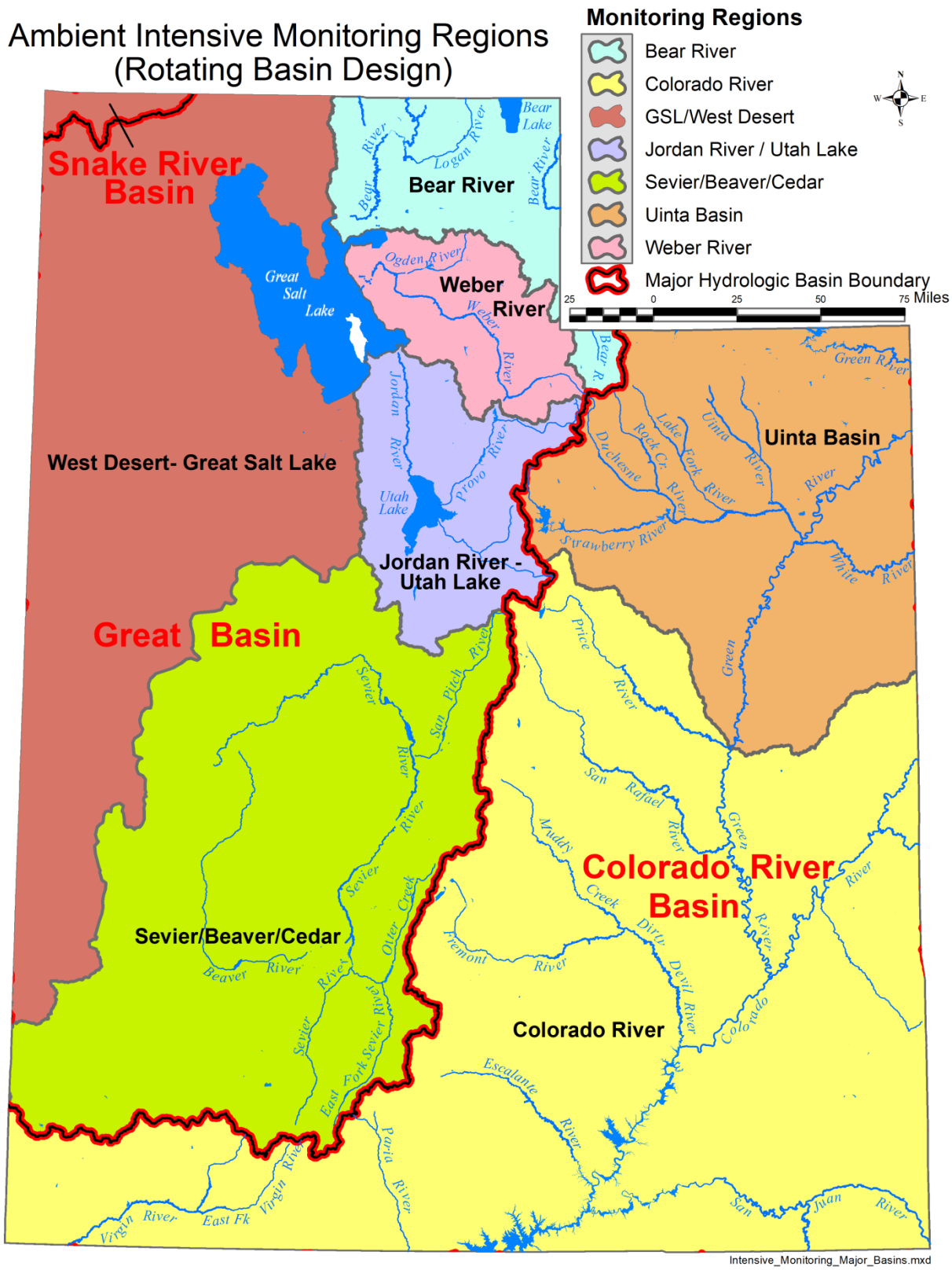

Figure 1 Utah's River Basins and Sub-Watersheds

1.3 Purpose of this Document

This document provides a blueprint for accomplishing the Monitoring Section's priorities for the next ten years. This plan presents the details of DWQ's long-term objectives and outlines the respective monitoring strategy elements for its different monitoring programs. The purpose of a long-term monitoring plan is to:

- Identify Utah's major state water monitoring program elements
- Provide a framework that articulates Utah's programmatic and resource needs to accomplish these statewide monitoring program elements
- Establish a fundamental approach for Utah to meet its environmental assessment, reporting, and programmatic needs

The implementation plans described throughout this document rely on the availability of program resources and technical support. Resource availability is established annually.

DWQ is responsible for administering rules under the CWA, guided by EPA. DWQ is also responsible for implementing and enforcing regulations adopted by the Utah Clean Water Act. The Division's monitoring and assessment strategy is framed on EPA's *Elements of a State Water Monitoring and Assessment Program*. This report is not intended to characterize or to encompass the monitoring and assessment activities of other federal, state, tribal, or local entities. This document will be used in conjunction with DWQ's Quality Assurance Project Plan (QAPP); Sampling Analysis Plans (SAPs); and Standard Operating Procedures (SOPs).

This document should be a basis for dialogue and guidance on DWQ's monitoring program with its partners, including EPA. While not a detailed monitoring plan, incremental improvements and updates will be made as necessary, and revisions to this plan will be made after 5 years. It will address major topics and provide a long-term plan for enhancing DWQ's monitoring and assessment programs. Annual monitoring summaries will accompany this document, which will include an overview of monitoring projects that occur within the year.

1.4 Document Organization

Section 2.0 of this document will address each of the ten elements of monitoring plan as they relate to Utah's monitoring program. Each section discusses status, areas of potential improvement, and resource implications. These 10 program elements are:

- Strategy
- Objectives
- Design
- Indicators
- Quality assurance

- Data management
- Data analysis and assessment
- Reporting
- Evaluation
- Support and infrastructure

Section 3.0 gives an overview of each of DWQ's monitoring programs. These overviews include the objectives, rationale, purpose, utilization of data, and a description of the program.

2.0 Ten Elements of a State Monitoring and Assessment Program

2.1 Element A - Program Strategy

In an adaptive monitoring program, monitoring iteratively improves the knowledge base of management, so decision making is based on the best science available. As more information becomes available, the scientific uncertainty about the ecosystem is reduced and initial actions and management decisions are revisited and refined. While DWQ has a number of monitoring programs to address water quality issues, its strategy and prioritization must adapt from year to year. Annual monitoring summaries will be incorporated into this ten-year plan. These will outline monitoring efforts for the current year in a more specific manner. As resource prioritization and allocation changes within the Division, monitoring programs must also adapt. Each monitoring program goes through a number of phases during its lifespan. Broadly, these include:

1. Planning phase
2. Monitoring phase (field implementation)
3. Evaluation phase (with the potential to reassess)
4. Assessment phase

Figure 2 shows a generalized approach of the monitoring and assessment process that is used when managing monitoring projects. The process usually starts by framing the water quality questions that need to be answered. This then leads to the development of a SAP, and if applicable, includes the development of new SOPs. Sample collection and lab analysis then occurs. Next is the data management component followed by an assessment or analysis of data. The reporting process occurs next and then the entire process is repeated and adapted from feedback. These broad steps are addressed throughout the remaining sections of this document.

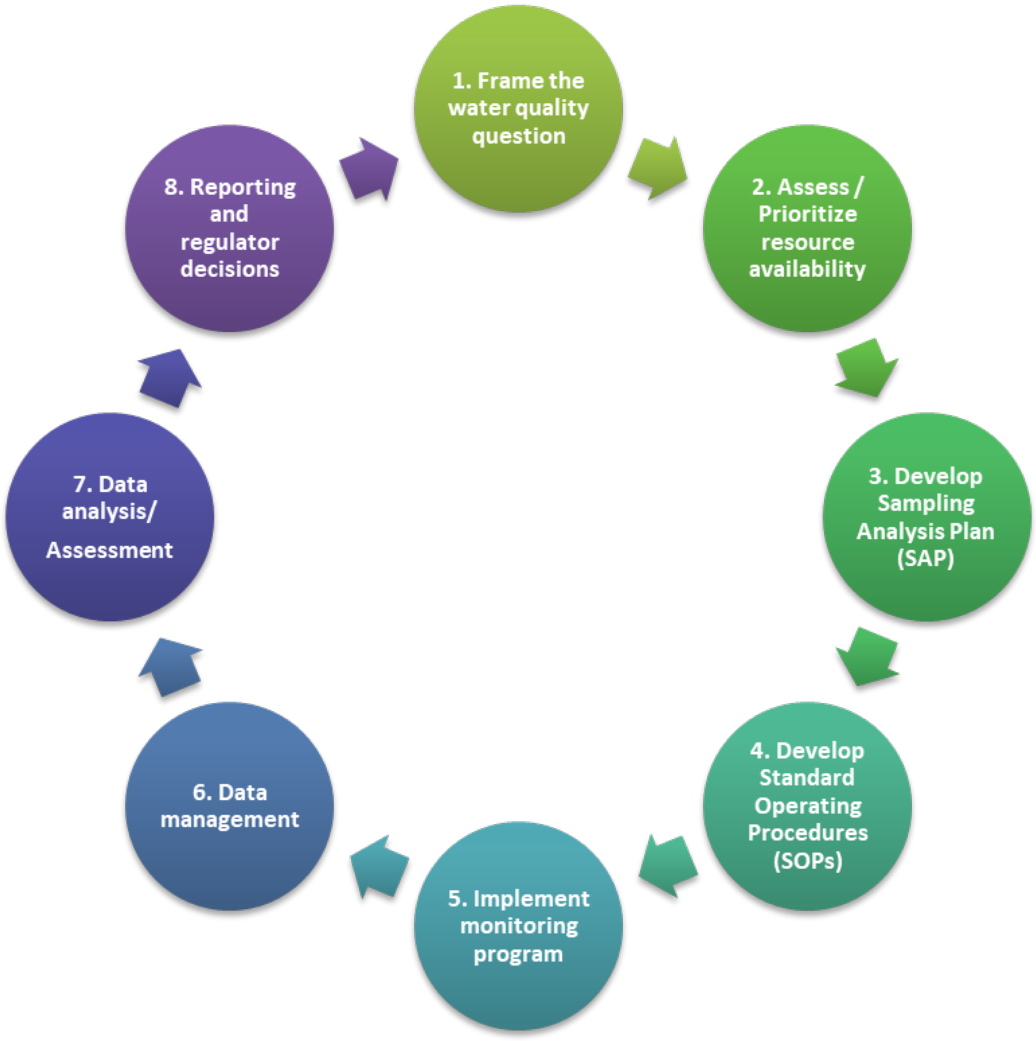

Figure 2 Generalized Monitoring and Assessment Approach

DWQ's monitoring program has evolved substantially over the last ten years. What used to be a program focused primarily on water chemistry collection, with occasional biological collection, has morphed into a program integrated with robust and dynamic projects. Historic core programs, programs developed over the last ten years, and conceptualized projects for the next ten years are summarized below.

Core Programs

DWQ's current monitoring projects include (descriptions of individual monitoring programs can be found in Section 3.0):

- Ambient Monitoring Program (AMP)/Rotating Basin schedule
    - Intensive runs (streams)
- Priority Lakes Monitoring Program
- Biological Monitoring Program
    - Utah Comprehensive Assessment of Stream Ecosystems (UCASE)
    - National Aquatic Resource Surveys (NARS)
- Fish Tissue Contamination Program
- Incident response monitoring
- Groundwater permit monitoring
- Discharge compliance/enforcement monitoring via the Utah Pollution Discharge Elimination System

Recent Project Development/Enhancement (over the last 10 years)

- Utah Lake Monitoring Program
- Harmful Algal Bloom Monitoring Program
- Statewide probabilistic monitoring (biological monitoring)
- E. coli Monitoring Program
- High Frequency Data Monitoring Program (continuous monitoring)
    - Deployment of buoys on lakes/reservoirs
    - Fixed stations for multi-parameter probe deployment
    - Remotely deployed devices over a length of time
- Wetlands Monitoring Program
- Metals loading assessment in Great Salt Lake (GSL)
- Water quality assessment in the Willard Spur
- Rotating Basin monitoring approach
- TMDL Monitoring (i.e., Waste-load allocation (WLA) and Load Allocation (LA) sampling methods

Proposed Project Development/Enhancement (for the next ten years)

- Contaminants of Emerging Concern (CEC's)
- Groundwater contamination monitoring
- Headwater nutrient monitoring
- Stormwater monitoring
- Establishment of a long-term trend monitoring program
- Address data gaps related to assessment category 3A listings

- Direct discharger in-stream compliance monitoring

Overall, the general purpose of DWQ's Monitoring Section is to fulfill the water quality data demands for the Division. The Division has an array of monitoring programs it uses to maintain its objectives and goals. Some programs are active every year while others are intermittent. These programs serve to:

- Answer resource specific questions (specific to waterbody)
- Describe water quality status and trends
- Develop TMDL endpoints
- Develop NPS criteria
- Describe existing problems
- Support WLA development
- Design management and regulatory programs
- Evaluate program effectiveness
- Respond to emergencies
- Integrated Report development
- Assess regulatory compliance
- Describe ground water quality and support aquifer classification activities
- Assess the overall quality of surface waters in the state
- Assess how water quality is changing over time
- Determine problem areas and areas needing protection
- Determine what level of protection is needed
- Assess effectiveness of clean water projects and programs
- Determine where water quality needs to be restored and how

Embodied in these general purposes are many specific programs or regulatory objectives. DWQ prioritizes its resources on an annual basis to accomplish its monitoring objectives.

Section 2.3 discusses what strategies are used to design the specific monitoring programs, which are described further in Section 3.0

2.1.1 Utilization of Cooperating Agencies to Collect Data

It is often challenging for DWQ to collect sufficient data throughout the state in a consistent manner considering the state's land area. To help alleviate data gaps and maintain efficient operations, DWQ utilizes its Cooperative Monitoring Program to partner with other agencies that help with sample collection and field observations. Under this program, DWQ pays for lab analyses while the partnering agency is responsible for collecting samples. Cooperators are usually from federal and state agencies (i.e. US Forest Service (USFS); Bureau of Land Management (BLM); Bureau of Reclamation (BOR); National Park Service (NPS); and Utah Division of Wildlife Resources (DWR)). Assistance from local health departments, county agencies and water conservancy districts is utilized as well.

DWQ's Monitoring Section has dedicated staff to manage this program in the form of coordination, training, and data management. Cooperators are largely used to collect ambient water quality data

(water chemistry samples, flow measurements, and multi-parameter probe measurements) and E. coli samples. These agencies may collect macroinvertebrates for DWQ as well. Cooperators benefit DWQ by allowing for monitoring to occur in parts of the state that would otherwise be cost prohibitive for DWQ to visit on a routine basis. Cooperators help address data gaps and time sensitive issues. The benefit to the cooperating agency is they receive lab analysis at no cost for waterbodies that lie within their jurisdictional boundaries or areas of concern. See Section 3.8 for more information on this program.

2.2 Element B - Program Objectives

The Division's current monitoring and assessment objectives reflect a strong emphasis on meeting the goals of the CWA and the Utah Water Quality Act. These goals and other state water quality management objectives are discussed in the following section.

2.2.1 CWA, Utah Water Quality Act, and Standards of Quality for Waters of the State (UAC R317-2) Objectives

DWQ's monitoring and assessment programs support the following objectives:

- Establishing, reviewing, and revising water quality standards and classifications (CWA section 303(c))
- Determining water quality standards attainment (CWA section 305(b))
- Identifying impaired water (CWA Section 303(d))
- Identifying sources of water quality impairments (CWA Sections 303(d), 305(b))
- Supporting the implementation of CWA Section water quality monitoring programs:
    - 106-established monitoring programs
    - 303-development of standards to protect beneficial uses
    - 305-report to Congress on the status of waters of the state
    - 314-status and trends of lakes
    - 319-identifying non-point source pollution sources
    - 402-permitting for discharging pollutants into US waters
- Supporting the evaluation of program effectiveness

The Division's monitoring and assessment programs also support the following objectives under the Utah Water Quality Act (Title 19-5). Some of the more notable sections relating to monitoring include:

- Supporting the duties of the Director under Section 106
    - 2(a); 2(h); 2(j); 3(c); 3(d); 3(f); 3(g)
- Supporting the duties of the Director under Section 114
- The Utah Water Quality Act gives broad authority to the Division Director to manage rules relating to Standards of Quality for Waters of the State (UAC R317-2)
- Establishing, reviewing, and revising water quality standards, classifications, control regulations, and water quality designations

- Monitoring of water quality, including the nature and amount of pollutants, attainment of standards, and source of pollutants
- Identify waterbodies where human health advisories are necessary. These include things like fish consumption advisories and swimming advisories

2.3 Element C - Program Design

DWQ applies four broad monitoring strategies to categorize its monitoring programs. These strategies summarize the approach DWQ takes to meet its monitoring objectives. The following section describes these strategies and lists specific monitoring performed within each one. The four monitoring strategies are:

1. Routine core monitoring
2. Programmatic monitoring
3. Probabilistic monitoring
4. Incident response

In many cases, certain projects might include multiple strategies. An example is the UCASE monitoring program. The collection methods for UCASE are often used in the following ways:

- Routine core monitoring strategies (i.e., TMDL, non-point source, rotating basin objectives)
- Programmatic monitoring strategies (i.e. accompany biological sampling protocols to a unique survey)
- Probabilistic monitoring (i.e. statewide census on stream conditions)

Table 2 lists DWQ's monitoring programs and the strategies used to design them.

Table 2 - Strategies for Each of DWQ's Monitoring Programs

Monitoring Program	Strategy 1 Routine Core Monitoring	Strategy 2 Programmatic Monitoring	Strategy 3 Probabilistic Monitoring	Strategy 4 Incident Response
Integrated Report	X	X		
Standards Development	X	X		
Ambient Monitoring	X	X		X
Priority Lakes Monitoring	X	X		
Total Maximum Daily Load	X	X		
Non-Point Source	X	X		
Permit/Compliance	X	X		
Cooperative Monitoring	X	X		
Fish Tissue Contamination	X	X		X
Utah Comprehensive Assessment of Stream Ecosystems	X	X	X	X
National Aquatic Resource Surveys			X	
High Frequency Data	X	X		
Utah Lake	X	X		
Great Salt Lake	X	X		
Contaminants of Emerging Concern	X			
Headwater Nutrients	X	X	X	
E. coli	X	X		X
Harmful Algal Blooms		X		X
Wetlands	X	X	X	
Stormwater		X		
Groundwater		X		
Underground Injection Control		X		
Incident Response				X

The following section will summarize each of these and provide examples of different monitoring projects that fall within each strategy.

2.3.1 Strategy 1 - Routine Core Monitoring

Projects in Strategy 1 are often the foundation of DWQ's monitoring program. These kinds of projects have been the basis for many water quality programs in Utah since 1970s and produce very useful information. Sampling projects that are part of this strategy are often considered ambient by nature. Data collected under this strategy are used to address the most fundamental needs within DWQ. This includes: monitoring for TMDL and NPS projects (pre and post project), the Integrated Report, permit/compliance monitoring, status and trends, and Waste-load Allocation monitoring. These kinds of projects address the following objectives:

- Provide chemical and biological data for assessment, stressor identification, and prioritization of waterbodies

- Provide extensive assessments of the chemical and biological integrity of all waters in Utah's major watersheds on a 6-year rotation. This is useful for identifying waterbodies that are/are not meeting their designated uses or have insufficient data to perform a proper assessment
- Detail the status of the waters of the state (including a list of the waterbodies requiring TMDLs) every two years in the Integrated Report

Projects that fall under this strategy are often part of the Rotating Basin Approach, which includes a 6-year monitoring schedule. Sampling is based on a water calendar year (October-September). When efforts are focused in a particular basin in any given year this is known as the "intensive" cycle. While sampling still occurs outside of intensive basins during off-cycle years (i.e. to address data needs for special studies or for statewide assessment purposes), intensive cycles allow time to gather sufficient data within the basin to determine if a waterbody is impaired. The intention of this approach is to better assess the state's waters on a broad watershed scale. The current Rotating Basin Schedule can be found in Table 3.

