STRATEGIC MONITORING PLAN

2010-2020

Utah Division of Water Quality

DWQ's 10-year strategy for monitoring and assessing the condition of Utah's waters.

STRATEGIC MONITORING PLAN

UTAH DIVISION OF WATER QUALITY

EXECUTIVE SUMMARY

This document represents a significant revision of DWQ's water quality monitoring and assessment programs in an effort to more directly assess the status and trends of the condition of Utah's rivers, lakes and wetlands. The strategy incorporates three tiers of monitoring designed to fulfill the reporting requirements of the Clean Water Act and meet the various programmatic data needs. The first tier includes a probabilistic survey designed to report on the average conditions of water quality and the biological communities of streams, lakes and wetlands. This provides the foundation for the 305(b) report to congress on the condition of "all waters of the state" which is submitted every two years as part of the "Integrated Report". The second tier or Targeted Monitoring" is designed to collect higher frequency data to support the other main component of the Integrated Report which is the 303(d) list of impaired waterbodies. Concurrent to the Probabilistic and Targeted Monitoring are project specific Tier 3 Programmatic Monitoring activities, examples of which include monitoring for TMDL development, groundwater, nonpoint source project effectiveness, and special studies for standards development. This design was implemented in order to provide data users with the necessary data to make decisions while adhering to an adaptive and efficient system of data collection.

INTRODUCTION

The Department of Environmental Quality (DEQ) works with individuals, community groups, and businesses to safeguard human health and quality of life by protecting and enhancing the environment.

Background

Established in 1991 to protect the environment and human health, Utah's DEQ is responsible for implementing and enforcing delegated programs under the Clean Water, Safe Drinking Water, and Clean Air Act, as well as enforcing the many state environmental regulations.

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 performing remediation.

- Monitoring is performed to assess conditions, set state standards, and ensure that current health and environmental standards are met.
- Permits are issues by DEQ to limit the amounts of wastes and ensure the release pollutants for safe levels.
- And, inspections of potential pollution sources and citizen complaints are performed to ensure compliance with state and federal regulations and standards.

To accomplish the agency's environmental commitment, DEQ partners with a range of public and private entities, including: federal and state agencies, city and county governments, tribal governments, educational and community organizations, and citizens.

DEQ's Vision

A quality environment will be achieved through: careful, open, and fair consideration of the concerns of all Utahns; excellence in science, communications, and operations; timely, effective, and consistent response to all customers; and actively promoting pollutions prevention.

Division of Water Quality's Monitoring Program

Throughout the year DWQ's Monitoring Program performs comprehensive monitoring activities all over the state and conducts regular environmental assessments to determine the quality of the state's surface and ground waters and document how these water resources change through time. To guide these activities, the Division maintains and reviews a Strategic Monitoring Plan every 10 years.

> **The Division of Water Quality's (DWQ's) Monitoring Program is committed to protecting and restoring Utah's water and conducting sound, scientific water quality monitoring.**

To assess the effectiveness of the monitoring design in meeting the needs of the growing data requirements of the Division's ambient water quality monitoring programs, DWQ performed an internal survey in 2008. During the review process, three key deficiencies were identified:

- Monitoring did not adequately assess all of the waters of the state (e.g., assessments from study sites were potentially biased because the location and assessment unit divisions were incongruous with the ecological or land-use gradients).
- Monitoring required more direct irect measures of biological condition. The focus on water chemistry data over the last 20 years did not adequately assess support of aquatic life uses.
- Sampling schedules did not align with programmatic schedules and needs and resulted in reporting delays.

Following the review, it was determined that the Monitoring Program would initiate a redesign of its water resource monitoring approach. This restructuring of the Strategic Monitoring Plan would not only allow the Division to address the identified deficiencies but let the Division also improve upon its assessment process, better serve its data users, and provide a monitoring design that would better align with the program's goals and schedule.

Purpose of the Strategic Plan

The Strategic Monitoring Plan provides a blueprint for accomplishing the Monitoring Division's priorities for the next ten years. This plan presents the details of the Division's long-term objectives and outlines the respective monitoring strategy elements for the seven programs with in the Division.

The purpose of the long-term monitoring strategy is threefold:

- It allows Utah to identify its major state water monitoring program elements
- Provides a framework for Utah to articulate its programmatic and resource needs to accomplish its identified state water monitoring program elements
- Presents a fundamental approach for Utah to better meet its environmental assessment, reporting, and programmatic needs.

It should be noted that this strategic plan and its objectives are specific to the Division's Monitoring Program and not intended to substitute for, or summarize, the guidance documents produced and utilized by DWQ's Water Quality Management Section for assessment purposes. Additionally, the implementation plans described throughout this plan are dependent on the availability of the resources and technical support that are described throughout the Strategic Plan.

Structure of the Strategic Plan

In an adaptive monitoring program, monitoring continues to iteratively improve the knowledge base of management, so decision making is based on the best science available (Ringold et al., 1996). As more information becomes available, the scientific uncertainty about the ecosystem is reduced, and initial actions and management decisions are revisited and refined (Figure 1).

To integrate the various programmatic data needs within the Division, DWQ will employ a tiered approach to its annual monitoring plans, which will allow for an efficient and adaptive Monitoring Program.

The proposed tiered adaptive monitoring framework for DWQ's Strategic Plan will allow the Division to develop robust data sets in one tier that will inform the data collection in subsequent tiers (Figure X). During the monitoring evaluation process (e.g., the annual monitoring plans, which are described in section "XXX") the information that is gathered will provide the staff with critical input on how to adjust the next round of monitoring in the three tiers that are proposed below.

- **Tier1 - Probabilistic Surveys:** Designed to meet the reporting requirements of the Clean Water Act's 305(b), tier 1 surveys will assess all waters of the state by randomly selecting and monitoring different water bodies within one of the ten major watersheds in Utah (see Figure X and Table X for the proposed rotating basin schedule over the next ten years). The information collected from the environmental surveys will be used to: (1) assess the attainment of various designated uses (e.g., aquatic life and contact recreational uses) and (2) better understand the significant causes of pollution throughout Utah.