Table 3 - DWQ Rotating Basin Schedule

Watershed Management Unit	Water Year						
	WY20	WY21	WY22	WY23	WY24	WY25	WY26
Sevier-Beaver-Cedar	X						X
Bear River		X					
Weber River			X				
Uinta Basin				X			
Jordan River/Utah Lake					X		
Colorado Basin						X	
GSL/West Desert*				As needed			

*The nature of this region is very arid and dry. While perennial surface waterbodies do exist in this region it is not enough to sustain routine ambient monitoring proportionate to the rest of the state. DWQ performs monitoring in this area as needed and for probabilistic based surveys.

By focusing the Division's monitoring efforts in one particular basin each year (versus the entire state), DWQ is able to concentrate its monitoring efforts on a smaller geographical area. This allows for a greater frequency of sites visits from numerous waterbodies within a watershed management unit during a single sampling season. Using the rotating basin structure allows DWQ staff to have more accurate assessments and informed 303(d) listing decisions by having a more robust dataset to work with.

Examples of DWQ's routine core monitoring programs:

- Ambient Monitoring Program (AMP)-Intensive runs (Section 3.3)
- Priority Lakes Monitoring Program (Section 3.4)
- UCASE (Section 3.10)
- High Frequency Data Program (continuous monitoring data) (Section 3.12)

2.3.2 Strategy 2 - Programmatic Monitoring

Projects that are part of Strategy 2 follow an adaptive strategy based on information derived from other programs within DWQ. Monitoring activities under this strategy fall into three main program areas:

- Restoration of water quality
- Compliance/permitting
- Standards development

As such, the design of these monitoring components will focus on the determination of sources of pollution and the attainment of water quality standards and biological results through the various programs intended to restore surface and groundwater quality.

Programmatic and targeted monitoring strategies can complement surveys that crossover into other strategies. For example, the data collected in probabilistic sites can identify streams not meeting certain designated uses and identify the reasons for the possible causes of impairment. This analysis allows for the development of more effective programmatic sampling designs that are specific to the watershed and associated parameters of concern.

This strategy is used to address specific questions related to a particular resource type, event, or waterbody. Projects under this strategy element tend to be variable from one season to the next and are not as routine as projects that fall under the core monitoring strategy. These projects are often new and innovative and require custom sampling plans and the development of unique SOPs. Examples of these include:

- Nonpoint Source effectiveness monitoring (Section 3.6)
- Utah Fish Tissue Contamination Program (Section 3.9)
- HAB Monitoring Program (Section 3.18)
- Utah Lake Monitoring Program (Section 3.13)
- E. coli Monitoring Program (Section 3.17)
- Wetlands Monitoring Program (Section 3.19)
- Great Salt Lake Monitoring Program (Section 3.14)
- Contaminants of Emerging Concern (Section 3.15)
- Headwater Nutrients Monitoring Program (Section 3.16)
- Groundwater Monitoring Program (Section 3.21)
- Stormwater Monitoring (Section 3.20)

2.3.3 Strategy 3 - Probabilistic Monitoring

Waterbody assessments based on randomly selected sites, or probability-based surveys, allow DWQ to make statistical inferences as to the condition of all waters based on the conditions of those randomly selected and assessed sites. Probabilistic monitoring based projects help describe the status of waterbodies and help guide targeted monitoring efforts thereafter (define pollution sources and define impairments). Overall, probabilistic designs help assess the conditions of the state's surface waters and also evaluate changes in condition to Utah's watersheds over time. This strategy is particularly useful when a project has a broad distribution (i.e. assessing the chemical, physical, biological conditions of the entire state) and resources are limited. There are times where probabilistic surveys will lead to the development of projects under the programmatic strategy. An example is when taxonomic identification of biological samples (e.g. macroinvertebrates) shows signs of impairment in a probabilistic monitoring study may lead to a targeted monitoring study to identify water quality impairments and stressors.

The information gained from these surveys not only describes the status of the water bodies in the State, but also guides future targeted monitoring efforts in those basins. The main objectives of this strategy are:

- Assess the biological, chemical, and physical integrity of all waters throughout Utah and determine attainment status
- Compare chemical, physical, and biological measures of water quality to identify human-caused stressors most likely to affect designated uses

Examples of programs where DWQ uses probabilistic based designs:

- UCASE (Section 3.10)
- NARS (Section 3.11)

2.3.4 Strategy 4 - Incident Response

DWQ is obligated to respond to unplanned incidents that negatively impact surface waters of the state. This includes spills, illegal discharges, fish kills, sewage leaks; anything related to a foreign substance entering a public waterway. Activities that occur under this strategy are usually unplanned, unique, and dynamic. There is usually a sense of urgency to address issues related to the incident and little time to prepare for the event. DWQ utilizes its monitoring resources to address these kinds of events and to assure adequate sampling occurs. More on this can be found in Section 3.23.

2.3.5 Updates to this Document

Most monitoring activities discussed in this document are estimates that require a number of incremental steps to fully implement. This plan identifies DWQ's monitoring programs and how they are used to gather information based on current data needs within the Division. By using an adaptive management approach, these programs will continuously improve as they are evaluated annually and modified for evolving conditions. Periodic reviews of monitoring programs will be performed to evaluate the efficacy of new or expanded programs as they are implemented.

While long-term planning is useful, unanticipated programmatic needs inevitably arise and new water quality concerns manifest themselves. This includes sociopolitical pressures, which can result in reprioritization of monitoring goals, and unforeseen logistical barriers, which can develop as new programs are initiated.

DWQ will respond to changing monitoring needs in two ways:

1. Short-term changes in monitoring requirements will be documented yearly in DWQ's annual monitoring summaries
2. Long-term changes in monitoring requirements will be addressed by conducting an overarching review of all the monitoring activities every five years, which will culminate in revisions to this document

2.4 Element D - Core and Supplemental Water Quality Indicators

This section provides details on the biological and chemical parameters that are used to assess the support of water body designated uses (e.g. domestic drinking water sources, recreation, aquatic life, and agricultural irrigation). Where applicable, each sub-section in Section 3.0 of this document includes a summary of the available indicators that are assessed for individual monitoring programs/projects. For example, both core and supplemental indicators are discussed as part of the probabilistic assessment. In the programmatic monitoring section of this document, discussions focus on the parameters that help identify potential stressors and causes of impairment, as well as the core and supplemental indicators that were identified in the areas of suspected concern.

Indicators used will depend on the monitoring objectives of particular projects. Generally, DWQ collects a full set of chemical parameters (i.e., metals, nutrients, inorganics) at most sites to satisfy data needs for assessment and standards review of surface waters. Additional monitoring may include collection of other chemical parameters or indicators such as aquatic life and habitat data. Table 4 lists the core and supplemental indicators by Beneficial Uses for DWQ's monitoring programs. Each of these programs are discussed further in Section 3.0 of this document.

Table 4 - Core and Supplemental Indicators by Beneficial Use

Monitoring Program	Aquatic Life and Wildlife	Recreation	Drinking Water	Fish/Shellfish Consumption	Agriculture	Other
Integrated Report	Dissolved oxygen, temperature, pH, periphyton, trace metals, condition of benthic macroinvertebrates, fish assemblages, chlorophyll, nutrients (N and P), habitat assessment, flow, toxic indicators	Pathogen indicators, pH, nutrients (N and P)	Trace metals, pathogen indicators, pH, nitrates	Waterfowl and fish consumption advisories, mercury	Trace metals, total dissolved solids, pH, gross alpha	N/A
Standards Development	Dissolved oxygen, temperature, pH, periphyton, trace metals, condition of benthic macroinvertebrates, chlorophyll, nutrients (N and P), composition of algal community, flow, toxic indicators	Pathogen indicators, pH, nutrients (N and P)	Trace metals, pathogens, pH, nitrates	Waterfowl and fish consumption advisories, mercury	Trace metals, total dissolved solids, pH, gross alpha	N/A
Ambient Monitoring	Dissolved oxygen, temperature, pH, trace metals, chlorophyll, nutrients (N and P), BOD, flow, toxic indicators	Pathogen indicators, pH, nutrients (N and P)	pH, total dissolved solids, trace metals, pathogen indicators, nitrates	N/A	Trace metals, total dissolved solids, pH	N/A
Priority Lakes Monitoring	Dissolved oxygen, temperature, pH, periphyton, trace metals, fish,	Pathogen indicators, pH, nutrients (N and P)	pH, nitrates, pathogen indicators, total dissolved solids, trace metals	Waterfowl and fish consumption advisories, mercury	Trace metals, total dissolved solids, pH, gross alpha	N/A

	nutrients (N and P), composition of algal community, trend analysis, phytoplankton, toxic indicators					
Total Maximum Daily Load	Dissolved oxygen, temperature, pH, periphyton, trace metals, condition of benthic macroinvertebrates, fish assemblages, sediment, chlorophyll, nutrients (N and P), habitat assessment, BOD, flow, toxic indicators	Pathogen indicators, pH, nutrients (N and P)	pH, nitrates, pathogens indicators, total dissolved solids, trace metals	Waterfowl and fish consumption advisories, mercury	Trace metals, total dissolved solids, pH	N/A
Non-Point Source	Dissolved oxygen, temperature, pH, periphyton, trace metals, condition of benthic macroinvertebrates, fish assemblages, chlorophyll, nutrients (N and P), habitat assessment, flow, toxic indicators	Pathogen indicators, pH, nutrients (N and P)	pH, nitrates, pathogen indicators, total dissolved solids, trace metals	Waterfowl and fish consumption advisories, mercury	Trace metals, total dissolved solids, pH, gross alpha	N/A
Permit/Compliance	Dissolved oxygen, temperature, pH, ammonia, trace metals, sediment, nutrients (N and P), BOD, flow, toxic indicators	pH, Pathogen indicators	pH, nitrates, pathogen indicators, total dissolved solids, trace metals	N/A	Trace metals, total dissolved solids, pH, gross alpha	N/A

Cooperative Monitoring	Dissolved oxygen, temperature, pH, trace metals, periphyton, chlorophyll, nutrients (N and P), flow, ammonia	Pathogen indicators, pH, nutrients (N and P)	Trace metals, pathogens, pH, nitrates	N/A	Trace metals, total dissolved solids, pH	N/A
Fish Tissue Contamination	N/A	N/A	N/A	Waterfowl and fish consumption advisories, mercury, selenium, arsenic, PCBs	N/A	N/A
Utah Comprehensive Assessment of Stream Ecosystems	Dissolved oxygen, temperature, pH, periphyton, trace metals, condition of benthic macroinvertebrates, fish assemblages, sediment, chlorophyll, nutrients (N and P), habitat assessment, flow, ammonia	pH, pathogen indicators	pH, nitrates, Pathogens, total dissolved solids, trace metals	Waterfowl and fish consumption advisories, mercury	Trace metals, total dissolved solids, pH	N/A
National Aquatic Resource Surveys	Dissolved oxygen, temperature, pH, periphyton, trace metals, fish, nutrients (N and P), condition of benthic macroinvertebrates, phytoplankton, vegetation assessment, sediment, flow, ammonia	Pathogen indicators, pH, Cyanobacteria, Algal toxin	pH, nitrates, Pathogens, total dissolved solids	Waterfowl and fish consumption advisories	Total dissolved solids, pH	N/A
High Frequency Data	Dissolved oxygen, temperature, pH,	pH,	pH, total dissolved solids	N/A	Total dissolved solids, pH	N/A

	periphyton, flow, ammonia					
Utah Lake	Dissolved oxygen, temperature, pH, trace metals, periphyton, nutrients (N and P), BOD, flow, ammonia	Pathogen indicators, pH, BOD, Algal toxin, Cyanobacteria	Pathogen indicators, pH, nitrates, total dissolved solids, trace metals	N/A	Trace metals, total dissolved solids, pH	
Great Salt Lake	Dissolved oxygen, temperature, pH, trace metals, nutrients (N and P) , ammonia	N/A	N/A	Waterfowl and fish consumption advisories, mercury, selenium	N/A	N/A
Contaminants of Emerging Concern		PFAS				
Headwater Nutrients	Dissolved oxygen, temperature, pH, nutrients (N and P), periphyton, condition of benthic macroinvertebrates, habitat assessment, sediment, ammonia	pH, nutrients (N and P)	pH, nitrates, total dissolved solids	N/A	Total dissolved solids, pH	N/A
Headwater Nutrient Criteria	Dissolved oxygen, pH, phosphorus, nitrogen, gross primary production, ecosystem respiration, filamentous algae cover	Benthic chlorophyll, ash-free dry mass, algae biomass	pH, phosphorus, nitrogen	N/A	pH, phosphorus, nitrogen	N/A
E. coli	Temperature	Pathogen indicators	Pathogen indicators	N/A	N/A	N/A
Harmful Algal Blooms	Dissolved oxygen, temperature, pH, nutrients	Cyanotoxins, cyanobacteria cell counts	Cyanotoxins, cyanobacteria cell counts	Waterfowl and fish consumption advisories	Cyanotoxins	N/A
Wetlands	Dissolved oxygen, temperature, pH, periphyton, trace	N/A	pH, nitrates, Pathogens, total	Waterfowl and fish consumption advisories	Trace metals, total dissolved solids, pH	N/A

	metals, condition of benthic macroinvertebrates, fish, sediment, nutrients (N and P), habitat assessment, ammonia		dissolved solids, trace metals			
Stormwater	Dissolved oxygen, temperature, pH, trace metals, nutrients (N and P) , ammonia	N/A	pH, nitrates, trace metals	N/A	Trace metals, total dissolved solids, pH	Total suspended solids, total volatile solids, volatile suspended solids, ammonia, petroleum, hydrocarbons
Groundwater	N/A	N/A	Trace metals, nitrates, pH	N/A	Trace metals, total dissolved solids, pH	N/A
Underground Injection Control	N/A	N/A	Dependent on the nature of the injectate	N/A	N/A	N/A
Incident Response	Dependent on the nature of the incident	Dependent on the nature of the incident	Dependent on the nature of the incident	Dependent on the nature of the incident	Dependent on the nature of the incident	Dependent on the nature of the incident

2.5 Element E – Quality Assurance

Quality assurance and quality control (QAQC) is a critical component of every environmental monitoring program. The quality of monitoring data collected by the Division is maintained by adherence to four key elements of Utah DEQ's Quality System:

- Utah DEQ, Quality Management Plan (QMP)
- Utah DWQ, Quality Assurance Program Plan (QAPP)
- Project-specific Sampling and Analysis Plans (SAPs)
- Standard Operating Procedures (SOPs)

DEQ's QMP sets the basis for review and approval of DWQ's ambient monitoring QAPP to ensure that environmental data developed by, or submitted to, DWQ are high quality, of sufficient quantity, appropriately documented, and scientifically and legally defensible. Broadly, quality data are assured through clear delineation of roles and responsibilities, maintenance of up-to-date quality assurance planning, continuous personnel training, and data assessment procedures. Primary responsibility for ensuring technical and QC requirements for ambient surface water monitoring projects are met rests with a Designated Project Manager (DPM). DPM tasks also include timely development of project-specific SAPs and ensuring that appropriate SOPs have been developed. Overall, UDEQ utilizes a team approach where DPMs have access to technical experts for assistance with development of data quality objectives and review of project work plans; however, the DPM has primary responsibility to ensure that environmental data collected are of the type, quality and quantity required to meet project objectives.

DWQ's QAPP serves as the Division's overarching quality assurance guidance for monitoring activities. As required by DEQ's Quality Management Plan, the QAPP is being revised in 2020, and will then be reviewed and approved by DEQ's Quality Assurance Council. The QAPP will be reviewed each year and may be revised to better reflect the changes in the Monitoring Program on a more frequent basis.

The QAPP requires each individual monitoring program/project have a SAP that describes the details specific to each planned activity. SAPs will be reviewed each year for accuracy and applicability (by DWQ personnel, such as designated project managers, basin coordinators, and watershed coordinators). SAPs are reviewed and approved internally within DWQ (Monitoring Section manager and QA Officer) and do not require approval from the Quality Assurance Council.

To reduce uncertainty DWQ requires that all data are collected and processed according to the appropriate SOPs by well-trained staff. DWQ also requires that all samples are analyzed by qualified and competent laboratories. DWQ's field monitoring SOPs are undergoing review in 2020 and 2021. Thereafter, they will be reviewed and updated biannually.

2.6 Element F - Data Management

For any organization handling large amounts of environmental data, data management is an ongoing challenge. For most ambient surface water monitoring projects, DWQ houses its water quality data in EPA's Water Quality (WQX) database. Customized applications have been developed for specific monitoring projects to gather data more appropriately in the field. These applications allow for better data transfer and management practices from the collection of data in the field to the importing of data into a database.

Data management objectives and data quality objectives are discussed within the Quality Management Plan and program/project specific SAPs. While the Monitoring Section plays a large role managing its field data, DWQ also has an Information and Data Services Section (IDS) dedicated to managing data and databases. After data are collected by the Monitoring Section, the field staff reviews and performs an initial level of QAQC on the data. Confirmation of the completion of the initial level of QAQC review is recorded in a tracking spreadsheet next to the record associated with each field data file. Files that have gone through this initial review are then ready to be passed to the IDS Section for a second round of QAQC.

In addition to field data files, the IDS Section also receives and manages electronic data deliverables (EDDs) from respective labs contracted with DWQ. Lab EDDs are run through a series of QAQC checks using select tools and applications to ensure data integrity.

After the lab EDDs and field data files have gone through these initial QAQC checks, the two files are then linked to confirm that lab data records have corresponding field records (if applicable) and vice versa. This ensures that all expected data are present prior to loading the data into the appropriate database. After verifying that the appropriate lab and field data are accounted for, both lab and field data are imported into the appropriate database(s).

Field data are usually managed in Excel or a project specific application. Initially, these data are largely managed and reviewed by field coordinators. The Monitoring Section and IDS Section work closely together to track, manage, and organize the status of field data. Much of DWQ's data is managed and stored on DWQ's internal network until it is pushed into AWQMS. Field forms, calibration sheets, site packets, and the like are scanned and stored on DWQ's internal networks as well.

In regards to the Integrated Report, DWQ assembles and evaluates all readily available and credible data to determine whether a waterbody is supporting or not supporting its beneficial uses as mandated in 40 CFR 130.7(b)(5). Data are compared to Utah's Standards of Quality for Waters of the State using 303(d) Assessment Methods. More information on how DWQ manages data submitted from outside parties can found on the Utah Integrated Report webpage.

2.7 Element G – Data Analysis and Assessment

In the data analysis and assessment sections of this document, brief general summaries of the analytical methods used are provided for each of the monitoring programs. Programs that have specific methods and analyses are constantly evolving. These details are addressed in greater detail in program specific documents (e.g. standards program, TMDL programs, the Integrated Report's (IR) Methods for Assessing and Reporting the Conditions of Lakes and Streams.

2.8 Element H – Reporting

For every monitoring program described in this document, a summary of the individual reporting requirements and a description of the purpose and content of each report are included. All of the identified reports are written to meet CWA requirements and other DWQ program objectives.

In addition to programmatic reporting, DWQ also submits an Integrated Report (IR) to EPA every two years. The IR contains both 305(b) and 303(d) assessment elements, as well as chemical, physical, habitat, and biological data to determine which waters of the state are supporting their designated beneficial uses. The information contained in the IR is also used to populate the ATTAINS database (Assessment, Total Maximum Daily Load Tracking and Implementation System). This database is an online system used for accessing information about the condition of the Nation's surface waters (water quality assessment data).

2.9 Element I - Program Evaluation

When applicable, each monitoring program strategy described in this plan (Section 3.0) contains a section that summarizes potential areas of improvement or expansions of existing programs to meet ongoing data needs. Overall, the current program strategies are structured to allow for an evaluation of immediate data requirements to meet the fundamental reporting elements and provide an adaptive approach for developing annual monitoring summaries. In addition, the planning process allows for the integration of program specific monitoring or special studies or answer questions regarding the nature and extent of potential impairments.

2.10 Element J – General Support and Infrastructure Planning

Development of this plan is a multi-phased process that requires collaboration among many people. First, data needs are identified and prioritized by DWQ staff and outside cooperators. Second, a monitoring strategy and schedule will be developed that will efficiently obtain the data required to meet regulatory needs. Wherever possible, monitoring sites are selected that can serve multiple programmatic functions.

Once core monitoring requirements are established, DWQ determines resources available for implementation of the potential monitoring enhancements identified in the elements of this monitoring plan. DWQ then prioritizes incremental monitoring program improvements that can be accomplished over 1-3 years. For each prioritized project, DWQ develops a SAP that includes an overview of the project, a budget, and a timeline for project completion with incremental milestones.

Section 3.0 summarizes each of DWQ's monitoring programs and their strategies. Management and goal planning are subject to change due to programmatic priorities and available resources. The implementation of any new type of monitoring will depend on increases in funding from the Utah Legislature or from EPA, either through grants or direct funding. Current priorities for enhancements to existing monitoring programs are ranked, but these priorities are subject to changes due to changes to programmatic priorities that are altered at state or national levels.

3.0 Overview of Utah DWQ's Current Monitoring/Assessment Programs

3.1 Integrated Report

3.1.1 Objectives

The purpose of the water quality assessment program is to compile and evaluate all readily available and credible data every two years to determine whether or not water quality conditions are meeting the beneficial uses and numeric criteria assigned to Utah's surface waters.

3.1.2 Design

To help DWQ determine which waters are meeting or not meeting their assigned beneficial uses, DWQ and cooperating agency field monitors collect data throughout the state to identify:

- New and existing impairments
- Surface waters that were previously impaired and now meeting their beneficial uses and criteria (i.e., removed from the state's impaired waters, 303(d) list)
- Surface waters where there are not enough data and information to confirm the quality of the water

Frequency of monitoring is often dictated by IR data needs to ensure sufficient data are available for assessments. Data to support the IR largely comes from the Ambient Monitoring Program (Section 3.3) and the Cooperative Monitoring Program (Section 3.8)

3.1.3 Core and Supplemental Indicators

Federal regulations (40 CFR 130.7(b)(5)) require DWQ to examine all existing and readily available data when making assessment decisions, which includes consideration of data collected by DWQ and others. Utah's Clean Water Action Section 303(d) Assessment Methods provide a framework for categorizing and determining whether a waterbody or segment within a waterbody supports or does not support the assigned water quality standards and designated uses found in Utah Administrative Code (UAC) R317-2. See Table 4 for more information.

3.1.4 Reporting

Results from the water quality assessment program's analyses are summarized biennially in the IR. The report identifies which waters are supporting or not supporting their beneficial uses and prioritizes which impaired waters to address.

3.1.5 Programmatic Evaluation

As part of the IR, the 303(d) Assessment Methods are evaluated, revised, and open to public comment each cycle. For more information on what waterbodies and datasets are used for 305(b) and 303(d) assessments, refer to the 303(d) assessment methods on the water quality assessment program's website.

3.2 Standards Development

3.2.1 Objectives

Much of DWQs monitoring is conducted in support of the Utah's water quality standards program. Water quality standards define the goals for a waterbody by determining its designated uses, setting criteria to protect those uses and establishing provisions to protect those waterbodies from pollutants.

Statewide water quality standards, or those applied to individual sites, are revised to address emerging water quality concerns. Any proposal to change to water quality standards must scientifically demonstrate that the changes will sufficiently protect designated uses. These include drinking water, fish and aquatic life, wildlife, agricultural, industrial, and recreational use. Documentation justifying the standards changes may require extensive analyses of water quality data and must undergo rigorous review by DWQ, EPA, and our stakeholders. Hence, much of DWQ's monitoring is in direct support of water quality standards development and compliance.

As potential standard revisions are identified, it is frequently necessary to develop a specific monitoring plan to obtain the data necessary to determine appropriate changes and to provide a scientifically defensible rationale to justify proposed changes. In this document we describe the monitoring that is being conducted to support key standards changes that are currently in progress. It is not practical to develop long-term monitoring strategies in support of water quality standards that have not yet been developed or adopted. Nonetheless, this report includes a generalized long-term monitoring strategy that describes how monitoring will be conducted to support future proposed changes to water quality standards.

Monitoring to Support Changes to Designated Uses

All of Utah's waters have been assigned designated uses that protect aquatic life and recreation (CWA §101(2)(a) uses). The CWA requires the States to adopt water quality standards that are protective of the most sensitive of these uses. The CWA requires that a Use Attainability Analysis (UAA) be developed to justify any change to a less protective use (one with less stringent numeric criteria) or a request to remove a use altogether. These UAA reports almost always require additional monitoring using methods employed in other programs (e.g., biological samples, habitat assessments, chemical collections) and other non-traditional types of monitoring (e.g., interviews and photographic records). While specifics differ with each situation, these reports all share the monitoring objective to obtain sufficient data to document the existing designated use and justify the proposed change in the use.

Monitoring to Support Changes to Numeric Criteria

Many of Utah's waterbodies have numeric criteria adopted into rule as part of the water quality standard. Numeric criteria may be adopted on a state-wide level or on a site-specific basis. Through monitoring activities, the DWQ may determine that a statewide criterion is either over-or under-protective for a specific waterbody. In these cases, a site-specific standard can be created. The process of creating site-specific criteria represents another common need for monitoring data. Monitoring

efforts also have the objective of obtaining the data to determine if a site-specific standard is necessary and to justify the proposed standards changes.

Monitoring to Develop New Standards

Sometimes it is necessary to develop entirely new numeric criteria for a class of waters. The development of new criteria requires monitoring that provides DWQ scientists with the data necessary to demonstrate, with a high degree of scientific rigor, that the proposed criteria are protective of designated uses. One such example of this is the DWQ's proposed approach to develop numeric criteria for Great Salt Lake, which will require extensive monitoring due to the unique physical and chemical characteristics and beneficial uses of this waterbody.

3.2.2 Design

The specific monitoring design necessary for a change to water quality standards is highly dependent of the proposed change. However, DWQ generally follows a similar process to develop an appropriate monitoring design for all standards changes:

- Evaluate existing monitoring data to ensure that a need for a standard change exists and to begin to justify the need for the changes
- Present the justification and data to DWQ staff and outside stakeholders to identify potential concerns with the proposed changes and key data gaps
- Develop a specific monitoring design to address the data gaps

Most standards changes require targeted data collection efforts. A monitoring design that most efficiently and effectively meets DWQ's data collection needs will be implemented.

3.2.3 Core and Supplemental Indicators

Utah's water quality standards help define the core and supplemental indicators for water quality programs. All of the indicators listed in Table 4 are potential core or supplemental indicators that might be used to support standards revisions. In addition, the development of new standards sometimes requires the development and implementation of toxicology studies. While these studies are often conducted in laboratory settings, sometimes it is useful to add information from natural settings to help put laboratory toxicology data in context with conditions observed in natural settings. See Table 4 for more information.

3.2.4 Data Analysis and Assessment

The data analysis and assessments conducted will remain highly dependent on the nature of the proposed change to the water quality standards. However, standard changes often require that analyses be rigorously compared to other studies to demonstrate the need for the change or support of the designated use.

3.2.5 Reporting

There are primarily four types of reports that use monitoring data to support the water quality standards program:

1. Use Attainability Analyses (UAAs)

While specifics differ, all UAA's present monitoring data to objectively demonstrate that one of the standards are not attainable due to any of the following circumstances (40 CFR 131.10(g)):

- Naturally occurring pollutant concentrations prevent the attainment of the use; or
- Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating State water conservation requirements to enable uses to be met; or
- Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
- Dams, diversions or other types of hydrologic modification preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use; or
- Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
- Controls more stringent than those required by Sections 301(b) and 306 of the Act would result in substantial and widespread economic and social impact

Unlike most other reports, these data often require the use of historical monitoring data to establish that current conditions are representative of the most protected, or sensitive use that has existed at the site, particularly if the justification for the UAA is argues that current conditions result from natural causes.

2. Site Specific Standard Justifications

Reports used to justify site-specific standards are similar to UAAs except the primary focus is on proposed changes to numeric criteria as opposed to a use. Monitoring information presented in these reports typically focuses on chemical data to demonstrate that chemical concentrations observed at a site are the result of natural or irreversible conditions. As a result, these studies also require monitoring information that describes any human-caused pollution sources.

3. Response to Public Comments

Federal regulations and Utah laws require open public participation for any change in water quality standards. Monitoring data are sometimes compiled and used to address some of the concerns raised by stakeholders during these reviews. When this occurs, the monitoring data are included in the "responsiveness summary" report.

4. Adoption of New Water Quality Standards

Standards for Quality for Waters of the State are contained in UAC R317-2. The water quality standards are intended to protect Utah's waters and improve the quality for beneficial uses. Once beneficial uses are established, criteria that are protective of the beneficial use are set. The standards must be reviewed and updated (if necessary) every three years through a process called the Triennial Review. In addition to the Triennial Review, standards are changed and updated as new information becomes available in response to changes in laws form the State or Federal government.

3.2.6 Programmatic Evaluation

Utah DWQ must open water quality standards at least every three years in a process called the triennial review. This process ensures that stakeholders have an opportunity to suggest changes to Utah's water quality standards. In Utah, potential standards revisions are vetted with the Water Quality Standards Workgroup. Workgroup members are selected to represent different stakeholder interests. Revisions to the standards may only be made by the Utah Water Quality Board after considering public comments and are subject to EPA approval. Sometimes changes to water quality standards merely clarify the intent of previously adopted rules, while other changes take years to develop and often involve many targeted monitoring activities. A brief summary of water quality standards projects currently under development statewide or regionally follows:

Stream Classification - Accounting for Natural Variability

Nutrients vary naturally due to varying physiochemical characteristics such as watershed geology, soil structure and hydrology. DWQ is using data collected at reference sites to establish classes of streams with similar background nutrient concentrations. To classify streams DWQ has obtained variables that describe soil composition, geology, weathering rates, and hydrology from widely available GIS datasets. Empirical relations among these variables and reference nutrient concentrations are being developed with the aim of establishing groups of streams with similar background concentrations of nitrogen and phosphorus. Once these groups are established, numeric nutrient criteria will be generated and applied to each stream class.

Evaluating Potential Costs and Environmental Benefit

Implementation of any numeric nutrient criteria will likely have far-reaching economic consequences. These will be evaluated with investigations of biogeochemical processes in surface waters and mechanistic models to estimate future conditions and potential economic outcomes after the proposed numeric nutrient criteria have been developed. This process will be similar to other economic analyses completed by the state for adoption of other water quality standards revisions (i.e., ammonia). Demonstration of both costs and benefits will be critical in outreach efforts in establishing numeric nutrient criteria in accordance with the CWA 303(c) and EPA's regulations under 40 CFR Part 131.

2013 EPA Ammonia Criteria

In 2013, EPA updated the recommendations for ammonia ambient water quality criteria to protect a wide spectrum of aquatic life. The updated recommendations incorporate studies protecting freshwater fish and mussels, specifically unionid mussels, which are sensitive to the toxic effects of ammonia. DWQ's biological monitoring program did not previously target these organisms and little data were available regarding their occurrence and corresponding need for protection in Utah. The 2017 *Utah Implementation Guidance for the 2013 USEPA Ammonia Criteria for the Protection of Aquatic Life* recommends methods for Utah waters to be surveyed for the presence of unionid mussels and other sensitive species to support adoption of the appropriate ammonia criteria. These efforts are coordinated with the Utah Division of Wildlife Resources program that is focused on identifying and protecting existing populations of native mollusks.

DWQ is currently evaluating the efficacy of using eDNA methods, as opposed to resource-intensive physical surveys of stream substrates, to identify the presence of unionid mussels. These evaluations are predicted to be completed in 2021 and include specific recommendations for implementing the surveys.

2016 EPA Selenium Aquatic Life Use Criteria

In 2013, EPA updated the recommendations for selenium ambient water quality criteria to protect aquatic life. EPA (2013) recommends tiered criteria consisting of fish tissues and water concentrations. For fish tissue, egg/ovaries are preferred over muscle (fillet) or whole-body measurements. If fish tissue data are unavailable, water-based criteria are recommended. The muscle, whole-body and water-based criteria are based on empirical translators from egg/ovary tissue studies. Fish tissue-based criteria have the potential to require a significant reallocation of DWQ monitoring resources.

DWQ is currently developing an implementation plan that will define the specific monitoring needs. Initial monitoring efforts will focus on determining if the translators recommended by EPA (2013) are representative for Utah. Collocated fish tissue and water samples will be collected and analyzed for selenium. The sample locations will represent the range of selenium concentrations found in Utah waters.

Aquatic Life Use Surveys – Great Salt Lake

As described in *Core Component 1: Developing Aquatic Life Criteria for Priority Pollutants*, *A Great Salt Lake Water Quality Strategy*, DWQ continues to make progress for the development and adoption of numeric water quality criteria for Great Salt Lake. An essential step for developing criteria is to define the specific organisms to be protected. In 2016, an Aquatic Life Use Workshop was convened to compile the available information regarding the organisms observed in the different bays of Great Salt Lake. One of the key data gaps identified was a lack of sufficient fish surveys.

In 2020, DWQ and the Utah Division of Wildlife Resources cooperated in executing fish surveys in Farmington and Bear River Bays. These data will be compiled and directly support the development of numeric criteria for these bays.

3.3 Ambient Monitoring Program (AMP)

3.3.1 Objectives

The main focus of ambient monitoring is to support data needs for some of the most foundational operations within the Division (NPS and TMDL programs, IR, WLAs, status and trends). Ambient monitoring usually includes the collection of basic water chemistry data (metals, nutrients, and inorganics) along with field readings (pH, oxygen, conductivity, and temperature) and discharge.

Following the rotating basin approach outlined earlier in this document (Section 2.3.1), data collected under the AMP complements a number of programs managed by DWQ. For example, sites selected for intensive runs often fulfill the data needs for the TMDL, NPS, and WLA programs.

3.3.2 Design

As outlined in the rotating basin schedule in Table 3, ambient monitoring is ongoing year after year. Chemical samples are collected at targeted sampling sites within an assessment basin to identify the:

- Stressors to biological community
- Causes of impairment to system
- Source locations or problem areas
- Specific impaired segments (303d listing)

Sampling requests are solicited the previous winter for the targeted basin to allow time to organize and prioritize sampling needs. Specifics on the biological and chemical data that will be collected in Utah's rivers and streams are discussed below.

3.3.3 Core and Supplemental Indicators

Targeted monitoring in subsequent years will focus on potential stressors and causes of impairment and will include additional monitoring of the core indicators and supplemental indicators in areas of suspected concern. Individual site monitoring may vary depending on the site conditions and watershed characteristics. See Table 4for more information.

3.3.4 Data Analysis and Assessment

The main approach to assessing data and determining impairment status has focused on attainment of water quality criteria set forth in UAC R317.2 Standards of Quality for Waters of the State. Exceedance reporting based on criteria established for the designated uses (see Core and supplemental indicators) is the primary assessment tool for determining whether a waterbody is placed on the 303(d) list for the development of TMDLs. The IR contains detailed information on the assessment methods used for listing determination.

3.3.5 Reporting

The primary reporting function supported by AMP is the 303(d) listing component of the IR. Section 303(d) of the CWA requires that states assess and identify waterbodies not meeting water quality standards and compile a list of waterbodies requiring the development of TMDLs to meet those

standards. The 303(d) list is submitted to EPA for review and approval every two years via the ATTAINS database and published as part of the IR for public review and input.

3.3.6 Programmatic Evaluation

Ambient monitoring will be characterized by an adaptive approach based on prior sampling runs, historic data, and other available data. The details of the specific field collection will be made explicit in SAPs and annual summaries. This targeted approach will amend data sets for source identification, fill data gaps, develop and supplement TMDL datasets, and provide focus on additional waterbodies.

Due to increasing strain to meet the data needs of new and emerging programs, DWQ has not identified rigorous methods for determining long-term trends of water quality. While there is a long-term dataset collected at a significant number of "ambient" water quality stations, this dataset lacks the frequency and resolution to perform trend analysis. Therefore, DWQ staff will evaluate alternative methods for gauging these trends over time. These will likely include a combination of approaches such as the establishment of continuous monitoring stations and possibly integrating probabilistic monitoring into its sample design.

While DWQ's ambient monitoring program produces a robust dataset that can be used across multiple programs, it is also susceptible to producing Category 3 listings (insufficient data/information to make a use support determination) in the IR. Efforts will be made to reduce these listings in the future by scheduling supplemental monitoring runs outside of monthly intensive sampling runs. At times, these runs might occur outside of the rotating basin schedule to obtain an adequate sample size in certain Assessment Units.

3.4 Priority Lakes Monitoring Program

3.4.1 Objectives

DWQ actively monitors 133 lakes and reservoirs in Utah. While this program does not sample or assess all of the lakes in the State, those that are not assessed are remote and expected to be minimally impacted by human alteration or pollution.

Of the 100+ lakes that are identified as potential sampling locations, DWQ conducts routine lake sampling on the lakes that are within the current intensive basin (Table 3). Lakes that are either currently impaired or are identified as having water quality concerns are sampled more frequently until the water quality concerns are addressed. This approach allows DWQ staff to focus monitoring efforts on those waters with the greatest concerns. Routine freshwater lake monitoring supports water quality assessment, TMDL development, permitting decisions, standards development, and the tracking of long-term water quality trends in Utah's lakes and reservoirs.

The primary objectives for this program are:

- Assess water quality and trends in priority lakes and reservoirs in Utah

- Determine water quality sources and impacts for water quality assessment and TMDL development

3.4.2 Design

Lakes are selected for monitoring based on the priority lakes list or as requested by Division staff. Routine monitoring goals support a variety of projects including of water quality assessment, TMDL development, permitting decisions, standards development, and the tracking of long-term water quality trends.

3.4.3 Core and Supplemental Indicators

See Table 4 for more information.

3.4.4 Data Analysis and Assessment

Similar to streams and rivers, the main approach to assessing data and determining impairment status of lakes has focused on attainment of water quality criteria set forth in UAC R317.2 Standards of Quality for Waters of the State. Exceedance reporting based on criteria established for the designated uses (see Core and Supplemental Indicators) is the primary assessment tool for determining whether a waterbody is placed on the 303(d) list for the development of TMDLs. The IR contains detailed information on the assessment methods used for listing determination.

Measurements of total phosphorus, Secchi transparency, and chlorophyll-a allow calculation of the Carlson's Trophic State Index (TSI). Long-term plots of the TSIs are used as a secondary weight-of-evidence in assessing beneficial use support. These data are critical in establishing appropriate subclasses for reservoirs in our efforts to develop lake nutrient criteria. In addition to tracking TSI data, phytoplankton samples are collected for community analysis. Presently the primary use of these data is to identify the relative abundance of Cyanobacteria. Where Cyanobacteria comprise > 50% of the phytoplankton community, these data are used as additional evidence for performing the 305(b) and 303(d) assessments. More complete characterization of the phytoplankton community including diatoms is anticipated for future monitoring efforts.

Long-term trend analysis of trophic conditions is accomplished primarily by tracking the TSI. The TSI characterizes three important measures of productivity of lakes, total phosphorus, chlorophyll-a, and Secchi transparency. Currently lakes and reservoirs are sampled relatively infrequently (every 6 years). In the event a waterbody has an established TMDL, monitoring intensity increases to collect data for the TMDL analysis. Ideally, monitoring would be conducted more proactively so that water quality problems can be identified and corrected before impairment actually occurs. Trend data can potentially be used to empirically evaluate locations where water quality is degrading. Lakes and reservoirs exhibiting increases in trophic status would receive subsequent intensive monitoring to better understand causes of degradation.

3.4.5 Reporting

Data from the Priority Lakes Monitoring Program are reported in the IR, TMDL, permitting and 319 reports.

3.4.6 Programmatic Evaluation

Long term lake data provides outlook on the state of Utah's waters and trend data on the lakes. As lakes are receiving bodies for the watershed, lake monitoring and trend analyses guide additional watershed monitoring, water quality modeling, site-specific water quality criteria, and TMDL development. Returning to the lakes on a rotating basin schedule ensures that data is collected on a routine basis to monitor the status of the lakes and reservoirs.

While current sampling techniques suffice for TMDL and assessment purposes, DWQ is considering expanding its protocols to include biological and physical habitat monitoring into its lakes program. Funding and protocol development have yet to be developed, however, DWQ would likely create its design similarly to the National Lakes Assessment (NLA) protocol developed by EPA (Section 3.11).