- **Tier 2 - Targeted Monitoring:** Environmental surveys within this tier will be performed annually to develop the 303(d) impairment status reports that are required by the EPA. Using the water quality concerns that are highlighted during monitoring efforts in Tier 1as a guide, site-specific monitoring plans in Tier 2 will be developed to assess the biological and chemical conditions of a specific stream (Figure 1). These more intensive surveys will allow managers to more fully understand the scope and extent of water quality problems within the state.

- **Tier 3 - Programmatic Monitoring:** The data derived from routine water chemistry monitoring efforts in tier 3 will be to used to meet the programmatic needs of the Division, including Total Maximum Daily Load (TMDL), evaluation of NonPoint Source (NPS) project effectiveness, development or refinement of numeric water quality criteria, and a variety of compliance monitoring programs.

Elements

Within each monitoring tier several key elements are addressed for each water body type. The inclusions of these key elements are required by the EPA to ensure compliance with CWA requirements and are discussed in the EPA's national Guidance document, Water Quality Monitoring and Assessment Strategy. In this 10-year strategic monitoring plan, these elements are briefly described below, with short discussions of tier and monitoring program specific constraints.

For each water body type several key elements will be discussed:

- **Monitoring Design and Objectives**
- **Core and Supplemental indicators**
- **Data Analysis and Assessment**
- **Reporting**
- **Programmatic evaluations**
- **General Support and Infrastructure Planning**

Monitoring Objectives

This section describes the monitoring objectives for the Probabilistic Surveys and Targeted and Programmatic Monitoring sections for the proposed 10-year strategic monitoring design. At the beginning of each section the monitoring objectives are described; these objectives are based on DWQ's priorities and initiatives and are subject to change.

Monitoring Design

There are three basic monitoring designs employed in this strategic monitoring plan: (1) a probabilistic based approach, (2) a targeted monitoring approach, and (3) a programmatic monitoring approach.

The Monitoring Design section summarizes the:

- Approaches for each of the three tiers as they relate to monitoring objectives
- Specific monitoring activities that are performed within each tier

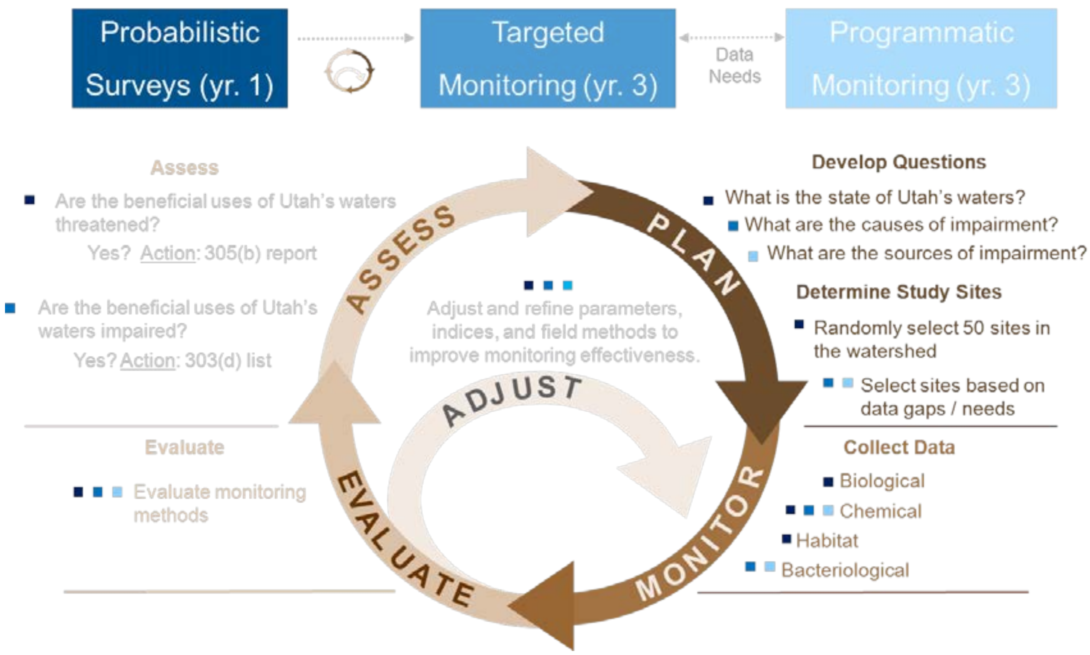


Figure 1 illustrates the relationship between the three tiers and the critical steps required for the assessment and reporting process.