3.5 Total Maximum Daily Load (TMDL) Monitoring

3.5.1 Objectives

Waterbodies not meeting state water quality standards are listed on the CWA 303(d) list of impaired waters. For these waters, the Division must develop TMDL plans that set limits on pollution sources to ensure that water quality criteria and applicable endpoints are met and beneficial uses are supported. This process of developing TMDLs requires considerable water quality data and related watershed information to assess sources of pollution, assign allocation of pollutant loads and proposed reductions, and track implementation effectiveness. Often, TMDL development will integrate water quality models to represent complex systems and may require special studies and specialized data collection for model calibration and validation. The primary objective of this program is to provide sufficient data for the development of TMDLs and associated implementation strategies for improvement of water quality.

3.5.2 Design

As mentioned above, the targeted approach will identify impaired waterbodies and begin the process of developing datasets for TMDL development. This approach offers data users the opportunity to further refine data collection and create meaningful and defensible datasets for TMDLs. At a minimum, these datasets are compiled by intensive monitoring of parameters of concern coupled with discharge measurements to generate loading information at sites of source loading or chosen for compliance monitoring. In addition to traditional water chemistry parameters outlined in the Core and Supplemental Indicators section, programmatic monitoring may include a number of field activities and special studies. TMDL monitoring requirements are specific to each watershed and based on specific impairments, watershed characteristics, and individual approaches to developing the TMDLs. Therefore, these activities will vary from year to year.

Additionally, TMDL staff coordinate with various land management agencies through the cooperative monitoring program to assist them with data collection and development of TMDLs. DWQ will seek to

enhance these monitoring activities and empower land managers to collect data meaningful to their agencies and assist DWQ staff with identifying and addressing water quality problems. While building this capacity will increase buy-in with stakeholders and reduce the burden of TMDL development and monitoring on DWQ staff, laboratory resources will likely be the limiting factor to the breadth of cooperative monitoring. Therefore, to distribute laboratory and equipment resources, the data needs of the TMDL section and cooperators will be coordinated for inclusion into annual planning efforts via SAPs.

3.5.3 Core and Supplemental Indicators

The core and supplemental indicators for TMDL monitoring are determined through the assessment and CWA 303(d) listing process. TMDL monitoring will be specifically designed to address the indicators identified on the CWA 303(d) list and will include associated indicators or related stressors. For example, if a waterbody is listed for low dissolved oxygen, a suite of nutrients, biological oxygen demand, chlorophyll a, and other physical factors may be included in the individual monitoring design for the impaired waterbody. See Table 4 for more information.

3.5.4 Data Analysis and Assessment

Although each study of impaired waterbodies undergoes unique data analyses for TMDL development, the process typically begins with an evaluation of all existing data and a determination of critical sites with a sufficient frequency and abundance of data to develop existing stream loads. These loads are typically developed for parameters of concern as well as parameters which may be a supplemental indicator of impairment or directly related to the cause of impairment. For example, an analysis of sediment oxygen demand and biological oxygen are critical factors to examine when developing a TMDL for low dissolved oxygen. Often the initial data analysis will include evaluation of data sources for developing models to understand the complex relationships of factors effecting parameters such as dissolved oxygen. Since TMDLs are often data intensive, after the initial step of data evaluation, a SAP is developed to program additional data needs to parameterize models or perform loading analysis.

3.5.5 Reporting

The TMDL reports developed from the targeted data collection comprise the second reporting element. These reports are part of a long public process of review, watershed investigation, and implementation planning. While each TMDL report is unique, they typically include several fundamental reporting steps. These include the development of Data Evaluation Reports (DERs) summarizing all available data for the study area including water quality, hydrology, GIS and summaries of special studies that may relate to the TMDL. The main reporting function of the TMDL program is the submittal of TMDL reports to EPA for approval. The reporting process typically follows a timeline of public input and evaluation prior to submission, with report drafts made available to the public via DWQs website. Final reports approved by EPA are published and maintained on DWQs website.

3.6 Non-Point Source Monitoring

3.6.1 Objectives

The mission of the Utah Nonpoint Source Pollution Management Program is to protect, restore, and enhance the waters of the state of Utah through the reduction of nonpoint sources pollution by means of voluntary implementation of best management practices (BMPs). The broad and often undefined nature of nonpoint source pollution coupled with increasing requirements for reporting project effectiveness and load reductions creates a significant challenge from a monitoring perspective. There are multiple tasks identified in the Nonpoint Source Pollution Management Plan which describe the various components of the Nonpoint Source Monitoring Program. However, reporting challenges have influenced our evolving approach to assessing the effectiveness of a diverse number of restoration efforts state-wide. The main objectives for this program are:

- Perform effectiveness monitoring for nonpoint source water quality projects.
- Foster and develop efficient and effective methods for assessing nonpoint source projects.

3.6.2 Design

States are asked to monitor Best Management Practices (BMPs) and restoration activities to address nonpoint source pollution under the CWA 319 program. This reporting requirement is intended to demonstrate individual project effectiveness, track implementation plan goals, and determine nonpoint source load reductions intended to meet TMDLs.

Non-point Source projects in Utah can address loading from a variety of sources including degradation of riparian corridors, depletion of rangelands, improper agriculture practices, and impacts from urban growth. The goal of projects implemented through this program is to restore aquatic life and beneficial uses of these waterbodies impaired by NPS pollution. These projects can substantially reduce erosion and inputs of sediment and nutrients to streams and rivers, in addition to improving the localized conditions of aquatic habitats.

The parameters that will be monitored, and the frequency of the monitoring at each site will vary based on various factors such as the pollutant causing the impairment, the source of the pollution, and seasonal factors. Only parameters relevant to the impairment associated with the watershed will be monitored. In addition to the chemical analyses DWQ has required the grant recipients to collect biological and physical parameters (i.e., vegetative, fishery, and photo point monitoring). Collecting these additional parameters will help determine if water quality is being improved, and provide important information that can be used to develop success stories, and show the effectiveness of installed BMPs.

Each monitoring location has been strategically placed to quantify pollutant loading reductions in critical areas of the watershed. By monitoring several locations throughout the watershed, it will allow DEQ to better determine which BMPs are working effectively, and where additional project work needs to occur.

DWQ staff will work with their EPA counterparts to justify and design monitoring approaches that are appropriate to individual and watershed plans to ensure measurable parameters are selected. This will be done by developing a SAP and a QAPP for each individual watershed scale project. By integrating these enhancements, the monitoring of implementation activities will be designed on the appropriate scale, both over time and space. The NPS Program Coordinator for DWQ will compile a summary of all of the SAPs that are being implemented for individual projects around the state into one comprehensive document on an annual basis. This document will help evaluate and understand the monitoring that is being conducted for the purpose of evaluation NPS project effectiveness.

3.6.3 Core and Supplemental Indicators

Core and Supplemental indicators for nonpoint source effectiveness monitoring are site specific and depend on parameters of concern identified in TMDL reports and monitoring strategies included in individual project QAPPs. Table 4 lists potential indicators which may be employed under this program element.

3.6.4 Data Analysis and Assessment

Analysis of these sites will utilize a combination of physical, chemical, and biological linked to PIPs and TMDLs. Specific monitoring plans will be developed individually for implementation strategies and QAPPs and subsequent reporting documentation will detail specific data analysis for each project.

3.6.5 Reporting

Annual and final reports are required for all PIPs that are developed in association with Section 319 funding. Annual reports highlight the practices that are installed, and determine the load reduction cost estimates associated with the implementation of those practices. These load reductions are often calculated using models or loading calculations such as the Spreadsheet Tool for Estimating Pollutant Loads (STEPL). Monitoring data are requested for the final reports to demonstrate the improvements achieved for each project. EPA is aware that it may take several years to document the success of the projects that are implemented. Data are often collected several years after the project is completed. Once improvements are observed, these data can be used to develop a success story. These are often used to document the overall effectiveness of the state's NPS program

In addition, DWQ submits an overall Annual Report for the NPS Program under Section 319(h)(11), in which DWQ is required report annually progress in meeting the Goals, Objectives and Tasks outlined in the NPS Management Plan and, to the extent that appropriate information is available, reductions in NPS loading and improvements in water quality. Over the last several years, EPA has emphasized reporting on the reduction of nutrients and sediment as they relate to PIPs and the statewide criteria for aquatic life use support. EPA is also highly interested in receiving surrogate indicators that describe incremental progress to demonstrate improved stream and riparian habitat, and even upland conditions, that can be closely linked to achieving TMDLs and improved water quality.

3.6.6 Programmatic Evaluation

Nonpoint source monitoring for assessment and project effectiveness monitoring has long been a challenge for states participating in the 319 funding program. Established measures of project success must be evaluated regularly to ensure indicators are applicable and the scale of monitoring activities appropriate to the individual or watershed project area. Since each PIP is unique, DWQ will periodically review its NPS monitoring strategy with EPA to ensure it meets critical 319 program reporting requirements.

In many of Utah's watersheds nutrient loads from non-point sources far exceed those of point sources. As a result, ultimately obtaining environmental benefits from implementation will require monitoring programs that identify and then seek reductions from all sources of nutrients. DWQ is exploring a number of watershed approaches that together will allow a holistic approach to solving eutrophication problems including: pollutant trading, market-based incentives, and exploring ways to promote and incentivize cooperative non-point source pollution improvements.

3.7 Permit/Compliance Monitoring and Waste-Load Allocation Monitoring

3.7.1 Objectives

The State of Utah DEQ maintains the Utah Pollution Discharge Elimination System (UPDES) program, which permits discharges to waters of the State of Utah. As part of the permit requirements, facilities must submit Discharge Monitoring Reports (DMR) to the Division to ensure compliance with permit limits (see UAC 317-2). Historically, the Division has sampled the permitted facilities on a regular basis as part of the municipal and industrial compliance monitoring. In addition, compliance monitoring is also intended to support the establishment of wasteload discharge limits and to ensure that endpoints developed as part of the TMDL program are met. The Division will continue to perform compliance monitoring in an adaptive manner to better serve these programs. These sites are usually sampled during intensive runs on a monthly basis (rotating basin schedule). However, these kinds of sites can be visited even during off-cycles from the rotating basin schedule. The primary objectives for this monitoring program are:

- Ensure permittees are meeting effluent limits included in UPDES permits
- Consistent development and application of wasteload analyses for permitted facilities to protect water quality and ensure compliance with approved TMDLs and water quality standards

3.7.2 Design

Currently, the DWQ requires permitted facilities to submit DMRs to the Division to ensure compliance with water quality discharge limits set forth in their individual permits.

In cases where additional data are necessary to develop wasteloads and permit limits, DWQ staff will collect more frequent targeted data at discharge locations (effluent) and above and below facilities (instream) for integration into water quality models and WLA development. Additionally, sampling can occur at facilities with a discharge permit along with their receiving waters during the intensive basin monitoring every 6 years or upon request. Currently, DWQ is using the Utah River Model and the QUAL2Kw model for the development of nutrient related wasteloads and assessing the data.

3.7.3 Core and Supplemental Indicators

See Table 4 for more information.

3.7.4 Data Analysis and Assessment

Traditional use of compliance monitoring has focused on supplementing datasets from DMRs submitted to the division by permitted facilities. These data can be utilized by staff as a quality check on these DMRs and for identifying permit violations. With the emphasis on tracking compliance using DMRs, the monitoring data collected by the division can provide staff with quality control measures for evaluating the facilities collection and laboratory analysis.

3.7.5 Reporting

The primary reporting mechanism for permit and compliance monitoring is through monitoring reports or DMRs, required by the permit via the UPDES program. In addition, if analysis is performed in conjunction with the TMDL process, the permit limits may also be incorporated into TMDL implementation strategies. In cases where compliance monitoring is performed as part of an emergency response or discharge, data may be published as part of the Notice of Violation (NOV) process if applicable.

3.7.6 Programmatic Evaluation

Publicly Owned Treatment Works (POTW) Sampling to Support Wasteload Analysis

Due to resource limitations, DWQ currently conducts only one full year of monthly sampling on each of the 6 basins in Utah on a rotating basis. This means that each POTW receiving water is monitored approximately 10-12 times by UDWQ during a typical 5-year permit cycle. This sampling frequency results in a limited data set as the basis for the WLA and makes determination of seasonal permit limits challenging. In the absence of data, DWQ utilizes conservative assumptions to evaluate critical wasteload concentrations. This can lead to more stringent permit limits, which could potentially be relaxed through a more robust data set. POTWs are well positioned to collect supplemental data due to their proximity to the monitoring site and for the larger facilities, operation of their own analytical laboratories. Therefore, supplemental data collection is recommended and requested from POTWs per the guidelines outlined below. Since it may not be feasible to collect the entire list of supplemental data requested, UDWQ will work with each POTW to prioritize and customize data collection locations, frequency, and specific analytes based on the resources available to each POTW and to address the concerns of their specific receiving waters.

QUAL2Kw Model Development

DWQ uses several different water quality models to develop effluent limits for municipal and industrial discharges. Numerous data are required to populate and calibrate these models, for instance typical model input parameters include (but not limited to): Biological Oxygen Demand (BOD), nutrients, Total Suspended Solids (TSS), Total Volatile Solids (TVS), and chlorophyll a, and a number of physical channel characteristics. In addition, continuous monitoring of dissolved oxygen, temperature, and pH, concurrent with water quality collections, is useful for calibration because these parameters exhibit extensive daily variability. The data collection requirements and procedures for QUAL2Kw model development are documented in the field SOP for QUAL2Kw data collection. It is anticipated that yearly monitoring plans will be developed by the program manger based on pending permit renewals and that monitoring for each facility will involve collecting synoptic (numerous sites along the length of the receiving water) over a reach length that is scaled to the size of the discharge and the receiving water.

3.8 Cooperative Monitoring Program

3.8.1 Objectives

Utah DWQ maintains its Cooperative Monitoring Program to provide credible data for water quality investigations and assessment purposes. The nature of our expanding program needs and the geographic scope of our monitoring requirements require that the Division enhance our monitoring network. DWQ has long maintained a cooperative monitoring program with governmental agencies from all levels (e.g. Forest Service, Bureau of Land Management, National Parks Service; Division of Wildlife Resources; county agencies) to help facilitate the assessment of waterbodies on waters they manage. In addition, DWQ coordinates with DEQ District Engineers to respond to emergencies and spills which may impact water quality to collect samples and document these events. The emerging E. coli assessment framework requires frequent sampling to generate geometric means which will require the assistance of District Engineers, watershed coordinators, and other cooperative monitoring participants to ensure we meet data needs to properly assess recreational uses. The objectives of this program include:

- Enhance the network of cooperative and volunteer monitoring by providing training, supplies, equipment, and lab analysis
- Administer quality assurance and standard operating procedures for participating agencies

3.8.2 Design

The DWQ's Monitoring Program has focused on the collection of water chemistry and biology through cooperative agreements with governmental agencies, both to generate assessment data for 305(b) and 303(d) reporting as well as assisting land management agencies with their specific assessment needs.

A major challenge in maintaining these monitoring networks is coordination of the diverse nature of data collection and the multitude of entities performing this work. In addition, ensuring quality control and data comparability will require close attention and record keeping if these data are to be utilized by the Division for assessment and TMDL development purposes. To address these issues, DWQ has dedicated a full-time staff member to coordinate the collection of data from participating entities. In addition, this individual will work closely with assessment staff on issues relating to data comparability and dissemination of SOPs and QA/QC information to cooperators and volunteers. By developing this network of data collection, DWQ expects to increase its capacity to perform assessments, develop TMDLs, and monitor lakes and streams for long term trends and restoration effectiveness.

3.8.3 Core and Supplemental Indicators

Due to the unique nature of cooperative monitoring programs the core and supplemental indicators may vary considerably depending on the capabilities and funding of the participating agencies and groups. However, water chemistry, bacteriological monitoring, and HABs sampling of lakes and streams are likely to dominate the parameters of concern. It is anticipated that E. coli monitoring will be prevalent due to its affordability, rapid analysis, and applicability to human health concerns. See Table 4 for more information.

3.8.4 Data Analysis and Assessment

Cooperative monitoring data will be submitted to DWQ for storage in its database and inclusion in Integrated Reports where applicable. The main approach to assessing data and determining impairment status or attainment of water quality criteria set forth in UAC R317.2 Standards of Quality for Waters of the State. Exceedance reporting based on criteria established for the designated uses (see Core and Supplemental indicators) is the primary assessment tool for determining whether a waterbody is placed on the 303(d) list for the development of TMDLs. The IR contains detailed information on the assessment methods used for listing determination.

3.8.5 Reporting

The primary reporting function supported by the Cooperative Monitoring Program (similar to the AMP) is the 303(d) listing component of the IR. Section 303(d) of the CWA requires that states assess and identify waterbodies not meeting water quality standards and compile a list of waterbodies requiring the development of TMDLs to meet those standards. The 303(d) list is submitted to EPA for review and approval every two years via the ATTAINS database and published as part of the IR for public review and input.

3.8.6 Quality Assurance

Developing quality assurance plans with a wide variety of participants is a priority for DWQ. This element will be addressed as part of DWQs revision of its Quality Assurance (QA) program elements as discussed in Section 2.5. DWQ has developed processes to ensure cooperating agencies understand SOPs, can perform a Demonstration of Capability (DOC), and are collecting samples the correct way. Historically, DWQ has facilitated a number of trainings across the state with federal partners to ensure

they were properly performing sample collection and handling protocols. To ensure quality control similar DOC procedures for all collection methods may be required for certification.

Cooperative Monitoring programs submit or update a SAP each year for inclusion into annual monitoring summaries. To facilitate these activities, the program coordinator will assist with the development of SAP templates and QA documentation.

3.8.7 Programmatic Evaluation

Cooperative Monitoring programs often support TMDL, E. coli and assessment needs by the DWQ. Data are used to fill data gaps, provide water quality trends and support of the Utah's Integrated Report. Sampling Analysis Plans require evaluation each year to ensure the monitoring aligns with DWQ program needs.

3.9 Fish Tissue Contamination Program

3.9.1 Objectives

DWQ's fish tissue program focuses on the protection of human health and is focused primarily on mercury. Other contaminants such as selenium, arsenic, and Polychlorinated Biphenyls (PCBs) are investigated on a site-specific basis. In an effort to assess the extent and distribution of chemicals in fish tissue and protect human health, Utah DWQ has implemented a statewide fish tissue monitoring program undertaken in cooperation with the Utah Department of Health (DOH) and the Utah Division of Wildlife Resources (DWR). When contaminant levels are unsafe DWQ and its partners issues fish consumption advisories. More on this program can be found at DWQ's Utah Fish Advisory website. This website shows statewide fish advisories and provides background information such as sources of mercury and public health effects. The objectives for this program are:

- Provide an annual sampling plan and coordinate collection efforts with DWR
- Maintain quality assurance and standard operating procedures in fish tissue collection and analysis.

3.9.2 Design

DWQ in partnership with DWR collects fish tissue samples to identify waterbodies where game species of fish may contain unsafe levels of heavy metals or other parameters. The DWQ monitoring section's role in this process is to:

- Provide an annual sampling plan
- Coordinate collection efforts with the DWR
- Preparation of tissue samples for laboratory analysis
- Track and manage dataset

- Maintain quality assurance and standard operating procedures
- Assist with issuing health consumption advisories

Each year, DWQ devises a sampling plan based on the previous year's results and overarching data needs. Sampling criteria currently include:

- Sampling when a current consumption advisory is greater than 5 years old
- Sampling when there is no advisory but the existing data are greater than 5 years old
- Sampling to address uncertainties from previous years data
- Sampling waterbodies that have no mercury data

DWQ coordinates with DWR monitoring program who supplies the majority of fish tissue samples for the advisory program. DWQ supplements fish collections if needed. Once collected, DWQ processes the fish in preparation for the laboratory analysis. Analysis depends on available resources. In addition to baseline data collection for development of health advisories, future monitoring efforts are intended to identify areas of concern, bracket areas of potential sources of contamination, and to verify the extent of contaminants in fish populations. DWQ will continue its annual efforts and maintain and update quality assurance plans and standard operating procedures.