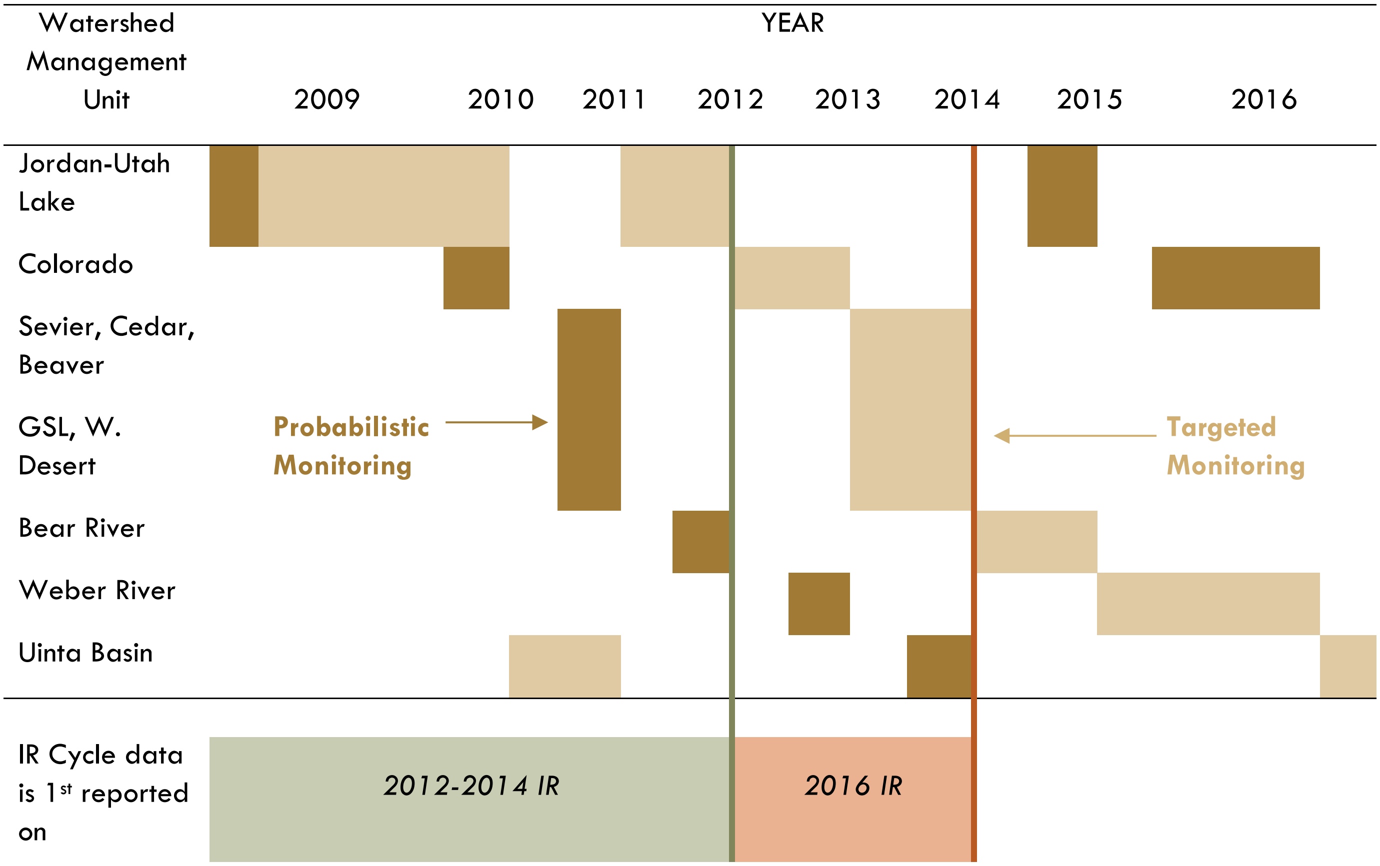
Rotating Basin Approach

DEQ developed the 6-year rotating basin monitoring schedule to ensure:

- Staff has sufficient data to determine if a water body is impaired
- DWQ can work towards its goal of assessing all 12,000 miles of wade able rivers and streams and approximately 1.47 M acres of lakes and reservoirs in the State.

By focusing the Division's monitoring efforts on a couple of river basins each year (versus the whole State), DWQ is able to concentrate its monitoring efforts on a smaller geographical area and collect more water quality samples from numerous water bodies within a watershed management unit during a single sampling season. Using this rotating sampling structure allows DWQ staff to make more accurate assessments and informed 303(d) listing decisions by having a more robust dataset to work with.

As noted in Table 1, integrating the proposed tiered monitoring approach into current Division and programmatic needs and constraints will require the Targeted and Programmatic monitoring efforts to follow the Probabilistic Surveys after ~2 years and will focus on ongoing TMDL needs around the State until the initial round of Probabilistic surveys are assessed .



A main reason for this approach is to allow for the taxonomic identification of biological samples collected in the Probabilistic Survey and analysis of those samples to identify water quality stressors to be collected during Targeted Monitoring activities. It is anticipated that it will take several years before the DWQ can fully comply with the rotating schedule in Table 1; until that time DWQ staff will focus on their most critical data needs.

Additional Reporting

While the rotating basin approach will be maintained each year, additional data collection for special studies or assessment purposes statewide may be integrated into annual plans.

Annual Monitoring Plans

Beginning in the spring of 2010, DWQ will develop and publish individual Annual Monitoring Plans. These plans will:

- Incorporate collection activities under all three tiers of the monitoring strategy (including cooperative and volunteer monitoring where available)
- Detail the implementation of the monitoring design of the program
- More directly address the data requirements of the individual monitoring programs in a flexible manner

Although the exact format has yet to be determined, these plans will be published on the DWQ website for comment from the general public and cooperative agencies.

Updates to Strategic Monitoring Plan

Most monitoring changes discussed in this document are broad, long-terms goals that will require a number of incremental steps to fully implement. This Strategic Monitoring Plan identifies many areas where exiting programs can be expanded or improved. Some of these programs will likely be more successful than others in achieving desired environmental benefits. Hence, periodic reviews of all monitoring programs will be performed to evaluate the efficacy of new or expanded programs as they are implemented. At a minimum, DWQ will conduct a review of all monitoring programs every 5 years (see Appendix 1 for the implementation schedule).

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 the reprioritization of monitoring goals, and the unforeseen logistical barriers, which can develop as new monitoring programs are initiated.

DWQ will respond to the changing monitoring needs in two ways:

- Short-term changes in monitoring requirements will be addressed yearly in DWQ's Annual Monitoring Plan
- Long-term changes in monitoring requirements will be addressed by conducting an overarching review of all of the monitoring activities every five years, which will culminate in revisions to this Strategic Monitoring Plan.

Core and Supplemental Indicators

The section on Core and Supplemental Indicators provides details on the biological and chemical parameters that are used to assess the support of DWQ's designated uses (e.g., domestic sources, recreation, aquatic life, and agricultural).

Where applicable, each section of this document includes a summary of the available indicators that are assessed. For example, both core and supplemental indicators are discussed as part of the probabilistic assessment. This allows DWQ to make more general statements on the conditions of all of Utah's surface waters to fully meet 305(b) requirements and inform the targeted monitoring efforts of tier 2 on potential problem areas and parameters of concern. In the targeted 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.

Quality Assurance

Quality assurance and quality control (QA/QC) is a critical component of every monitoring program. QA/QC requirements for the Division's monitoring activities are covered primarily in three types of documentation:

- The Division Quality Assurance Program Plan (QAPP),
- Project-specific Sampling and Analysis Plans (SAPs), and
- Standard Operating Procedures (SOPs).

The QAPP documents how quality assurance and quality control are applied to environmental data operations within DWQ to ensure that the results obtained are of known and suitable quality and quantity needed to meet the Division's goals and objectives. As required by DEQ's newly-drafted Quality Management Plan, the QAPP is undergoing a major revision in 2011-2012 and will 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 as they are implemented.

Under the revised QAPP, each individual monitoring program/project, starting in 2012, must have a SAP that describes the details specific to each planned monitoring activity. SAPs will also be reviewed each year for accuracy and applicability. SAPs are reviewed and approved within DWQ and do not require approval from the Quality Assurance Council.

To reduce uncertainty in the measurement data DWQ requires that all data is collected and processed according to the appropriate Standard Operating Procedure (SOP) by well-trained staff. DWQ also requires that all samples are analyzed by qualified and competent laboratories. These SOPs are reviewed and approved within DWQ on an annual basis.

Data Management

For any organization handling large amounts of environmental data, data management is an ongoing challenge. Currently, there is a nationwide shift toward the standardization of data storage, nodes, and data flows from states to the EPA and the Central Data eXchange (CDX). The Water Quality eXchange (WQX) component of the national network will replace DWQ's existing data storage and data serving technology.

For More Information:
Since the WQX database will be the primary data storage and management tool for all programs at DWQ, a discussion of the existing and future direction of these tools are provided in a stand alone chapter, as opposed to in a description of the data management element for each monitoring program.

Data Analysis and Assessment

In the data analysis and assessment sections of this document, brief general summaries of the analytical methods are provided for each of the monitoring programs. In programs where the specific methods and analyses are adaptive or evolving or addressed in greater detail in documents from DWQ's assessment and data analysis programs (e.g., the Water Quality Management and TMDL programs), the corresponding documents are cited [e.g., the Integrated Report's (IR) Methods for Assessing and Reporting the Condition of Lakes and Streams].

Reporting

For every monitoring program described within the three tiers of 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 (see Table 2 for a summary of the reporting requirements for various monitoring programs in DWQ).

In addition to programmatic reporting, DWQ also writes a comprehensive monitoring report every two years to the EPA [e.g., the Integrated Report (IR)]. As noted in Table X, 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 Assessment Data Base (ADB) – a database that is used for tracking water quality assessment data.

Programmatic Evaluation

Each monitoring program within this strategy contains a section that describes, where warranted, a summary of the areas of improvement or expansions of existing programs to meet ongoing data needs. These programmatic evaluations will be identified in the implementation schedule in Appendix 1. Overall, the current strategy is structured to allow for an evaluation of immediate data requirements to meet the fundamental reporting elements of the IR and provide an adaptive approach for developing annual monitoring plans. For example, the tiered approach to monitoring allows for the evaluation of data collected in the Probabilistic survey to inform the design of the Targeted Monitoring in a watershed. By evaluating the biological conditions, specific stressors can be identified and integrated into a more intensive, water quality monitoring plan for the target watershed/waterbody of interest. In addition, the planning process allows for the integration of program specific monitoring or special studies to answer questions regarding the nature and extent of potential impairments. These aspects are described in greater detail in the individual Tiers of the strategy.

General Support and Infrastructure Planning

This section summarizes the current monitoring and possible future monitoring for each of DWQ's monitoring programs. The funding estimates for each program are based on historic resource allocations which provide the basis for projected estimates for future monitoring activities. Beginning in 2009, considerable changes will be made to the historic monitoring program as DWQ implements the elements of the proposed monitoring design. The estimates provided here represent the cost of individual program activities based on the historic monitoring program, although every effort was made to project actual cost associated with implementing the proposed strategy. Implementation schedules are identified in Appendix A; however, these goals are subject to change when based on changes to programmatic priorities and available resources. The implementation of any new type of monitoring will depend upon 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.

TIER1: PROBABILISTIC SURVEYS

MONITORING OBJECTIVES

Section 305(b) of the Clean Water Act requires states to report biennially on the attainment of water quality standards on all waters of the State. DWQ will perform this reporting requirement through probabilistic surveys – an approach that will allow DWQ to make statistical inferences on the condition of all water bodies based on a set of randomly selected and assessed sites in a target population of rivers, lakes and wetlands. The information gained from these surveys will not only describe the status of the water bodies in the State, but also guide future targeted monitoring efforts in those basins. The main objectives of this initial tier are:

Objective 1: Assess the biological, chemical, and physical integrity of all waters throughout Utah and determine attainment status on a 6-year rotating basin schedule.

Objective2: Compare chemical, physical, and biological measures of water quality to identify human-caused stressors most likely to affect designated aquatic life uses. ☐

Probabilistic Surveys of streams, lakes, and wetlands ensure that DWQ meets the fundamental goal of the 305(b) report to Congress on the status of all waters of our state.

MONITORING DESIGN

To achieve the two objectives for this tier, the probabilistic assessments will be performed on a rotating basin schedule once every 6 years (see Table 1). Coordinating with EPA staff, DWQ and the EPA will use a spatially-balanced survey design [e.g., Generalized Random Tessellation Stratified (GRTS)] (REF>) to determine the 50 study site locations that DWQ will visit in each rotating basin. Since mountainous watersheds contain a large proportion of stream miles of headwater streams compared to lower order valley streams or rivers, the GRTS survey design ensures that all types of waterbodies are appropriately weighted within a waterbody and selected for the survey.

A key feature of the Probabilistic Survey is a statistically valid sub-sampling of waterbodies within a watershed to perform assessments and status reports.

Within each study area biological, chemical, and physical samples will be collected in the fall with additional chemical monitoring efforts continuing throughout the year to capture seasonal variability. Both reference (e.g., sites absent of human-caused disturbances) and non-reference sites are sampled, so DWQ staff can then later merge the data sets to develop biological integrity metrics specific to Utah.

A full discussion of these assessment protocols are presented in the biennial Integrated Report's Part 1: Methods for Assessing and Reporting the Condition of Lakes and Streams (REF).