3.9.3 Core and Supplemental Indicators

The core indicator for this program is mercury content of fish tissue from a variety of individual game fish species. However, selenium, other heavy metals, and PCBs are also tested depending on the project at hand or impairment of recreational use. See Table 4 for more information.

3.9.4 Data Analysis and Assessment

Once lab results are received by DWQ staff, the average concentration per species at a site are reviewed and a power analysis is performed to assess appropriate sample size for statistical analysis. Once data are analyzed and there is an adequate sample size a number of steps are taken to issue health advisories.

When an advisory is warranted DWQ sends the data to the Utah Department of Health toxicologist who uses the mean mercury concentration to calculate the actual consumption recommendations. Consumption amounts are calculated for three target populations including pregnant women and children < 6, women of child-bearing age and children 6-16, and adult women past child-bearing age and men >16.

3.9.5 Reporting

Once health advisories are documented and consumption levels are determined, press releases, signage, fact sheets, and a number of other outreach materials targeting women, children, and the angling community are issued. The health advisories, an updated map, and the data are posted at http://www.fishadvisories.utah.gov/.

3.9.6 Programmatic Evaluation

While DWQ and DWR staff have the capacity to collect target species for testing, much of the lab analysis is dependent on the availability of funding.

DWQ plans to conduct waterfowl tissue monitoring at Great Salt Lake to revisit its historic consumption advisories.

3.10 Utah Comprehensive Assessment of Stream Ecosystems (UCASE)

3.10.1 Objectives

UCASE monitoring is used for assessment of Utah's waters using probabilistic surveys as well as targeted monitoring to characterize and track the health of streams. Monitoring objectives include:

- Assess the biological, physical, and chemical conditions of Utah's wadeable and partially wadeable streams using a statistically balanced design
- Provide data for the assessment of the chemical condition of the waterbody for Utah's biennial Integrated Report
- Provide data for the assessment of the biological condition of the waterbody, according to UAC R317-2-7.3, for Utah's biennial Integrated Report
- Provide physical data for use in wasteload analysis development
- Provide data to characterize pollution/contamination linkages and sources to water quality impairments
- Provide data to assist with the development of water quality standards
- Provide data for the development of pollutant indicator tools
- Establish a baseline to compare future stream survey data for trend assessments
- Assess the effectiveness and changes in stream habitats after restoration projects (i.e. NPS projects) to determine project effectiveness
- Establish reference site criteria

3.10.2 Design

UCASE protocols are based on sampling/assessing wadeable stream systems. Protocols are based on capturing the physical, chemical, and biological characteristics at any given site. The sampling design for this program supports a number of DWQ's programs and projects. The current monitoring design for this project is described in Table 5.

Table 5 - UCASE Monitoring Design

	Probabilistic Design	Rotating Basin Approach	Programmatic/Targeted Sampling

Description	Statewide probabilistic survey design	Re-visit sites from previous probabilistic surveys in conjunction with the Rotating Basin Schedule	Statewide targeted sites to address data need for NPS projects, TMDL effectiveness, reference site evaluation, address data gaps
Number of sites/ season	25	10-15	10-15

Utah's biological beneficial uses require the protection of fish (e.g. cold or warm-water species) and the organisms upon which they depend. In the past, DWQ has assessed these beneficial uses via water chemistry sampling and associated water quality standards that presume to protect aquatic organisms. However, DWQ developed a RIVPACS (River Invertebrate Prediction and Classification System) model that directly assesses attainment of biological beneficial uses by quantifying the "health" of macroinvertebrate assemblages. Measuring biological communities directly has the advantage that it integrates the combined effects of all pollutants. This allows for a direct examination of how interacting pollutants affect the condition of a stream ecosystem. Moreover, because aquatic macroinvertebrates spend the majority of their life in aqueous environments, they are capable of integrating the effects of stressors over time providing a measure of past, transient conditions.

An important component of the biological monitoring program is the identification and incorporation of reference sites, which serve as controls, or benchmarks, that are used to establish the chemical, physical, or biological condition expected in the absence of human disturbance. Ideally, all reference sites would be in near-pristine condition. However, few pristine sites remain in Utah, especially among streams in valleys, which have experienced a long history of human occupation. As a result, systematic protocols for quantifying the relative extent of human-caused alteration at both reach-and watershed-level spatial scales are being developed to help DWQ objectively identify suitable reference sites throughout Utah.

DWQ has developed a RIVPACS model that directly assesses the attainment of biological beneficial uses by quantifying the 'health' of macroinvertebrate assemblages. To quantify the biological conditions the model compares the list of taxa that are observed (O) at a site to the list of taxa expected (E), which are estimated from a reference site.

Reference sites serve as controls, or benchmarks, that are used to establish the chemical, physical, or biological conditions expected in the absence of human disturbances. DWQ is to develop protocols on how to objectively identify locations that are near-pristine conditions.

Because an important component of the RIVPAC model is the input of expected taxa (E), a major goal of biological monitoring efforts is to further identify and incorporate reference sites samples.

To date, DWQ has established ~100 locations that are thought to represent minimally impaired conditions and can serve as reference sites. At each station DWQ staff collects biological and physical habitat parameters and chemical data, following DWQ's SOPs.

3.10.3 Core and Supplemental Indicators

In an effort to keep biological sampling efforts consistent with other projects, both state and nation-wide, DWQ has chosen to adopt similar indicators and methods used in the Environmental Monitoring and Assessment Program (EMAP) and NRSA program. While UCASE procedures are similar to these national programs some areas differ such as: collection methods, logistics, labs, and lab methods. Indicators used for UCASE not only compare with national methods, but have also been designed to meet Utah-specific sampling objectives developed by DWQ. Biological indicators sampled in this protocol help develop direct measures for aquatic life uses.
Over the last ten years DWQ has shifted toward a focus on biological indicators as direct measurements for aquatic life uses. Before making final decisions about biological beneficial use support, DWQ makes comparisons between the impairment assessments obtained from stream biota and those obtained from stream chemistry. The primary goal behind these evaluations is to further limit both false positive and false negative assessments beyond what is considered in the biological assessment. All sites identified within biological assessment surveys will be assessed for the core and supplemental indicators (though individual site monitoring may vary depending on site conditions and watershed characteristics). See Table 4 for more information.

3.10.4 Data Analysis and Assessment

Over the last several years, DWQ has incorporated probabilistic stream assessments into the monitoring schedule to start systematically assessing all waters of the state. While assessment methods for probabilistic surveys are still under development, DWQ will follow the EPA's Office of Research and Development (ORD) methodology for the National Assessment Program and will, in general, focus on extrapolating the: (1) measures of biological integrity, and (2) effects of key stressors (pollutants and pollution) from the sampled sites to all waterbodies and from the sample frame used for the random draw. As statewide sampling events occur, the data will be combined to provide precise statewide estimates of water quality characteristics.

The data analyses from UCASE monitoring efforts focus on direct measures of biological uses and on recreation indicators. Also, chemistry and habitat data collected at these sites are analyzed to understand the distribution of key stressors and the relative threat that these stressors pose to the degradation of aquatic life and recreation designated uses. Together, these analyses allow DWQ to identify waterbodies, or classes (types) of waterbodies, that are threatened and therefore require more spatially and temporally intensive follow-up monitoring activities. Additionally, examining the data on the distribution of stressors will also help guide the development of specific monitoring plans for threatened waterbodies.

3.10.5 Reporting

Reporting mechanisms for the UCASE program are currently under review by DWQ. Upon a thorough overhaul regarding how to best incorporate biological data into DWQs programs, this section of the document will be updated.

3.10.6 Programmatic Evaluation

From 2010-2016, DWQ sampled 50 probabilistic sites in each of its 6 broader watersheds. 300 sites were sampled for this survey. While these efforts produced a very valuable dataset for DWQ's monitoring program, it consumed a large amount of staff resources. Given the time resources needed to accomplish this task, there was little room to address targeted site requests during this time. DWQ reassessed its approach in 2018 and decided an updated design would be more adequate (Section 3.10.2). Probabilistic surveys will remain a vital element to DWQ's monitoring program. The index period for this project will remain the same (May-October).

Enhancements that have been identified as this program evolves are summarized below:

Development of Assessment Methods for Diatoms and Fish

To date, rigorous assessment tools and methods have only been developed for macroinvertebrates. DWQ hopes to expand our assessment methods to include diatoms and fish. DWQ has been collecting fish and diatom data for the past several years in anticipation of expanding this portion of the biological monitoring and assessment program. Analytical tools will be developed over the next couple of years to allow fish and diatoms to be used as additional lines of evidence when quantifying beneficial use support.

Development of Stressor-specific Diagnostic Tools

The ability to assess overall biological condition is only the first step; ideally biological data can also be used to ascertain the most likely stressors involved in the degradation of biological conditions. Over the next several years DWQ scientists intend to ultimately develop empirically-derived, stressor-specific indicator values for stream taxa. The development of these indicators requires that biological data are available for sites across the range of conditions observed for each stressor that DWQ evaluates. For instance, the development of nutrient indicators will require the analysis of samples from oligotrophic (e.g., nutrient poor with low production rates) to hyper-eutrophic (e.g., nutrient-rich and productive) streams. To develop indicators for the range of potential stressors found among Utah's streams DWQ anticipates that monitoring designs will need to be augmented to generate the requisite data.

3.11 National Aquatic Resource Surveys (NARS)

3.11.1 Objectives

The NARS are collaborative programs between EPA, states, and tribes designed to assess the quality of the nation's coastal waters, lakes and reservoirs, rivers and streams, and wetlands using a statistical survey design. Utah has been participating in these surveys since 2007. While EPA coordinates these surveys, it gives states and tribes the opportunity to conduct sampling efforts within their respective jurisdictions. If states and tribes opt-in to the surveys, EPA supplements sampling efforts with additional funding to help offset costs and enhance internal monitoring programs. The NARS provide critical,

groundbreaking, and nationally-consistent data on the nation's waters. The surveys are designed to answer questions such as:

- What percent of waters support healthy ecosystems and recreation?
- What are the most common water quality problems?
- Is water quality improving or getting worse?
- Are investments in improving water quality focused appropriately?

These surveys are providing critical, groundbreaking, and nationally-consistent water quality information. Additionally, the national surveys are helping stronger water quality programs across the country by fostering collaboration on new methods, new indicators, and new research.

The NARS are made up of four individual surveys that are implemented on a rotating basis:

- National Coastal Condition Assessment (NCCA)
- National Lake Assessment (NLA)
- National Rivers and Streams Assessment – wadeable and non-wadeable systems (NRSA)
- National Wetland Condition Assessment (NWCA)

Utah participates in all surveys except the NCCA.

3.11.2 Design

Each resource type has its own individual design based on the objectives of respective the surveys. In general, they all address three key points: 1) estimating current status of the particular resource; and 2) estimating changes in the resource (establishing a baseline); and 3) help build state and tribal capacity for monitoring and assessment and promote collaboration across jurisdictional boundaries.

All surveys are probabilistic and site lists are provided by EPA. During each survey rotation, a number of new sites are included in the site lists as well has a number of re-visit sites from previous surveys (re-visit sites are randomized as well). More information on survey designs and the NARS program in general, can be found here at the NARS website.

The NRSA-wadeable protocol and UCASE protocol are very similar in design. Many of the UCASE's procedures/protocols are derived from this protocol and earlier renditions of this project (EMAP). Considering both programs have similar protocols and indicators, they are used synonymously with one another to assess biological conditions in the state.

3.11.3 Core and Supplemental Indicators

Each survey includes a suite of biological, chemical, and physical indicators used to assess biological integrity, trophic state, recreation suitability, and key stressors impacting quality. Each survey uses some of the indicators below for assessment purposes. Although there are more indicators and/or stressors, Table 6 lists the indicators for the NARS survey most representative on a national scale.

Table 6 - List of Indicators Used for NARS Surveys

Biological Indicators

- **Benthic macroinvertebrates**
- **Chlorophyll a**
- **Fish assemblage**
- **Fish tissue contaminants**
- **Macrophytes**
- **Phytoplankton**
- **Sediment diatoms**
- **Wetland vegetation**
- **Zooplankton**

Chemical Indicators

- **Acidification**
- **Atrazine**
- **Conductivity**
- **Dissolved oxygen**
- **Nitrogen**
- **Phosphorus**
- **Sediment enzymes**
- **Sediment mercury**
- **Soil chemistry**

Physical Indicators

- **Lakeshore habitat/riparian vegetative cover**
- **Human disturbance**
- **Physical habitat complexity**
- **Shallow water habitat/in-stream fish habitat**
- **Streambed sediments**
- **Water clarity**

Recreational Indicators

- Algal toxins (microcystin)
- Cyanobacteria
- Enterococci
- Fish tissue contaminants

The timeline for future surveys is as follows (Table 7):

Table 7 - NARS Schedule

2020	NCCA
2021	NWCA
2022	NLA
2023	NRSA
2024	NRSA
2024	NCCA
2025	NWCA
2026	NLA
2027	NRSA
2028	NRSA

3.11.4 Reporting

EPA releases a report on each waterbody type 2-5 years after field sampling occurs. These reports are made available to participating partners as well as the public. The NARS surveys offer a unique opportunity to frame discussions and plan strategies for protection and restoration of the different waterbody types across the United States. Results of these surveys provide a broad range of information that can help better understand the conditions of the nation's waters, some of the stressors affecting them, and how stressors relate to local conditions. Data from these surveys compliment a variety of monitoring efforts that DWQ manages. The reports explain the extent of degradation and identify key stressors that are harmful to Utah's water and also help inform where to prioritize monitoring resources for watershed protection initiatives and restoration efforts.

3.12 High Frequency Data

3.12.1 Objectives

DWQ's High-Frequency Monitoring program supports a variety of programs including policy formulation, assessment, compliance, nonpoint source effectiveness and TMDL development by providing frequent and repeated measurements to adequately characterize dynamic variations in quality. High-frequency monitoring techniques are currently adapted to specific project requirements and are increasing in availability and utilization in Utah.

A device that measures water quality records in repeated small intervals is called a high-frequency water quality monitor. These monitors have sensors and recording systems to measure physicochemical water quality field parameters at discrete time intervals and at discrete locations. High-frequency monitoring is the sampling method of choice when water quality variations are to be characterized over time. Some characteristics of automated water quality monitoring are:

- Capability of measuring a number of water quality parameters in situ, unattended, and at short/long time intervals
- Provide high-frequency water quality data accessible in a timely basis, transmitted directly by telemetry, and published on the web in real time
- Track real time environmental events (e.g. algal blooms, dissolved oxygen, temperature, pH)
- Set sampling intervals to detect water quality variations specific to the study site

3.12.2 Design

Installations of long-term continuous monitoring stations are established at key locations in a watershed to provide the data resolution necessary for trend analysis. These high-tech stations containing numerous sensors are increasingly utilized, such as the monitoring stations in Utah Lake to collect high frequency data.

The sensors selected for use at monitoring stations depend on the complexity of continuous data necessary and are available as individual instruments or as a single combined instrument that has several different sensors in various combinations. Sensors can be electrical, electrochemical, or optical and respond to changing water conditions with an output signal that is processed and either displayed or recorded. A group of sensors configured together commonly is referred to as a sonde. A sonde typically has a single recording unit or electronic data logger to record the output of multiple sensors. Stations supported by telemetry provide real-time data while others require site visits to download the data on a weekly, monthly, or yearly basis.

Although sonde installations offer limited set of parameters, surrogate measures such as turbidity may be used to build relationships with nutrients and sediment. In addition to installing water quality probes, trend analysis of more direct measures of aquatic life use support may also be possible by incorporating data collected through the UCASE monitoring program.

3.12.3 Core and Supplemental Indicators

High frequency monitoring installations typically include water temperature, conductivity, dissolved oxygen, pH, turbidity, and water stage. Additional monitoring may include total algae (chlorophyll-a, cyanobacteria (phycocyanin), oxidation reduction potential (ORP), total dissolved gas (or total gas pressure), and fDOM (fluorescent dissolved organic matter). See Table 4 for more information.

3.12.4 Data Analysis and Assessment

Final data review requires reanalyzing the data record, verifying data corrections, and making any needed final corrections. When review is completed, the data are graded and approved for reporting. Systematic adoption of a standardized final data-evaluation process is vital in finalizing in-stream monitoring records. Final approval is the last step in the data management process that not only verifies the data, but also verifies the corrections, grading, and decision-making processes of the individual originally responsible for the data. Final approval is typically conducted by individuals with the most experience with continuous monitoring.

3.12.5 Reporting

High frequency data is used in the assessment of water quality data in the IR and/or project specific reports such as produced for the Utah Lake Water Quality Study or TMDLs.

3.12.6 Programmatic Evaluation

The daily and seasonal variability of data provided is a valuable tool to understanding the health of lakes and streams and is used to guide further assessments and inform the public. These data, paired with water chemistry monitoring, help toward developing relationships between parameters of concern and high frequency surrogate measures.

3.13 Utah Lake Monitoring Program

3.13.1 Objectives

The goal of the Utah Lake Water Quality Study (ULWQS) is to develop numeric nutrient criteria to protect the recreation, aquatic life, and agricultural beneficial uses of the lake. The ULWQS is guided by a Stakeholder Process which established a 16 member interest-based Steering Committee and a 10 member disciplinary-based Science Panel. The two committees work together with the goal of developing a scientifically defensible consensus-based nutrient criteria recommendation.

The ULWQS Science Panel developed a Strategic Research Plan (SRP) to guide data collection and research activities to ensure data collection meets the study objectives and related ULWQS Phase 2 Purpose and Initial Charge to the Science Panel from the Steering Committee. DWQ's Utah Lake monitoring is intended to continue development of baseline data for understanding lake and watershed processes, to fill known data gaps identified in the SRP, and to enhance data abundance to improve confidence for all analytical and water quality model products.

The monitoring objective is to collect environmental data that informs the ULWQS in characterizing tributary and stormwater quality, future source estimation, load allocations, and characterization of in-lake water quality conditions in support of empirical and mechanistic stressor response modeling.

Monitoring goals include:

- Characterize the current water quality (nutrients, algae, and organic matter) in Utah Lake
- Characterize the nutrient loadings to Utah Lake
- Support the development of predictive water quality models
- Support the charge of the Utah Lake Steering Committee

3.13.2 Design

DWQ installed a network of three real-time telemetered monitoring buoys in Utah Lake in the summer of 2016. These buoys collect a variety of relevant parameters including pH, turbidity, chlorophyll a, dissolved oxygen, and phycocyanin at 15-minute intervals. An additional buoy was installed in Provo Bay in May of 2020. DWQ will continue to deploy the buoy network annually from April through November at four sites: two miles west of Vineyard (Vineyard), one mile west of Provo Marina (Provo Marina), the middle of Provo Bay (Provo Bay), and one mile west of Bird Island (Bird Island).

New as of 2019 was a stormwater monitoring component to differentiate this source of pollutant loading from other sources such as agricultural return flows and wastewater treatment plant discharges. DWQ installed 3 telemetered, real-time, automated stormwater samplers in strategic locations to collect flow and water quality parameters. Samplers are located in drainage areas that reflect representative land use characteristics to allow application of data to similar drainage areas. DWQ is coordinating this effort with the Utah County Stormwater Coalition and the individual municipal separate storm sewer system (MS4). This monitoring effort will determine BMP effectiveness associated with MS4 permitting and ultimately assist in developing a robust water quality model.

3.13.3 Core and Supplemental Indicators

To assess the inputs and relationships of water quality parameters in Utah Lake, the following indicators are currently included in the monitoring plan:

- Incoming flow rates and water samples are monitored at 18 tributary sites to identify nutrient inputs and estimate nutrient loads
- Field measurements: Dissolved Oxygen (DO), temperature, pH, chlorophyll-a, phycocyanin, Secchi, photosynthetically active radiation (PAR), and specific conductance
- Water chemistry analytes: Total nutrients, total metals, 5-day biochemical oxygen demand (BOD_5), filtered nutrients, filtered metals, chlorophyll a, general chemistry (major ions, suspended solids)
- Phytoplankton and cyanotoxins samples: Samples are collected monthly at the open water sites
- Long term sonde deployments will continuously characterize lake conditions at four locations. These sondes record measurements every 15 minutes and can identify anomalies in important water quality parameters (i.e., dissolved oxygen, temperature, chlorophyll, pH, phycocyanin, turbidity and specific conductance) which may help indicate early bloom warnings

See Table 4 for more information.