Wetland and Lake Surveys

Similar reference site development for wetlands and lakes is still in the planning process. In 2012, DWQ will implement a survey for lakes in conjunction with the National Lakes Assessment coordinated by EPA. This will involve sampling an additional 24 lakes to augment the lakes selected by EPA for their national survey. Similar to the UCASE program for streams the lake survey will include the collection of chemical, physical and biological data from the selected lakes. This will provide DWQ assessment staff with dataset adequate to assess the condition of all lakes and identify potential stressors and impairments.

DWQ has also developed a Multi-Metric Index (MMI) for impounded wetlands adjacent to the Great Salt Lake. Developed for a sub-set of wetland areas across a gradient of conditions, this MMI includes important measures of wetland condition, which have demonstrated potential for application to a Probabilistic Survey of all impounded wetlands planned for the summer and fall of 2012.

CORE AND SUPPLEMENTAL INDICATORS

For years, DWQ has assessed biological beneficial use attainment with only water chemistry standards assumed to be protective of stream biota. However, this 10-year strategy marks a shift 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. To aid in these judgment decisions, DWQ staff refers to the framework in the EPA's Consolidated Assessment and Listing Methodology (CALM) guidance when evaluating the years of data for the biological, chemical, and physical core and supplemental indicators summarized in Table X.

The probabilistic survey emphasizes direct measures of aquatic life support (macroinvertebrates, diatoms and fish) in combination with habitat and water quality measures.

All sites identified within the probabilistic assessment survey will be assessed for the core and supplemental indicators in Table 2 (though individual site monitoring may vary depending on site conditions and watershed characteristics).

	Beneficial Use Assessment Categories				
	Aquatic Life & Wildlife	**Recreation**	**Drinking Water**	**Fish / Shellfish Consumption**	**Agriculture**
Core Indicators	Dissolved oxygen	Pathogen Indicators (E. coli)	Trace metals	Waterfowl and fish consumption advisories	Trace metals
	Temperature	pH	Pathogens	---	Total dissolved solids
	pH	---	pH	---	pH
	Trace metals	---	Nitrates	---	Gross alpha
	Condition of benthic macroinvertebrates community	---	---	---	---
	Periphyton	---	---	---	---

	Fish	---	---	---	---
Supplemental Indicators	Sediment	---	---	---	---
	Nutrients (N, P)	---	---	---	---
	Habitat assessment	---	---	---	---

Table 2. Core and Supplemental Indicators

DATA ANALYSIS AND ASSESSMENT

Beginning in the 2011, DWQ will incorporate probabilistic 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 from the sample frame used for the random draw. The selection of 50 sites within each watershed will provide ~90% confidence (+/- 5%) that the summarized water quality characteristics are reflective of the average conditions of all waters in the watershed. Once all watersheds are sampled, the data will be combined to provide highly precise statewide estimates of water quality characteristics.

The data analyses from probabilistic monitoring efforts focus on direct measures of biological uses and on recreation indicators. Also, chemistry and habitat data collected in these 50 random site surveys 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 (see Tier 2 for more details). Additionally, examining the data on the distribution of stressors will also help guide the development of specific monitoring plans for threatened waterbodies.

Utah's biological beneficial uses require the protection of fish and the organisms upon which they depend. DWQ must, therefore, assess this beneficial use via sampling.

Biological Data Assessment

Because Utah does not currently have numeric biological criteria, model outputs are used to guide assessments under the narrative standards of the Utah Clean Water Act (R317-2). To quantify the biological integrity in Utah DWQ currently employs the RIVPACS (River Invertebrate Prediction and Classification System) model approach – a method that classifies freshwater sites based on macroinvertebrate fauna. To quantify biological conditions, a RIVPACS model compares the list of taxa (the lowest practical taxonomic resolution to which taxonomic groups are identified) that are observed (O) at a site to the list of taxa expected (E) in the absence of human-caused stress (e.g., a reference site collection). In practice, these data are expressed as the ratio O/E or the index of biological integrity.

In essence, O/E quantifies the loss of biodiversity and is easily interpreted as it simply represents the extent to which taxa have become locally extinct as a result of human activities. For example, an O/E ratio of 0.70 implies that, on average, 30% of the taxa have become locally extinct as a result of human-caused alterations to the stream (see Figure 2).

Figure 2. A hypothetical example of O/E in different natural environments using numbers from macroinvertebrate taxa. In the desert, 7 taxa were observed (O) from an expected number of 10 taxa (E). Thus, the O/E score was 0.70 *or* a loss of 30% of the taxa expected at the site.

To make the narrative assessments as rigorous as possible, a systematic procedure was devised to use the RIVPACS model O/E values to determine aquatic life beneficial use support (see Figure X). As noted in Figure X the goal of this assessment process is to characterize each area being evaluated as "fully supporting" or "not supporting" its aquatic life beneficial uses based on chemical and biological data.

To utilize this assessment process, however, requires determining: How should O/E scores be developed for assessment areas with variable sample sizes?

Currently, DWQ determines the sample strength required for determining an O/E threshold by assessing watersheds based on established Assessment Units (AUs). AUs are watershed areas or reaches which are defined by their geographical extent and related designated uses and water quality standards. While many AUs contain a single biological collection site, some AUs contain multiple sites. For these assessments, DWQ requires at least 3 yearly samples. Because O/E scores can vary from year-to-year assessments are based on average conditions. Assessments based on the average condition of ≥3 samples reduces the possibility of making an error of biological beneficial use support as a result of an unusual sampling event (i.e., following a flash flood, improperly preserved sample).

To translate the O/E values into assessment categories requires devising a method for determining impairment thresholds, or O/E scores that indicate whether or not a site is meeting biological beneficial uses. DWQ currently uses statistical methods to calculate conservative thresholds as outlined by Lester Yuan (EPA, pers. Comm.). Details of these methods are outlined in the IR's Methods for Assessing and Reporting the Condition of Lakes and Streams, and the calculated E/O thresholds are summarized in Table 3.