3.13.4 Data Analysis and Assessment

The data collected by this monitoring program is routinely incorporated into a comprehensive project database, published in a public facing data visualization tool (Utah Lake Data Explorer) that is regularly used by the Utah Lake Science Panel to direct analytical products, research projects, and water quality model development. Data from this effort is specifically incorporated to analyses designed to answer

the Initial Charge Questions as described in the ULWQS Analysis Plan. In addition, results from this monitoring program will be used to re-calibrate and validate a set of hydrodynamic and water quality models for the lake. The Model Calibration Report identified several data limitations and recommended additional data characterization to improve understanding of contemporary water quality conditions in the lake. Data analysis and assessment from these products will be used to improve the ULWQS sampling and analysis strategy. All relevant data collected as part of the Utah Lake Water Quality Study program is analyzed and evaluated in the IR according to the defined assessment methods (e.g. DO, pH, temperature, among others).

3.13.5 Reporting

The ULWQS employs several data reporting tools including the Utah Lake Data Explorer, the SRP, and the Model Calibration Report. There are also several products in development that will report monitoring results for Utah Lake tributary sites, stormwater data, and nutrient source assessment for each. Also planned for 2020 is a report that summarizes the current data and information available for answering the Initial Charge Questions. Results of this program will also be reported through stressor-response analyses that defined in the NNC Technical Framework document, which serves to describe the approach for combining information and deriving numeric nutrient criteria for the lake.

3.13.6 Programmatic Evaluation

Utah Lake Water Quality Steering Committee and Science Panel will collaboratively evaluate and report data collected through this effort. This data will serve as the foundation for a numeric nutrient criteria recommendation that will be considered by the Utah Lake Commission, Utah Water Quality Board, and the EPA for adoption.

3.14 Great Salt Lake Monitoring Program

Development and Implementation of Water Quality Standards for Great Salt Lake

Great Salt Lake is a unique and ecologically important ecosystem, yet only one numeric water quality criterion has been established for the lake. GSL is a hyper-saline terminal waterbody, with unique biota and biogeochemical processes. These characteristics have made development of numeric criteria difficult because, without comparable reference sites, it is difficult to establish the extent to which contemporary conditions are natural or the result of human-caused activities. The hypersaline nature of GSL further complicates monitoring efforts because unique laboratory methods are often needed to obtain reliable concentrations of pollutants.

WQ proposed a selenium numeric criterion, based on concentrations in bird egg tissue, as GSL's first numeric criterion. The social and scientific complexities that DWQ encountered through the development and adoption of this terrestrial selenium criterion highlighted the need for robust, site-specific monitoring plans as other pollutant concerns are addressed in the GSL ecosystem.

DWQ is committed to establishing standards and associated assessment methods for the GSL, despite the inherent scientific and political difficulties in doing so. However, as the experience with the selenium criterion highlighted, moving forward with additional criteria will require carefully considered monitoring and assessment programs.

3.14.1 Objectives

The unique ecological characteristics of Great Salt Lake create water quality management challenges. Because water-quality criteria designed to protect beneficial uses in other waterbodies aren't applicable to the lake, DWQ scientists need site-specific data to determine the potential impacts of existing or proposed pollutant inputs to the lake's water quality and overall ecosystem.

DWQ's GSL monitoring program is designed to:

- Detect potential changes in water quality conditions
- Support the development of numeric and narrative water quality standards
- Guide discharge permitting decisions
- Assess beneficial use attainment in GSL

3.14.2 Design

Routine monitoring is conducted twice-yearly (June and October) and includes sampling of water-quality, brine shrimp, and bird eggs. Water quality and brine shrimp samples are collected at 11 sites across GSL in cooperation with USGS and Davis County Health Department.

DWQ typically takes the lead in monitoring at the Farmington and Bear River Bay sites. Depending on the depth of the location, one or two water samples are collected at each site. Bird eggs are collected by a contractor during the spring breeding season where nesting occurs along the GSL shoreline.

3.14.3 Core and Supplemental Indicators

Water samples are analyzed for nutrients, total recoverable metals (e.g., selenium and mercury, salinity, and chlorophyll-a.

Brine shrimp and bird egg samples are analyzed for trace metals concentrations, including mercury and selenium. Selenium concentrations from bird eggs are used to evaluate attainment of GSL's selenium standard. See Table 4 for more information.

3.14.4 Data Analysis and Assessment

Data analysis of routine monitoring is currently used for the development of criteria and methods for assessment of GSL beneficial uses.

3.14.5 Reporting

Results from DWQ and cooperator agency monitoring programs can be viewed and analyzed via DWQ's Great Salt Lake Data Explorer. The Data Explorer provides a comprehensive compilation of data for different parameters by visiting https://udwq.shinyapps.io/GSL_data_explorer/.

These include:

- Lake-level data from 1970 to the present, including lake levels for Gilbert and Gunnison Bay, estimated volumes, and north-to-south elevation differences
- Water-quality data (2010 to the present) for total phosphorus, total nitrogen, and salinity
- Metals data (surface and deep layer) for three matrices: water quality, brine shrimp, and bird eggs
- Water-quality map (surface and deep layer) for selected parameters, including salinity, water temperature, secchi depth (water clarity/light penetration), total phosphorus, chlorophyll-a, and total nitrogen

3.14.6 Programmatic Evaluation

Results from routine monitoring are used to evaluate Great Salt Lake water quality and refine the assessment tools used to determine the health and to protect this unique system.

3.15 Contaminants of Emerging Concern

3.15.1 Objectives

Contaminants of emerging concern (CECs) refers to any chemical discovered in water or in the environment that had not previously been detected, or were present at insignificant levels. CECs range from pharmaceutical and personal care products to persistent organic pollutants in many industrial processes. CEC is the general term covering a wide class of different types of chemical compounds, including:

- Per- and polyfluoroalkyl substances (PFAS)
- Disinfection by-products
- Endocrine disruptors
- Industrial chemicals
- Natural toxin analysis
- Persistent organic pollutants
- Micro-plastics
- Pharmaceuticals and Personal Care Products (PPCPs)

While monitoring of a variety of CECs is inevitable in the future, DEQ is currently focusing its efforts on the identification of PFAS contamination in Utah's environment (land and water). Considering the recent concerns regarding widespread contamination, environmental risk, and human health implications with

these compounds, DEQ is committed to researching whether or not there is widespread contamination throughout the state. Results will help determine the level of resource prioritization for this topic in upcoming years.

While consumer products and atmospheric emissions are also sources of human exposure, DEQ is focusing on water and land contamination from PFAS. DEQ has created an internal workgroup to address PFAS contamination throughout the state as well as human exposure risks.

The primary objectives for this program are:

- Develop sampling protocols/procedures that are adequate for PFAS compounds
- Address whether PFAS compounds are significantly present in Utah's environment
- Identify potential PFAS sources
- Develop an ongoing monitoring program to address PFAS contamination in Utah's land and waters

3.15.2 Design

DEQ examined potential exposure pathways to evaluate how people in Utah might come into contact with or be exposed to PFAS. The PFAS workgroup investigated possible sources of PFAS, their probable fate and transport in the environment if released, potential exposure areas, potential exposure routes, and potentially exposed populations.

The DEQ PFAS Workgroup used the potential for human exposure to prioritize its investigation and sampling for PFAS in Utah. The following recommendations are based on the workgroup's evaluations of the most likely avenues for PFAS to contaminate Utah's drinking water, groundwater, surface waters, or other sources of human exposure.

Priority 1: Drinking Water

In the U.S., elevated human exposures of PFAS are most often associated with contaminated drinking water linked to local manufacturers of PFAS or industrial sites where large volumes of PFAS were used and released to the environment. While DEQ did not identify any PFAS manufacturers in Utah, more information is needed to determine what industries use, or have used, significant amounts of PFAS that were released to the environment. These releases include the use of aqueous film-forming foams (AFFFs) at military installations, airports, and refineries. These releases should be evaluated further to determine if they have or could impact drinking water.

Priority 2: Agriculture/Food

The predominant route of PFAS exposure to the general public, apart from those living near a source of PFAS or working in an industry that manufactures/uses PFAS, is through the ingestion of PFAS in food. Releases to surface water and groundwater, as well as the land application of biosolids, can result in potential human exposure from agricultural products, wild game, or fish. Industries that use PFAS may

discharge to a POTW, which may contaminate liquid effluent/ solids and subsequently impact crops or domestic/wild sources of meat. DEQ has not identified any industries associated with high levels of PFAS that have direct discharge permits to Utah's surface or groundwater. Businesses that may use PFAS in their processes or products were identified, and, with one exception, these facilities are located in urban areas serviced by POTWs, limiting the impact to agricultural lands.

Priority 3: Environmental Exposures

Remaining potential PFAS sites will be evaluated to characterize releases to the environment. Less data are available to evaluate the potential environmental impacts of PFAS on ecological receptors such as aquatic life and wildlife. However, the persistence and tendency of some PFAS to accumulate in organisms supports a heightened level of concern if these exposures are occurring.

The DEQ PFAS workgroup established a phased approach to addressing PFAS contamination in Utah.

Phase 1

Phase 1 includes a focus on drinking water sources potentially impacted by the use of Aqueous Fire Fighting Foams (AFFFs) at military facilities such as Hill Air Force Base, the Salt Lake International Airport, and industries that may have used PFAS in their manufacturing processes.

In addition to sampling individual source wells of public water systems, Phase 1 will include sampling a selection of private wells in impacted areas. Since PFAS are not currently regulated by the EPA through SDWA, this effort will require significant outreach to water providers, local health departments (LHDs), and homeowners with private wells to obtain access to their wells. DEQ will work closely with the Utah Department of Health, LHDs, and water providers to interpret results of monitoring data and refine existing communication plans to relay the information to the public and well owners. Depending on the results, DEQ will help homeowners and water providers determine a course of action for evaluating health risks, treatment options, and alternative sources of drinking water. This will be a collaborative effort between DWQ, the Division of Drinking Water, and drinking water utilities throughout the state.

Phase 2

Phase 2 will focus on the presence of PFAS in surface waters and contributions of PFAS from industrial, pretreatment, and wastewater sources. Since the primary goal is to assess impacts to human health, the monitoring design will focus on waterbodies classified for agricultural uses such as livestock watering and irrigation. During SAP development, specific risk factors will be evaluated to target sampling locations that could identify the potential human health and agricultural impacts of PFAS contamination. In addition, sources of PFAS to important fisheries will be evaluated to inform future analysis of fish tissue (Phase 3).

Phase 3

Phase 3 will focus on evaluating concentrations of PFAS in fish and waterfowl tissue to determine the risk from human consumption. The intention of this monitoring is to compile data for consumption

advisories, similar to DEQ's existing program for tissue consumption advisories for mercury and selenium. Areas of focus will be high-use fisheries and known areas of PFAS contamination based on ongoing evaluation of industrial uses and AFFF releases and informed by subsequent sampling and analysis from Phases 1 and 2. DEQ will work closely with the Department of Natural Resources to prioritize sampling sites, coordinate specimen collection, and develop advisories and communication plans for notifying the public regarding the risk from consumption of contaminated tissue.

Additionally, DEQ will collaborate with POTWs across the state to sample biosolids used for agricultural production to determine the fate of PFAS after treatment and composting. This will require coordination with wastewater facilities and biosolids programs to understand the distribution and potential pathways from these biosolids to agricultural products, as well as working with LHDs to notify the public where risks might occur.

Future Phases

Additional phases will complete characterizations for any remaining potential human exposures identified in previous phases.
More can be found on this approach in DEQ's Per and Polyfluoralkyl Substances reconnaissance plan.

3.15.3 Core and Supplemental Indicators

A key challenge in developing a baseline survey of PFAS in Utah is identifying which PFAS compounds to evaluate. More than 6,000 distinct PFAS compounds have been produced or released to the global environment , but identification and quantitation of specific compounds at ultra-trace concentrations (e.g., ng/L) require specialized and expensive instrumentation and are limited by the availability of specific analytical standards .

EPA established drinking water health advisory levels for two PFAS compounds— PFOA and PFOS. EPA's UCMR3 survey of public water systems included six PFAS compounds. EPA Method 537 (Ver. 1.1, 2009) includes 14 compounds, EPA 537.1 (Ver. 1.0, 2018) includes 18 compounds and 7 surrogate/internal standards, and EPA Method 533 includes 25 PFAS compounds, 11 of which are not covered by 537.1. Other state programs (e.g., North Dakota and Michigan) have used in-house methods of Overview of Quantitative Methods for Drinking Water.

Drinking Water and Groundwater

Currently, the only EPA-approved methods for analysis of PFAS from drinking water are EPA Methods 537.1 and 533.

The number of available analytes for method EPA 537 range from six to 14, 18 for EPA 537.1, and 25 for EPA 533. For the six PFAS analytes surveyed under UCMR3 (PFBS, PFHxS, PFHpA, PFOA, PFOS, and PFNA).

Surface Water and Wastewaters

For environmental samples with more complicated matrices, such as surface waters (streams, lakes, wetlands) and wastewater (influent and effluent), the higher concentrations of suspended solids, dissolved organic compounds, or dissolved inorganic solutes (salts) compared to relatively pure finished drinking water may interfere with otherwise accurate analytical procedures and result in poor sensitivity or biased results. These matrix effects can be examined through analysis of particular QC samples.

Methods for non-drinking water samples are becoming available from consensus standards organizations (ASTM International and ISO Standards) and gradually being adopted by some commercial laboratories. See Table 4 for more information.

3.15.4 Data Analysis and Assessment

DEQ plans to use PFAS results primarily for screening and background purposes for now. As standards are developed and more information is developed for assessment purposes, DEQ will reevaluate its data accordingly in the future.

As DWQ starts sampling drinking water systems, at a minimum it will resample locations with positive detections to confirm initial results. From there drinking water distribution systems will be sampled to evaluate whether PFAS compounds can be detected (identify sources). Currently, only Lifetime Health Advisories (LHA) exist for PFAS compounds; water quality/drinking water standards do not exist. This said, if sampling results show levels above LHA thresholds, DEQ will need to assess this on a case-by-case basis.

3.15.5 Reporting

Similar to data analysis and assessment, DEQ is currently working on a plan to report data and notify the public as more information is gathered in upcoming years.

3.15.6 Programmatic Evaluation

The science of PFAS compounds continues to evolve rapidly. These recommendations will be re-evaluated as new information becomes available. The recommendations and resulting sampling priorities will also be re-evaluated as more Utah-specific data become available. As DEQ develops its monitoring program for PFAS, one of its biggest challenges will be to come up with a plan to communicate results to the public as well as developing an action plan to address areas with high results.

The DEQ PFAS workgroup has developed a preliminary communication plan that formed the basis of current web resources that inform the public about PFAS and provide updates on the DEQ PFAS program. Each phase of the strategy will require the development of outreach materials and information to communicate with stakeholders, the public, and impacted drinking water providers to ensure data and potential risk are clearly communicated. DEQ will coordinate closely with the Department of Health (DOH) and LHDs to develop communication plans and outreach materials.

3.16 Headwater Nutrient Monitoring Program

3.16.1 Objectives

Headwater streams—about 47% of all perennial streams in the state—are the focus of these criteria because they are ecologically and economically important, and ensuring their ongoing protection will protect downstream waters from adverse effects of nitrogen and phosphorus pollution (Figure 3). In June 2019 Utah proposed, and in December 2019 the Utah Water Quality Board adopted new headwater numeric nutrient criteria (NNC). The headwater nutrient criteria for Category 1 and 2 streams were approved by EPA in May 2020.

Excessive amounts of nitrogen (N) and phosphorus (P) can degrade aquatic life uses via a myriad of mechanisms, but all the mechanisms are related to increased growth of plants/algae (autotrophs) and/or microbes/fungi (heterotrophs). DWQ selected bioconfirmation criteria (ecological responses) to address both pathways. In the case of plant/algae growth, two indicators are not to be exceeded at any headwater stream: (1) a daily gross primary production (GPP) rate higher than 5 g O_2/m^2/day or (2) an aerial percent filamentous algae cover exceeding 1/3 of the stream bed. Linkages among microbes/fungi, nutrients, and aquatic life uses are less well understood, in part because these processes are more difficult to observe or measure. However, it is possible to measure ecosystem respiration (ER), which captures the net metabolic activities of all stream biota. DWQ proposes a not-to-be-exceeded rate for ER of 6 g O_2/m^2/day.

Nutrients can also degrade recreation uses. To protect these uses DWQ proposes a not-to-be-exceeded benthic algae concentration of 125 mg/chlorophyll-*a* (chl-*a)*/m^2, or the equivalent 49 g ash free dry mass (AFDM)/m^2. These criteria were selected from a survey of Utah citizens who were asked whether streams with varying amounts of benthic algae cover represented "desirable" or "undesirable" conditions. These recommended criteria fall just below the point where the proportion of undesirable responses start to increase and should therefore be protective of recreation from the perspective of degraded aesthetics or other factors influencing recreational use decisions.

Combining nutrients and ecological responses result in more accurate assessments of the NNC. However, the requirement to have both pollutant concentrations and ecological responses creates unique monitoring challenges. The most important monitoring objective is the integration the data collection requirements of the NNC into existing monitoring programs. This includes the collection of data necessary to identify headwater streams with nutrient-related adverse effects and also monitoring to demonstrate progress on any BMPs that are implemented.

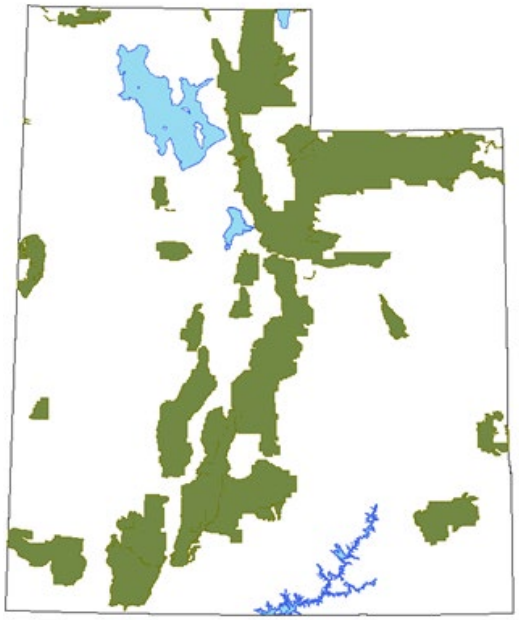

Figure 3 Map of headwater stream watersheds

3.16.2 Design

Targeted monitoring will be used to collect ecological response information at enriched headwater streams. Many of the headwater streams that are most likely to have nutrient-related problems are monitored through cooperative agreements with the USFS and other management agencies. Others are monitored due to know nutrient-related issue downstream (e.g., HABs in downstream reservoirs, nutrient TMDLs). Other headwater streams are added to the ambient water quality monitoring due to known or suspected nutrient-related adverse responses. Any headwater stream where the summertime average of N or P exceed the lower NNC threshold will be prioritized for the collection of ecological responses. In general, the requisite ecological response data will be collected during UCASE data collection activities.

An adaptive management strategy will be used to address NNC impairments in cooperation with DWQ's non-point source program. NNC responses will be integrated into the 319 monitoring efforts to track improvements associated with BMP implementation.

3.16.3 Core and Supplemental Indicators

Core indicators for the nutrient criteria are growing season averages of nitrogen and phosphorus, and the ecological responses specified in the NNC. Ecological responses for the protection of aquatic life include gross primary production, ecosystem respiration and percent filamentous algae cover. Recreational uses are protected by benthic chlorophyll-*a* and AFDM measures of algae biomass.

Additional indicators to monitor the ecological condition include dissolved oxygen, pH, macroinvertebrate assemblage (O/E), sediment, and habitat assessment.

3.16.4 Data Analysis and Assessment

The NNC will be assessed in conjunction with the IR and detailed analytical approaches will continue to be provided and updated, as appropriate, in the IR assessment methods. As BMPs are implemented to address NNC impairments trends toward meeting NNC ecological response objectives will be evaluated on conjunction with the 319 evaluations.

3.16.5 Reporting

Data from NNC monitoring will primarily be reported in regular IR and 319 reports. NNC data will also be reported in watershed management planning documents as impaired streams are identified.