Sample Size	O/E Threshold	Use Determination	Comments
≥ 3 samples collected over 3 years	Mean O/E score ≥ 0.83	Fully Supporting	Threshold based on 10% Type 1 error rate (10th Percentile)
≥ 3 samples collected over 3 years	Mean O/E score < 0.83	Not supporting	Threshold based on 10% Type 1 error rate (10th Percentile)
< 3 samples	Mean O/E score ≥0.78 – 0.83	Insufficient data	Lower Threshold based on 5% Type 1 error rate (5th Percentile)
< 3 samples	Mean O/E score <0.78	Not supporting	Threshold based on 5% Type 1 error rate (5th Percentile)

Table 3. Beneficial use support determination for O/E values obtained from different sample sizes (DWQ's Integrated Report, 2010).

REPORTING

The reports based on the data collected through the Probabilistic Survey tier will provide the basis for the 305(b) component of the IR and will fulfill the reporting requirements for assessing all waters of the state. However, since the probabilistic assessment occurs on a rotating basin schedule, accomplishing this goal for the entire state will occur over multiple reporting cycles. The IR will be compiled as data is made available and submitted every two years using the Assessment DataBase (ADB) system.

This database will be provided to the EPA and published reports of the assessments included in the IR will be made available to the public through published print materials, factsheet summaries and via the web on the Divisions website. Full details of required elements for the 305(b) and 303(d) reports are available in the Integrated Report (REF).

PROGRAMMATIC EVALUATION

Although the Probabilistic Survey assessment is a new element to DWQ's monitoring program, the Tier 1 type of surveys have been adopted for immediate implementation. However, given the newness of the assessment program there are several proposed enhancements that have been identified and are summarized below:

Extend Index Period

Currently, tools and models for biological assessments are based on an autumn index period (usually September through early November). In order to accommodate the additional probabilistic assessment and other biological data collection, DWQ will extend this index period into the summer months. While this change is driven to some extent by resource limitations, it will also allow staff to test existing models and tools for performance during other seasons of the year.

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 the Division's assessment methods to include diatoms and potentially fish. DWQ has been collecting fish and diatom data for the past few 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 (see Appendix 1 for implementation strategy).

Development of Stressor-specific Diagnostic Tools

The ability to assess overall biological condition is only the fist step; ideally biological data can also be used to ascertain the most likely stressors involved in the degradation of biological conditions. DWQ biologists 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.

Improve Collection of Algae for Chlorophyll a Analysis

As part of the ongoing development of nutrient criteria for rivers and streams, DWQ is integrating improved qualitative and quantitative measures of algae growth into its UCASE monitoring methods and probabilistic surveys. Qualitative improvements currently under evaluation as part of the surveys include the evaluation of the extent and potential for filamentous algae colonization in the physical habitat assessment. These measures will provide additional information on a site's trophic status as well as its susceptibility to nutrient enrichment.

In addition, DWQ is evaluating alternative methods for measuring chlorophyll a than those originally included in EMAP. The intention is to better and more accurately capture the coverage of algae (particularly filamentous algae) by removing sampling bias and variability. Several techniques are currently under evaluation, but the intent of this modification is to provide more accurate data for integration in the nutrient criteria assessment process which includes algae coverage as a component of nutrient impairment.

TIER 2: TARGETED MONITORING

MONITORING OBJECTIVES

A main focus of the Tier 2: Targeted Monitoring approach is to support the submission of biennial IRs to the EPA, which detail the attainment of water quality standards. As previously discussed in Chapter 1 of this strategic monitoring plan, the IR will include the 305(b) report derived from the probabilistic survey (Tier 1) and the 303(d) list of waterbodies requiring the development of Total Maximum Daily Loads (TMDLs; Tier 2).

Under the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters.

A Total Maximum Daily Load, or TMDL, is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards.

Following the rotating basin approach outlined in the Introduction of this document, the targeted data collection of Tier 2 will be guided by and, in turn, complement the initial survey datasets in Tier 1. For example, the data collected in Tier 1 will inform DWQ staff on the streams that may not be meeting the designated uses and identify the reasons for the possible causes of impairment. This analysis will allow DWQ staff to efficiently design sampling plans in Tier 2 that are specific to the watershed and associated parameters of concern. These sampling efforts in Tier 2 will then:

Objective 1: Provide chemical and biological data for assessment, stressor identification, and prioritization of waterbodies.

Objective 2: Provide extensive assessments of the chemical and biological integrity of all waters not meeting designated uses in Utah's major watersheds on a 6 year rotation.

Objective 3: Detail the status of the waters of the state (including a list of the waterbodies requiring TMDLs) every two years in the Integrated Report.

MONITORING DESIGN

As outlined in the rotating basin schedule in Table X, the targeted assessment monitoring will occur 1-2 years following the initial rotating probabilistic survey schedule. This anticipated lag in supplemental monitoring is due to the lab analysis of the probabilistic survey data (e.g., diatoms and macroinvertebrates), which will be used to design the targeted monitoring in each of the six assessment basins.

Guided by the data collected in Tier 1, Tier 2 monitoring will collect biological and chemical samples 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)

Specifics on the biological and chemical data that will be collected in Utah's rivers and streams and lakes and reservoirs are discussed below.

Biological Assessment Monitoring

As previously discussed in Tier 1, 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.

Reminder! 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 currently developing 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 the targeted biological monitoring efforts of Tier 2 is to further identify and incorporate reference sites samples into the assessment work of Tier 1.

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 Standard Operating Procedures (SOPs; see Appendix X). To further support the modeling work of Tier 1 and to better understand the range of naturally occurring conditions in Utah's streams, DWQ will collect data at 5-15 hand-picked reference stations each year. Of these selected sites, some will be:

- New locations to help fill data gaps, and/or
- Previously sampled reference stations to identify if shifts in biological conditions have occurred.

Every 3-5 years, DWQ will complete a reference site status report that summarizes the reference monitoring efforts (see the "Reporting" section of this chapter for more details); details on the potential enhancements for this monitoring program are outlined in the "Programmatic Evaluation" section of this chapter.

Why sample bugs?

Measuring biological communities directly has the advantage that it integrates the combined effects of all pollutants, which allows a direct examination of how pollutants are interacting to affect the condition of a stream ecosystem (Karr, 1981). Moreover, because aquatic macroinvertebrates spend the majority of their life in aqueous environments, they are cpable of integrating the effects of stressors over time, providing a measure of the past, transient conditions (Karr and Dudley, 1981).

Chemical Assessment Monitoring

Though water chemistry is an integral part of each of the three tiers of the proposed monitoring design, the main use of chemistry data within the "Targeted Monitoring " tier is to support the development of the IR for streams and rivers (targeted lake monitoring is discussed further below).

Rivers and Stream Monitoring

Using the data from the probabilistic assessment from Tier 1, the stressors and potential problem areas in Utah's streams and rivers are identified and flagged for further data collection in the targeted assessment monitoring tier. From this first level of analysis, an intensive data collection plan is designed to evaluate pollution sources, causes, and loadings in order to develop the 303(d) list of waterbodies, which requires the development of TMDLs.

As part of the planning process for data collection in Tier 2, stream and river sample site locations and chemical parameters are specifically selected to meet the assessment data needs (versus focusing on employing a network of static monitoring locations and suites of chemical parameters). As outlined in Table X, the selected sites for targeted monitoring are sampled once every 6 years in each basin 1-2 years following the probabilistic survey.

To ensure consistency between the measures of biological condition with water chemistry data at watershed or reach scales, chemical monitoring efforts follow the general framework summarized in the "Core and Supplemental Indicators" section of this chapter.

While aquatic life uses will be primarily assessed with targeted biological data collection, it will be necessary to monitor for toxic substances such as metals, organics, and other pollutants with established water quality criteria. In addition, assessment data for agricultural uses such as TDS and boron will continue to be collected during intensive cycles. However, instead of arbitrarily monitoring for these and other constituents at all sites, a thorough review of the voluminous data collected over the last 30 years will be performed in order to identify areas and parameters of potential concern and to make efficient use of limited laboratory resources.

Lake Monitoring

DWQ currently monitors 132 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 (see Table X). 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 [How do we know they are impaired?]. This approach allows DWQ staff to focus monitoring efforts on those waters with the greatest concerns.

During the summer when temperature and DO conditions are the primary limiting factors for fish assemblages, DWQ collects samples from the lakes of concern. A complete list of the targeted parameters are provided in the "Core and Supplemental Indicators" section of this chapter. Additional monitoring activities also includes collecting at least one E. coli sample at the shoreline most frequently used for recreation. This is done to better target the necessary data for 305(b) and 303(d) assessments and to provide data for the preparation of TMDL assessments.

Impairment Identification Monitoring

As DWQ continues to move towards a more long-term monitoring and assessment strategy for recreational beneficial use support, the Division has recently implemented bacteriological monitoring as a pilot study program. Developed to help identify and target priority waterbodies for monitoring and assessment purposes, the monitoring procedures are tiered (Figure X). This allows the initial sampling efforts of tier 1 to be less spatially and temporally intensive but also help DWQ identify potential problems, so staff can follow up with more intensive monitoring (tier 2) at locations where the data suggests that recreational uses are more likely threatened.

To identify sampling sites DWQ classifies existing sample locations as either priority or non-priority based on the extent and nature of site-specific recreation. Priority sites will be sampled preferentially when monitoring resources require E. coli sampling to be scaled back. DWQ identified priority rivers and streams as those that are not in support of recreation beneficial uses based on existing data. For lakes and reservoirs DWQ identified priority locations as those that are either protected for primary contact recreation beneficial uses or those identified by recreation managers as highly popular areas of recreation. For any of the aforementioned waterbodies, additional priority sites can be established when areas are frequently recreated and have E. coli concentrations that are high enough to present a concern.

Why sample E. coli?

DWQ measures E. coli to assess recreational use support because the presence of E. coli in water is a strong indication of recent sewage or animal waste contamination and may include sources from grazing pasture, confined feedlots, wildlife, or dog parks. When these waters are used as source waters for drinking and not treated properly or used for primary contact recreation, they can pose a threat to human health.

CORE AND SUPPLEMENTAL INDICATORS

While probabilistic assessments will focus on biological measures, 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. The proposed core and supplemental indicators for Utah's targeted monitoring program are presented in Table 4 and represent a summary of the available indicators; individual site monitoring may vary depending on the site conditions and watershed characteristics.

Table 4. Core and Supplemental Indicators					
Stream and River Assessment					
Beneficial Use Assessment Categories					
Indicators	Aquatic Life & Wildlife	Recreation	Drinking Water	Fish / Shellfish Consumption	Agriculture
Core Indicators	Dissolved oxygen	Pathogen Indicators (E. coli)	Trace metals	Waterfowl and fish consumption advisories	Trace metals
	Temperature	pH	Pathogens		Total dissolved solids
	pH		pH		pH
	Trace metals		Nitrates		Gross alpha
	Condition of benthic macroinvertebrates community				
	Periphyton				
	Fish				
Supplemental Indicators	Sediment				
	Nutrients (N, P)				
	Habitat assessment				

Table 4. Core and Supplemental Indicators					
Lake Assessment					
Beneficial Use Assessment Categories					
Indicators	Aquatic Life & Wildlife	Recreation	Drinking Water	Fish / Shellfish Consumption	Agriculture
Core Indicators	Dissolved oxygen	Pathogen Indicators (E. coli)	Trace metals	Waterfowl and fish consumption advisories	Trace metals
	Temperature	pH	Pathogens		Total dissolved solids
	pH		pH		pH
	Trace metals		Nitrates		Gross alpha
	Eutrophic condition (Chlorophyll a, Secchi depth)				
Supplemental Indicators	Fish kills				
	Composition of algal community (green, blue-greens, etc)				
	Trend Analysis				

DATA ANALYSIS AND ASSESSMENT

Biological Data Assessment

The analysis for targeted sites and the assessment information derived from the data are intended to determine the impairment status of individual stream reaches. Using the RIVPACs model approach, biological data will be evaluated and O/E scores generated for aquatic use support and stressor identification in concert with water chemistry data. Data analysis will be performed in accordance with the RIVPACs model outlined in the probabilistic survey tier (Chapter 2). Please refer to that chapter for additional detail.

O/E quantifies a loss of biodiversity. For example, an O/E/ ratio of 0.70 implies that, on average, 30% of the taxa have become locally extinct as a result of human-caused alterations to the stream.