3.16.6 Programmatic Evaluation

The NNC are potentially useful in helping to address problems with HABs in downstream reservoirs. As resources allow, DWQ will be integrated additional headwater assessments into the streams that enter reservoirs with HAB problems to help identify nutrient sources that could be reduced to decrease the frequency intensity of these blooms.

Efficiently addressing headwater nutrient impairments requires an action-oriented approach that focuses resources on the implementation of on-the-ground remediation efforts. In 2013, EPA completed a broad and collaborative review of the nation's Clean Water Act 303(d) program with the objective of identifying opportunities to more efficiently and effectively meet water quality objectives. Among the findings of this review was an acknowledgement that traditional TMDLs may not always be the most effective approach for meeting water quality efforts, particularly in circumstances where the flexibility required by adaptive management is desirable or where multiple resource management objectives can be combined into a comprehensive restoration effort. One way that these inefficiencies can be addressed is with alternative TMDLs that expedite BMP implementation and then focus on demonstrating ongoing ecological improvements in water quality indicators. The headwater NNC are ideally suited for these approaches because NPS nutrient loads are difficult to quantify and the NNC ecological responses are ideal for demonstrated iterative progress following BMP implementation. DWQ is exploring integrating these approaches with 319 stream remediation and cooperative monitoring efforts.

3.17 *E. coli* Monitoring Program

3.17.1 Objectives

E. coli monitoring program is designed to protect Utah's waters for recreational beneficial uses and includes both long-term monitoring for assessment and TMDL needs in addition to short-term advisory monitoring at high contact recreational waters. Short-term monitoring is in accordance with the newly

developed Waterborne Pathogen Advisory Program, adapted from the previous *E. coli* Advisory Program and following the EPA's 2012 guidance for Recreational Water Quality Criteria.

Utah has two recreational beneficial use categories (Class 2, DEQ Rule 317-2. Standards of Quality for Waters of the State) and waterbodies that are either protected for primary contact recreation such as swimming (2A) or for secondary contact recreation such as boating or wading (2B). Table 8 summarizes the assessment criteria for identifying impairment.

Table 8 - Assessment Criteria for Identifying E. coli Impairments

Recreation Use Category	Single sample max.	30-day geometric mean (min 5 samples)
2A – Primary Contact	409 MPN/100mL	**126 MPN/100mL**
2B – Secondary Contact	**668 MPN/100mL**	**206 MPN/100mL**

The geometric mean provides a more statistically significant representation of the *E. coli* concentrations than the arithmetic mean. Single event sampling will be for screening purposes to identify areas requiring intensive monitoring for the development of geometric means.

For short-term priority recreational waterbodies, a single threshold of 235 MPN/100mL is proposed for use in advisories.

3.17.2 Design

High intensity monitoring projects in areas that exceed the criteria in Table 8 are implemented during the recreational monitoring season (May – October). Intensive monitoring is used to determine the geometric mean and track changes in water quality for development of a TMDL or project successes. These projects are designed specific to the watershed and potential sources of *E. coli*.

Microbial Source Tracking (MST) is a tool the DWQ is testing to determine the main sources of contamination (i.e. human, bovine, avian, canine). These data are used when issue. *E. coli* are present to guide TMDL and project implementations.

DWQ coordinates routine *E. coli* monitoring for the Waterborne Pathogen Advisory Program. Locations of priority high contact recreation are determined in the early spring before the recreation season. Monitoring is conducted monthly May – October at these priority locations by the DWQ, LHDs and additional cooperators. DWQ and DOH provide guidance to the Local Health Departments (LHDs) based on monitoring and determined advisory thresholds. In instances of exceedance, follow-up and advisory monitoring following the Waterborne Pathogen Advisory Guidance may be implemented in coordination with the LHD.

3.17.3 Core and Supplemental Indicators

Primary indicators are currently *E. coli*. MST is in a testing phase for wider use in assessment and TMDL development. Additional tools may be employed to determine recreational health concerns due to waterborne pathogens as guidance is provided by EPA. See Table 4 for more information.

3.17.4 Data Analysis and Assessment

Data analysis is carried out primarily by DWQ staff used for development of TMDL guidance, guide project implementation in the improvement of recreational water quality. In addition, monthly and advisory data at priority waterbodies are reviewed regularly to provide advisory guidance to the LHDs. Reviewed data is submitted to the DWQ database and used for IR assessment.

Determining impairment status of streams and lakes for *E. coli* has focused on attainment of water quality criteria set forth in UAC R317.2 Standards of Quality for Waters of the State. Exceedance reporting based on criteria established for the designated uses (Table 4) is the primary assessment tool for determining whether a waterbody is placed on the 303(d) list.

3.17.5 Reporting

Data are reported for assessment in the IR. Data gathered for TMDL development will be included in the TMDL reports. Advisory data are reported on the Waterborne Pathogen website as soon as it is available for easy public reference.

3.17.6 Programmatic Evaluation

Results of *E. coli* exceedances may lead to project or TMDL implementation to improve water quality once the source(s) of contamination is determined. Intensive monitoring before implementation is used to determine the source and duration of contamination. Additionally, priority waterbodies with regular advisory may result in impairments and require additional assessment.

3.18 Harmful Algal Bloom Monitoring

3.18.1 Objectives

Harmful Algal Blooms (HABs) or cyanobacteria, are increasingly prevalent in many of Utah's lakes and reservoirs. Understanding the ecology and dynamics of the waterbody and having information on the presence of HABs helps water managers to both develop effective water management strategies and effectively direct resources to control and manage them. Waterbodies with frequent blooms create a health concern and can factor into levels of impairment for that waterbody, triggering a need for TMDL development. The HABs Monitoring Program is designed to collect environmental data to aid the development of assessment methods that will characterize the conditions of HAB events.

The primary objectives of the HABs program are to:

- Better understand the conditions that propagate HABs
- Identify the affected waterbodies and environmental effects
- Develop and improve sampling and monitoring techniques

- Report to the LHDs and public the extent and toxicity of HABs across the state
- Identify nutrient sources and potential controls

3.18.2 Design

Monitoring for HABs is focused at waterbodies with the greatest potential for a HAB where human contact with water is also likely to occur. These locations are developed based on known recreation, drinking water reservoirs and from past bloom events. DWQ staff and other cooperating agencies collect samples, take field measurements and photo the blooms during lake and reservoir surveys statewide. These sampling efforts generally occur monthly from summer through fall at the determined priority locations. Incident response based monitoring for HABs also occurs throughout the state when appropriate. Additional sampling may occur at waterbodies that are not part of DWQ's annual sampling plan and are experiencing a high volume of reported blooms or when livestock or pet incidents are identified.

Because of the nature of cyanobacteria to produce toxins, HAB monitoring is part of Utah's Recreational Health Advisory Program. DWQ works closely with LHDs, State Parks, and additional stakeholders to keep the public informed of cyanotoxin levels and potential for toxin development. DWQ and DOH provide guidance and recommendations to LHDs on issuing advisories.

Additional tools used to monitor for HABs and to guide field monitoring is the use of Remote Sensing and high frequency monitoring stations. These tools can provide a warning sign before DWQ or other samples are able to collect on site data.

3.18.3 Core and Supplemental Indicators

Cyanobacteria toxin analyses targeting microcystin, anatoxin-A, cylindrospomepsin and cyanobacteria cell counts. Photo documentation and phycocyanin testing are also used as supplemental indicators. See Table 4 for more information.

3.18.4 Data Analysis and Assessment

By collecting baseline data at designated high-risk lakes and reservoirs across the state, DWQ is able to build a model for understanding and predicting bloom occurrence. DWQ has developed assessment methods using HABs as an indicator for recreational use since 2016. DWQ has placed waterbodies on the 303(d) list using this methodology. Monitoring also guides incident response to HAB bloom events by the DWQ, LHDs and other local agencies. High risk waterbodies include drinking water sources, waterbodies with high recreation, and waterbodies with a history of HAB bloom events. If a bloom is identified and above thresholds, weekly/biweekly monitoring is triggered and sustained until toxin and cell count levels fall below threshold for two consecutive weeks.

3.18.5 Reporting

Data are primarily used to establish and report public health advisories related to swimming and drinking water systems. Data are used in TMDL and project reporting, and IR reports in addition to regular website reports for use by the public.

3.18.6 Programmatic Evaluation

As new and ongoing blooms occur, the program tracks changes and monitors influences of nutrient inputs, water levels, and additional factors contributing to the blooms. Monitoring is used to guide project implementation decisions and defining needs for additional data.

3.19 Wetlands Monitoring Program

3.19.1 Objectives

The overall purpose of the Wetlands Monitoring Program is to increase the amount and availability of scientific data on Utah's wetlands by continuing to build and deploy scientifically-based tools to assess wetland health and to afford great protection by determining wetland specific beneficial uses and criteria to protect those uses. The Wetland Program is currently focused particularly on wetlands associated with Great Salt Lake that comprise the majority of wetlands in the state of Utah. Objectives include:

- Mapping and Landscape Planning: Develop data, tools and methods that allow wetland data to be better incorporated into landscape-scale planning, including mapping to support planning and monitoring efforts
- Monitoring and Assessment: Develop and deploy methods to evaluate the condition, function, and beneficial use attainment of Utah's wetlands
- Water Quality Standards: Define science-based beneficial uses for Utah's wetlands with appropriate criteria that are protective of the use

3.19.2 Design

Utah's monitoring and assessment strategy is twofold. Baseline information and initial characterization of high-quality or 'reference' condition will be collected using a rapid assessment protocol with probabilistic surveys supplemented with some targeted monitoring. More intensive monitoring strategies will be developed and deployed to address specific regulatory goals, including developing appropriate beneficial uses for different wetland types and assessing whether wetlands are meeting those uses. Baseline data collection will be led by UGS and will generally occur across all wetland types. Regulatory assessments will be led by DWQ and will target specific classes of wetlands. Both UGS and DWQ will organize assessments around the three main Level III Omernik ecoregions in Utah: the Central Basin and Range, the Wasatch and Uinta Mountains, and the Colorado Plateau.

3.19.3 Core and Supplemental Indicators

This program is designed to determine the best indicators for beneficial uses of wetlands. While there may be some overlap with current indicators, numeric criteria and unique indicators are being determined. See Table 4 for more information.

3.19.4 Data Analysis and Assessment

Data from the 2019 and 2020 wetland monitoring work are being used to identify the primary stressors to wetland health in Utah and best indicators of wetland condition. As wetland standards development proceeds, data are also being analyzed to support appropriate numeric criteria and potential UAA.

3.19.5 Reporting

All reports on wetland monitoring projects are shared on the web.

3.19.6 Programmatic Evaluation

Development of standards and assessment of wetland health is ongoing in coordination with UGS.

3.20 Stormwater Monitoring

3.20.1 Objectives

Stormwater monitoring is a new component to the Division's efforts to better understand and effectively mitigate these pollution sources into waters of the state. As development occurs throughout the state the proportion of stormwater in runoff increases as areas are paved, roofed, or otherwise made impervious to infiltration. Therefore, stormwater is an increasingly significant component of pollutant loading to the State's surface waters and groundwater that can impair their beneficial uses for the citizens of Utah.

The objective of Utah's stormwater monitoring effort is to inform governmental agencies and the public of potential water quality concerns associated with stormwater and the effectiveness of management practices such as low impact development and green infrastructure on mitigating these impacts. To accurately characterize stormwater quality and confidently identify changes over time will require several years of data encompassing multiple storm events due to its variable nature. Another objective of the monitoring effort is to establish consistent monitoring protocols to obtain reliable data that provides confidence among the public and decision makers and leads to effective actions to protect and improve water quality.

3.20.2 Design

DWQ will use portable automatic samplers to collect stormwater samples. These devices will be used in natural (streams, lakes) or engineered (stormwater outfalls, ditches, canals, basins) surface waterbodies. The primary use of portable samplers will be to obtain water quality data from stormwater outfalls during and following precipitation events.

Portable samplers are an effective and efficient means to collect water quality samples for laboratory analysis of chemical parameters such as nutrients, metals, total dissolved solids, and hydrocarbons. When combined with an area velocity flow meter or other flow measurement device, portable samplers can be used to estimate pollutant loads at remote locations that flow intermittently from precipitation driven events.

Representative sites (targeted) will be selected during the planning phase for the project at hand. Sites are determined based on a logical location where sampling stations can be managed appropriately (physical location) and where the condition of stormwater runoff best represents stormwater conveyance.

3.20.3 Core and Supplemental Indicators

See Table 4 for more information.

3.20.4 Data Analysis and Assessment

Previous studies, such as the Nationwide Urban Runoff Program, have characterized stormwater quality across the country, including similarities and differences between urban areas, the extent to which stormwater contributes to water quality problems, and the effectiveness of management practices to control pollutant loading. This study found that stormwater quality is highly variable between study sites and runoff events and led to the calculation and reporting of event mean concentration to characterize stormwater quality rather than mass loading which is biased by the size of monitored storm events. Event mean concentration is calculated from flow weighted composite samples for each event at each site.

Since stormwater monitoring is a new program for the DWQ, data collected will build on previous studies and provide local data. Additionally, it will be used to guide development of an established monitoring program.

3.20.5 Reporting

This monitoring program is still in development. A formal reporting process will be implemented over the next 2 years.

3.20.6 Programmatic Evaluation

Stormwater monitoring is an important part of DWQ's goals to protect, maintain, and enhance the quality of Utah's water for its beneficial uses and public health. It has been documented that stormwater in Utah can contain harmful pollutants for people, pets, and fish. These potential threats are likely to increase in the future as our population grows and land uses intensify to accommodate this growth. Understanding these potential threats and communicating them to decision makers and the public, along with recommendations and requirements to address them, are central to DWQ's mission.

3.21 Groundwater Monitoring Program

3.21.1 Objectives

The State of Utah is experiencing rapid population growth and thus needs to acquire and develop additional sources of water in many communities throughout the State. The rights to use surface water have been allocated in most areas so any new water supplies typically are from ground-water aquifers. Data collected by the USGS indicate the quality of water in aquifers can and has changed over time in

some areas of the State from either natural and/or anthropogenic influences. The necessity to develop water supplies will require the continued development of ground-water aquifers supplies. Water quality in some area of the State may be more of a limitation in developing additional water supplies than water quantity.

The groundwater program is primarily a permit program which issues groundwater discharge permits for any facility which discharges, or likely would discharge, to groundwater (UAC R317-6). For such a facility, the groundwater program prescribes a process for implementing technology, construction and design standards to control, contain and consequently minimize the discharge of pollutants to groundwater and its effects on current and future beneficial uses. The permitting process and regulations also require ongoing monitoring and reporting of the facility and the control features/wells to determine ongoing compliance with groundwater protection.

Groundwater permit compliance monitoring is being conducted at over 50 agricultural, municipal or industrial sites with over 300 shallow monitoring wells reporting compliance data on a quarterly, semi-annual or annual basis. In addition, an ambient groundwater monitoring network has been recently reestablished in cooperation with the USGS.

The objectives of the ambient groundwater monitoring network are outlined below:

- Provide an overview and identify trends of the groundwater conditions in Utah's four major aquifer types
- Integrate groundwater monitoring data where TMDLs have been developed or are under development
- Evaluate the long-term effectiveness of the Clean Water Act program activities in protecting groundwater in Utah
- Support Groundwater Aquifer Classification System.
- Allow for the detection and tracking of groundwater contamination through ambient and site-specific monitoring

3.21.2 Design

The State of Utah Department of Natural Resources in cooperation with the U.S. Geological Survey funds a state-wide ground-water level monitoring network. This network has measured water levels in about 800 wells across the state for almost 50 years providing a long-term record of water levels and changes that provides critical data for managing the State's ground-water resources. Collection of water-quality data in a systematic fashion is critical for the sustainability of aquifers and the health of the people of Utah. Monitoring groundwater quality for assessment of TMDLs, examining trends in naturally-occurring and anthropogenic contaminants, and monitoring ground-water levels are all important aspects of providing for the health, safety, and sustainability of water resources. The proposed ground-water quality monitoring program will target 300 wells distributed in all the ground-water basins and major aquifers in the State. One hundred wells will be sampled annually on a three-year rotation by the Utah Geological Survey. Results of the analyses will be included in the Annual Groundwater Conditions Report for Utah prepared each year in cooperation with the Utah Department of Natural Resources. The

data will also be available on the Internet via an ESRI ARC internet map server (IMS) graphical interface for the USGS National Water Information System database. Users will be able to query current and historic water-level and water-quality data through this interface.

Groundwater Permit-Compliance Monitoring

The objective of groundwater permit compliance monitoring is to protect current and future beneficial uses of groundwater resources by applying groundwater protection levels based on site-specific background groundwater quality. Through the use of protection levels, early detection of contamination is emphasized so that problems can be corrected promptly at the source before they develop into substantial groundwater contamination events. This approach, prevention and early detection and correction, versus after-the-fact cleanup, is preferable both for the long-term utilization of the groundwater resource and the avoidance of the considerable expense of groundwater remediation.

Groundwater monitoring occurs to obtain data for oversight of municipal and industrial ground water discharge permit requirements. Compliance monitoring points are located as close as practical to the point of discharge. Location of the compliance monitoring point is dependent upon the hydrology, type of pollutants, and other factors that may affect ground water quality. Periodically, DWQ will monitor wells in coordination with the permittees to evaluate their ongoing compliance monitoring.

The GWP divides groundwater into different classes (UAC R317-6-3) based on overall quality, i.e. TDS and specific contaminants, e.g. nitrate or arsenic and actual or potential beneficial uses such as drinking water or as groundwater important to the continued existence of wildlife habitat. Different levels of protection are described for each class in UAC R317-6-4 and the regulated contaminants are listed in Table 1 under UAC R317-2. The contaminants in Table 1 are, with the exception of arsenic, identical to the federal drinking water standards mandated under the Safe Drinking Water Act.

The GWP currently has more than 50 individual discharge permits around the state including facilities from mining, power generation, concentrated animal feeding operations and others. In addition to the individually permitted facilities, UAC R317-6 has a list of 25 types of facilities which are "Permit by Rule" (PBR) and are not required to obtain a groundwater discharge permit (UAC R317-6-6.2(A)). Number 10 on the PBR list includes individual septic systems approved by the local health department and large systems approved by the DWQ director.

Based on the PBR status for individual septic systems and regulations in the DWQ engineering section, which generally result in pretreatment of large septic system discharges, the GWP has not permitted these facilities on an individual basis. Programmatically and administratively within DWQ, the Engineering and GWP sections discuss and assess these facilities and the level of treatment necessary for director approval. However, since the GWP is primarily based on permitting and not general water quality, the GWP does not have a way to collect and assess overall water quality effects of these systems nor the regulatory authority to prevent their excessive use relative to natural dilution of the contaminants discharged.

The GWP and UAC R317-6 provide for the assessment of general ground water quality issues as described under UAC R317-6-5, Aquifer Classification. Under this part of the rules entire aquifers or parts of aquifers may be classified relative the criteria described above (UAC R317-6-3). An aquifer classification requires:

1. Factual data supporting the classification (TDS data and aquifer data on specific possible contaminants, e.g. arsenic or nitrate)
2. Description of the proposed groundwater to be classified
3. Potential contamination sources
4. Groundwater flow directions (and typically a delineation of high vulnerability recharge areas as well)
5. Current beneficial uses
6. Location of all water wells in the classification area.

Aquifer classifications have been used with the assistance of the GWP to gather the necessary data and information for local authorities to enact source protection ordinances and septic tank density studies. These studies and the information contained in them are critical in providing the necessary technical and factual information supporting local ordinances as well as decisions on the zoning and siting of potential contaminant sources, including septic systems.

While a number of aquifers have been classified around the state, many areas lack important information to make local decisions based on specific groundwater information. When specific groundwater data are absent in an area, and in consultation with the Engineering section, the GWP has indicated to the facility requesting approval of a large septic system that a groundwater permit may be required. In doing so the Director may require the submittal of a groundwater discharge permit application which can help to provide additional data and inform the PBR decision for groundwater protection.

While this permitting path can help in some ways, it can cause other problems. Specifically, when applying the permitting approach to a septic facility, which is an uncontrolled source of contamination, it would almost certainly violate groundwater standards. For example, pristine, Class 1 groundwater with drinking water as its current and primary beneficial use under UAC R317-6-3would require a protection level under UAC R317-4-6-4 to be or 25% of the applicable drinking water standard for nitrate (2.5 mg/l).Since the uncontrolled septic source has a constant concentration of somewhere between 50 and 70 mg/L nitrate and monitoring wells are typically installed as close as practicable to the source, a conventional septic system would most likely immediately exceed the applicable standard.

Therefore, when groundwater is at risk, this approach is ultimately used to have the facility gather additional information and provide for a higher level of treatment for groundwater protection. However, the additional treatment can be more costly and the impacts to water quality as well as the data used to make determinations are often limited. Nevertheless, in certain specific instances DWQ and the GWP have stated that to receive Director Approval and avoid the likely failure of a discharge

permit the facility must meet 2.5 mg/L nitrate or 25 percent of the applicable drinking water standard at the end of the treatment process and prior to the ground water discharge.

Meeting the 2.5 mg/L treatment standard, while costly, does allow the facility to meet the GWP PBR requirements and avoid applying for an individual permit. If the facility would like to treat to a lesser standard and still avoid a permit, the facility must show that the combination of treatment and dilution, i.e., proper spacing and distribution of septic systems throughout the aquifer, is sufficient to meet the GWP program requirements and remain protective of down gradient users and the beneficial uses.

3.21.3 Core and Supplemental Indicators

The primary contaminants of concern related to septic systems are nitrate, total inorganic nitrogen (TIN), Total TDS, bacteria, and viruses. Secondary contaminants include a wide range of other constituents typically found in domestic wastewater, but not analyzed for, such as pharmaceuticals. Bacteria and viruses are a concern but typically are removed or inactivated during travel through the subsurface. It is worth noting that there are no controls on what may actually go into septic systems. The systems are designed and intended to be used as a means of disposal for household and general municipal waste, however other types of contaminants could be introduced into these systems.

While a wide range of contaminants may be discharged to groundwater by septic systems, the most analyzed and identifiable is nitrate. In the septic system the nitrate originates as ammonia and organically-bound nitrogen. When allowed to contact with oxygen this nitrogen is converted to nitrate. Some loss of nitrogen may occur either through the conversion to nitrate along with some volatilization or possibly through some amount of adsorption in the subsurface. However, the losses of nitrogen due to these factors is generally quite small and the conservative approach is to assume that all of the ammonia is converted to nitrate and that the dissolved nitrate in the effluent behaves conservatively (i.e. remains in dissolved form and does not precipitate or adsorb) as it travels in the groundwater.

Nitrate is also a listed contaminant under the Safe Drinking Water Act and has a limit of 10 mg/L. Concentrations above this limit can have observable health impacts when the nitrate in the body interferes with the blood's ability to normally absorb oxygen.

See Table 4 for more information.

Groundwater Permit-Compliance Monitoring

The following physical parameters and chemical analytes are routinely considered as core indicators for ground water quality monitoring projects: field parameters (temperature, specific conductance, pH, and dissolved oxygen, major inorganic ions (Ca, Mg, Na, K, Cl, SO4), and TDS).

Supplemental water quality parameters may be added dependent upon the effluent chemistry, permit ground water quality standards and protection levels. Common parameters include metals and trace elements, nutrients (NO2 + NO3), ammonium, total phosphorous), bacteria, radionuclides, pesticides and volatile organic compounds

3.21.4 Data Analysis and Assessment

All analysis of ambient groundwater monitoring is performed by USGS in consultation with DWQ staff. The methods and summaries of the groundwater data can be found in the various reports published by USGS.

Analytical results associated with water samples collected from each area of ground-water development were compared to State of Utah maximum contaminant levels (MCLs) and secondary drinking-water standards of routinely measurable substances present in water supplies. A comparison of MCLs and secondary drinking-water standards with results of analyses is included in the text of the USGS reports.

Groundwater Permit-Compliance Monitoring

It is the responsibility of the permitted facility to do monitoring at the wells to determine compliance. Sample values from monitoring points are compared to established permit limits for compliance. Determination of compliance and non-compliance will be based on statistical evaluation of the data available.

3.21.5 Reporting

The approved data available for project analysis are archived in the USGS National QWDATA water-quality database. Progress updates are made to DEQ every six months, and significant findings will be presented. Statements of progress provided to the sponsoring agency (DEQ) also will be furnished to the EPA. The USGS Water Resources Investigations Report and the USGS Annual Data Report will be sent to the same agencies and will be placed in federal documents repositories and designated libraries. These reports contain both quantity and quality information for Utah's aquifers, and as such are the most widely read reports published by USGS.

The Utah Groundwater Quality Protection Regulations contain a provision for classification of entire aquifers or parts of an aquifer a method for maintaining groundwater quality in these areas. An aquifer classification may be initiated either by the Utah Water Quality Board or by a petitioner. Section UAC R317-6-5 of the Groundwater Protection Regulations describes what a classification petition should contain. The petition will be a report that represents a consolidation of knowledge about the given hydrological setting from a number of scientific technical sources.

3.21.6 Programmatic Evaluation

The Groundwater Protection Section administers more than 50 Groundwater Quality Discharge Permits under the Utah Administrative Rules for Groundwater Quality Protection to protect beneficial uses of groundwater quality from degradation. In addition, the Groundwater Protection Section administers Underground Injection Control (UIC) (Section 3.22) permits under section 1422 of the federal Safe Drinking Water Act to protect underground sources of drinking water from injection activities. Permittees submit quarterly or semi-annual Groundwater Compliance Monitoring Reports for Groundwater Quality Discharge Permits and periodic Monitoring Reports for UIC Permits. Groundwater monitoring is intended to determine if a facility is in compliance with the permit-specific groundwater

protection levels based on site-specific background concentrations and the federal maximum contaminant levels of UIC Permits.

3.22 Underground Injection Control Program

3.22.1 Objectives

An Underground Source of Drinking Water (USDW) means an aquifer or a portion thereof which:

A. Supplies any public water system, or which contains a sufficient quantity of ground water to supply a public water system; and

1. Currently supplies drinking water for human consumption; or

2. Contains fewer than 10,000 mg/l TDS; and

B. Is not an exempted aquifer.

UIC-regulated activities include subsurface emplacement of fluids into a bored, drilled or driven shaft whose depth is greater than the largest surface dimension; or a dug hole whose depth is greater than the largest surface dimension; or an improved sinkhole; or a subsurface fluid distribution system consisting of an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground. The UIC requirements do not apply to single-family residential septic system wells, or to non-residential septic system wells that are used solely for the disposal of sanitary waste and have a design capacity of greater than or equal to 5,000 gallons per day.

The primary purpose of the Utah 1422 UIC Program is to protect underground sources of drinking water (USDW) from endangerment by regulating subsurface emplacement of fluids. The nonendangerment standard for the UIC Program is stated in UAC R317-7-5.3 and 40 CFR 144.12(a). Excerpt from UAC R317-7-5.3(a) reads as follows: "Underground injections are prohibited which would allow movement of fluid containing any contaminant into underground sources of drinking water if the presence of that contaminant may cause a violation of any primary drinking water regulation (40 C.F.R. Part 141 and Utah Primary Drinking Water Standards R309-200-5), or which may adversely affect the health of persons."

The groundwater section of the DWQ has authority to administer the federally required Underground Injection Control (UIC) program (UAC R317-7). This program is based on the Safe Drinking Water Act but in most ways is similar to the State groundwater Protection program and is therefore administered by DWQ and not DDW. Under the UIC program, septic systems greater than 5,000 gallons per day are considered an injection well and may be permitted by the UIC program. However, similar to the GWP the UIC program has a "by Rule" provision called Authorization by Rule (ABR) when another program adequately provides protection of the groundwater. Whether through the Engineering section or through the GWP, DWQ intends to maintain the ABR status of septic systems relative to the UIC program to avoid unnecessary duplication of regulations.

The objectives of this program are:

- To ensure compliance with UIC permit limits
- To ensure UIC-regulated facilities authorized-by-rule are protective of USDWs and to determine a prioritized course of action for returning endangering facilities back to compliance
- Assess the effectiveness of UIC BATs and BMPs in protecting USDWs

3.22.2 Design

Monitoring design for the various types of UIC facilities (permitted, authorized-by-rule, and best available technology) will be specific to the type of facility and will include monitoring for those constituents most likely to be present in the injectate that could cause exceedances of MCLs in the receiving USDWs or that could result in elevated concentrations of other constituents in the receiving USDWs that are detrimental to human health or the environment. All compliance monitoring conducted by the facility owner and DWQ is conducted according to the requirements outlined in DWQ's QAPP UIC Program.

UIC Permit Compliance Monitoring

Annually, UIC staff will split samples collected by the UIC permittee to verify compliance with permit monitoring requirements and with any permit limits on constituent concentrations.

UIC Program Compliance Monitoring

During inspections of facilities with uninventoried injection wells, we arrive onsite with a monitoring kit so that we are prepared to collect samples if we discover a situation requiring sampling. This sampling will be employed to verify compliance with the non-endangerment standard of the UIC Program and to determine follow up course of action if any is required. Therefore, analytical results from this sampling is for compliance and enforcement purposes.

UIC BAT and BMP Monitoring

Although we have not yet conducted focused monitoring to verify the effectiveness of various BATs and BMPs in meeting the nonendangerment standard, we must have this option available to us in the near future.

3.22.3 Core and Supplemental Indicators

The UIC Program was established under the Safe Drinking Water Act therefore constituents with federal and state MCLs will be prioritized for monitoring and assessment. Only those constituents that are likely to occur in the injectate based upon the characterization of the injectate are included for monitoring. See Table 4 for more information.

3.22.4 Data Analysis and Assessment

In addition to ensuring compliance with the UIC nonendangerment standard, UIC programmatic analytical data will be further assessed and policy made with consideration for: groundwater classification made according to the administrative rules for the Ground Water Quality Protection Program; proximity to or inclusion within primary recharge areas and ground water-based source water protection zones; local ordinances pertaining to the operation of such facilities; and other relevant sensitive environmental considerations. Assessment of programmatic analytical data and development of program policy will be greatly facilitated through geospatial integration of relevant environmental and other data layers using Desktop ArcGIS.

3.22.5 Reporting

The UIC Program is required to submit analytical data to EPA for Class I injection wells. However, we do not have any Class I injection wells within the state. Class III facilities are required to submit analytical data periodically also, but we are not required to submit it to EPA.

3.22.6 Programmatic Evaluation

Although the UIC Program has not pursued this yet, DWQ would like to conduct targeted sampling to assess effectiveness of various BATs and BMPs in ensuring protection of USDWs. For example, BATs and BMPs for stormwater injection. We would also like to conduct studies to identify parameters that would assist us in determining the feasibility of injection activities. For example, geochemical characterization for aquifer storage and recovery (ASR) projects, to name one.

3.23 Incident Response Monitoring

3.23.1 Objectives

The DWQ Spills Coordinator position is responsible for evaluating, distributing, and responding to environmental incidents which are reported to DEQ and which fall under the DWQ's areas of responsibility.

3.23.2 Design

Responsibilities for DWQ are listed under three main categories:

- Response
- Outreach
- Enforcement

Response: Most environmental incidents are reported to DEQ through the incidents hot line maintained by DERR, but a significant number are reported to DWQ directly. The Spills Coordinator evaluates these incidents as soon as they are distributed through the DERR electronic mail system and determines if a response from DWQ is warranted, or if the incident would be better addressed by a different agency.

Outreach: The Spills Coordinator also provides support and assistance to local health departments in their response to these incidents. Once an incident has been resolved or claimed by a local health department it is closed in the database. If documents are submitted to DWQ as part of this resolution they are saved electronically and referenced in the incident report.

Enforcement: The Spills Coordinator initiates enforcement action when determined to be necessary under DWQ guidelines, and also at the request of local health departments. These enforcement actions range from Letters of Violation through Notices of Violation and issuance of compliance orders. The Spills Coordinator also provides expert guidance on cleanup and mitigation of environmental hazards.

3.23.3 Core and Supplemental Indicators

Indicators are dependent on the type and source of the emergency response and include a wide range of chemical spills, wastewater leaks or harmful algal blooms. Monitoring of indicators ensures that incidents have not affected surface water beneficial uses. See Table 4 for more information.

4.0 Supplemental EPA Funding – Gold King Mine Settlement and Water Infrastructure Improvements for the National (WINN) Act Projects

On August 5th, 2020 the EPA and State of Utah signed a settlement agreement resolving the state's legal claims associated with the Gold Kind Mine release, which occurred on August 5th, 2015 in southwest Colorado.

Pursuant to the agreement, Utah dismissed its legal claims against the EPA and the United States, as well as EPA's contractors. EPA also agreed to strengthen Utah's involvement in the Agency's work to address contamination at the Bonita Peak Mining District Superfund site, which includes the Gold King Mine and other abandoned mines. EPA will continue to partner with Utah on environmental priorities, including the assessment of abandoned mine sites in Utah that may be impacting its waters as well as other projects to improve Utah's water quality.

As part of the agreement, EPA granted DEQ $3 million in CWA funds for various projects, including the development of water quality criteria for Utah Lake, septic density studies, nonpoint source pollution reduction project, and nutrient management plans for agricultural sources. EPA will also initiate Superfund assessments of several abandoned mine sites in Utah.[1] See Appendix A for more information.

In addition, DEQ has conducted several projects under the Water Infrastructure Improvements for the Nation (WIIN) Act, San Juan Watershed Program.

5.0 Reference Link Summary

- EPA – Aquatic Life Ambient Water Quality Criteria for Ammonia, 2013
  - https://www.epa.gov/sites/production/files/2015-08/documents/aquatic-life-ambient-water-quality-criteria-for-ammonia-freshwater-2013.pdf
- EPA – Aquatic Life Ambient Water Quality Criterion for Selenium, 2016
  - https://www.epa.gov/sites/production/files/2016-07/documents/aquatic_life_awqc_for_selenium_-_freshwater_2016.pdf
- EPA – Elements of a State Water Monitoring and Assessment Program
  - https://www.epa.gov/water-pollution-control-section-106-grants/elements-state-water-monitoring-and-assessment-program
- EPA – Gold King Mine Settlement
  - https://www.epa.gov/goldkingmine/gold-king-mine-settlement-agreement-utah-august-5-2020
- EPA – Integrated Reporting Guidance
  - https://www.epa.gov/tmdl/integrated-reporting-guidance-under-cwa-sections-303d-305b-and-314
- EPA – National Aquatic Resource Surveys
  - https://www.epa.gov/national-aquatic-resource-surveys
- EPA – Statute and Regulations addressing Impaired Waters and TMDLs
  - https://www.epa.gov/tmdl/statute-and-regulations-addressing-impaired-waters-and-tmdls
- EPA – Summary of the Clean Water Act
  - https://www.epa.gov/laws-regulations/summary-clean-water-act
- EPA – Urban Runoff Program
  - https://www3.epa.gov/npdes/pubs/sw_nurp_exec_summary.pdf
- Great Salt Lake Aquatic Life Use Resident Taxa Summary, 2019
  - https://documents.deq.utah.gov/legacy/destinations/g/great-salt-lake/docs/gsl-alu-taxa-summary.pdf
- USGS – National Water Quality Database
  - https://nwis.waterdata.usgs.gov/usa/nwis/qwdata
- USGS – Utah Water Science Center
  - https://www.usgs.gov/centers/ut-water/publications
- Utah Administrative Code – R317-2
  - https://rules.utah.gov/publications/utah-adm-code/
- Utah DEQ – Quality Management Plan, 2017
  - https://documents.deq.utah.gov/admin/strategic-planning/UDEQ-Quality-Management-Plan.pdf
- Utah DWQ – Great Salt Lake Data Explorer
  - https://udwq.shinyapps.io/GSL_data_explorer/
- Utah DWQ – Great Salt Lake-Developing Aquatic Life Criteria for Priority Pollutants, 2014

  - https://documents.deq.utah.gov/water-quality/standards-technical-services/gsl-website-docs/gsl-wq-strategy/DWQ-2019-000421.pdf
- Utah DWQ – Harmful Algal Blooms
  - https://deq.utah.gov/water-quality/harmful-algal-blooms-home
- Utah DWQ – Utah's Integrated Report
  - https://deq.utah.gov/water-quality/utahs-integrated-report
- Utah DWQ – Utah Integrated Report, 2010
  - https://deq.utah.gov/legacy/programs/water-quality/monitoring-reporting/assessment/docs/2010/11Nov/IR2010/Part2/Chapter1_Statewide_Overview.pdf
- Utah DWQ – Per and Polyfluoroalkyl Substances
  - https://deq.utah.gov/pollutants/per-and-polyfluoroakyl-substances-pfas
- Utah DWQ – Quality Assurance Program Plan, 2014
  - https://documents.deq.utah.gov/water-quality/monitoring-reporting/sop/DWQ-2019-001869.pdf
- Utah DWQ – San Juan Watershed Program
  - https://deq.utah.gov/water-quality/san-juan-watershed-program
- Utah DWQ – Standard Operating Procedures
  - https://deq.utah.gov/water-quality/quality-assurance-and-quality-control-program-monitoring-water-quality
- Utah DWQ – Standards Workgroup
  - https://deq.utah.gov/water-quality/standards-workgroup
- Utah DWQ – Triennial Review
  - https://deq.utah.gov/water-quality/triennial-review-water-quality
- Utah DWQ – Utah Fish Advisories
  - https://deq.utah.gov/fish-advisories/utah-fish-advisories
- Utah DWQ – Utah Implementation Guidance for the 2013 USEPA Ammonia Criteria, 2017
  - https://documents.deq.utah.gov/water-quality/standards-technical-services/DWQ-2017-002062.pdf
- Utah DWQ – Utah Lake Data Explorer
  - https://tetratech-wtr-wne.shinyapps.io/UtahLakeDataExplorer/
- Utah DWQ – Utah Lake Water Quality Study
  - https://deq.utah.gov/water-quality/utah-lake-water-quality-study
- Utah DWQ – Utah Lake Water Quality Study Stakeholder Process, 2017
  - https://documents.deq.utah.gov/water-quality/watershed-protection/utah-lake/DWQ-2017-004494.pdf
- Utah DWQ – Utah Nonpoint Source Management Program
  - https://deq.utah.gov/water-quality/utah-nonpoint-source-management-program
- Utah DWQ – Waterborne Pathogens
  - https://deq.utah.gov/water-quality/waterborne-pathogens
- Utah DWQ – Water Quality Assessment
  - https://deq.utah.gov/water-quality/water-quality-assessment-map

- Utah DWQ – Water Quality Board
  - https://deq.utah.gov/boards/utah-water-quality-board
- Utah DWQ – Watershed Management Program
  - https://deq.utah.gov/water-quality/watershed-monitoring-program/watershed-management-program
- Utah DWQ – Wetlands Program
  - https://deq.utah.gov/water-quality/wetland-monitoring-assessment-wetlands-program
- Utah Lake Model Calibration Report
  - https://documents.deq.utah.gov/water-quality/locations/utah-lake/DWQ-2020-023692.pdf
- Utah Lake Water Quality Study-Analysis Plan, 2019
  - https://documents.deq.utah.gov/water-quality/locations/utah-lake/DWQ-2020-025208.pdf
- Utah Lake Water Quality Study-Numeric Nutrient Criteria Technical Framework, 2020
  - https://documents.deq.utah.gov/water-quality/locations/utah-lake/DWQ-2020-023700.pdf
- Utah Lake Water Quality Study-Phase 2, 2019
  - https://documents.deq.utah.gov/water-quality/locations/utah-lake/DWQ-2019-001871.pdf
- Utah Lake Water Quality Study-Strategic Research Plan, 2020
  - https://documents.deq.utah.gov/water-quality/locations/utah-lake/DWQ-2020-023698.pdf
- Utah Water Quality Act – Utah Title 19-5
  - https://le.utah.gov/xcode/Title19/Chapter5/19-5.html
- Utah Wetlands Program Plan, 2018-2023
  - https://documents.deq.utah.gov/water-quality/standards-technical-services/gsl-website-docs/wetlands-program/wetland-program-plan/DWQ-2017-013741.pdf

6.0 Appendices

6.1 Appendix A: Gold King Mine Settlement Workplan