Streams and Rivers- Chemical Data

The main approach to assessing data and determining impairment status has focused on attainment of water quality criteria set forth in 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.

Lakes

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 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. Current methodology requires an exceedance of the indicators for two consecutive monitoring cycles prior to changing the listing status of a lake. The IR contains detailed information on the assessment methods used for listing determination. These methods have resulted in the erroneous listing of some lakes and are currently under review.

Measurements of total phosphorus, Secchi transparency and Chl 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 we also collect phytoplankton samples 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, this data is used as additional evidence for performing the 305(b) assessments. More complete characterization of the phytoplankton community including diatoms is anticipated for future monitoring efforts.

TSI quality indicators are compared across years to examine long-term trends in the productivity of Utah's lakes and reservoirs.

Long-term trend analysis of limnological conditions is accomplished primarily by tracking the TSI. The TSI is a composite measure of three important measures of productivity of lakes, total P, Chl a, and Secchi transparency. Currently lakes and reservoirs are sampled relatively infrequently (once every two years) until they are determined to be impaired. Once impairment is identified, the 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. Once lakes and reservoirs with increasing trophic status are identified, DWQ would increase monitoring at these locations to better understand why water quality is degrading and how best to prevent the sites from becoming impaired.

Over the last decade, DWQ has spent approximately $400,000 on TMDL efforts at reservoirs that were later identified as not being impaired because pollutant loads were from natural sources, or where the primary cause of impairment was water management. Obviously, these funds would be better directed where they are needed to correct water quality problems. DWQ proposes a thorough and objective examination of the water quality standards, assessment methods, and monitoring activities that we currently employ at Utah's reservoirs. In particular, DWQ is interested in pursuing the concept of a 'habitat zone' that establishes a minimum amount of habitat with suitable DO and temperature that is needed to maintain fish populations. These studies will also address the extent to which a single 'habitat zone' is appropriate for all reservoirs or whether we need to stratify reservoirs and apply different methods to account for natural and human-caused environmental gradients.

E. coli Assessment

Utah has two recreational beneficial use categories (Class 2, DEQ Rule 317-2. Standards of Quality for Waters of the State) and waterbodies are either protected for primary contact recreation such as swimming

(2A) or for secondary contact recreation such as boating or wading (2B). Table 5 summarizes the assessment criteria for identifying impairment. .

Table 5 . Recreational use support criteria		
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

[edit this for the table caption]: Note the incorporation of geometric mean which provides a better representation of the extent of E. coli contamination since it captures the temporal variability of E. coli concentrations and better represents overall site conditions than a single sample. The main use of single event sampling will be for screening purposes to identify areas requiring intensive monitoring for the development of geometric means. Due to the data intensive nature of E. coli assessments, DWQ is evaluating the applicability of generating a season-wide geometric mean, incorporating 5 samples within the summer season to determine if uses are being met.

REPORTING

The primary reporting function supported by the targeted monitoring tier 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 Assessment Database tools and published as part of the IR for public review and input.

Every 3-5 years, DWQ will complete a reference site status report that summarizes the reference monitoring efforts.

PROGRAMMATIC EVALUATION

Targeted monitoring will be characterized by an adaptive approach based on prior examinations of the probabilistic survey data and other available data. The details of the specific field collection will be made explicit in Annual Monitoring Plans. While probabilistic assessments focus on rivers and streams for attainment of fishable/swimmable uses, the targeted approach will amend data sets for source identification, fill data gaps, develop and supplement TMDL datasets and provide focus on additional waterbodie, such as lakes and assessment data for agricultural uses. Initially, targeted data collection will be designed to complement probabilistic surveys and provide additional information for establishing 303(d) lists for waterbodies requiring the development of TMDLs and ultimately, the formation of meaningful and timely datasets to meet TMDL schedules.

Determining Water Quality Status and Trends

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 (see Nonpoint Source Monitoring Program below). Established at key locations in a watershed network, the installation of long-term continuous monitoring stations could provide the data resolution necessary for trend analysis. Although probe 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 incorporating data collected through the UCASE monitoring program.

Reference Site Classification

DWQ will examine methods to classify reference streams into similar groups so that the range of expected conditions can be readily established for all streams around Utah. The range of physical habitat measures, chemical constituents, and biological communities within each group will be identified to help DWQ better grasp naturally occurring conditions for all 'types' of streams in Utah. This classification process will allow DWQ to identify regions where additional reference data is needed. At present DWQ has established a goal of a minimum of 15-20 reference stations per major group.

Development of Biological Indicators of Lake Water Quality

TSI and algal composition both quantify potentially adverse consequences of nutrient enrichment in lake and reservoir ecosystems, which is among the principle threats to lentic biota. However, direct measures of biotic integrity based on the condition of lentic biota would provide a more comprehensive measure of lake and reservoir conditions. In 2007 DWQ participated in a project aimed at assessing the condition of lakes and reservoirs throughout the USA. Data collected in conjunction with this project included a myriad of indicators that could potentially be used to augment lake and reservoir assessments. Once data from this project are vetted, DWQ will evaluate lake and reservoir monitoring procedures to determine how future lake and reservoir monitoring efforts could be improved to provide more comprehensive measures of beneficial use support.

DWQ is planning to enhance our monitoring of algal communities in lakes and reservoirs. In addition to integrating “habitat zones” into assessment, we will soon add the identification and characterization of diatoms in the phytoplankton community. Shifts in diatom abundance (increasing or decreasing numbers of diatoms as well as relative abundance among indicator species of diatoms) may provide more accurate assessment information as well and information about water quality trends

TIER 3: PROGRAMMATIC MONITORING

The third tier of water quality monitoring will also follow an adaptive strategy based on information derived from other tiers. Each year, individual program managers and coordinators will evaluate their monitoring priorities for compilation into the Annual Monitoring Plan. Monitoring under this tier will fall into three main program areas: restoration of water quality, compliance/permitting, and standards development. As such, the design of these monitoring components will focus on determination of sources of pollutions and the attainment of water quality standards and biological endpoints through the various programs intended to restore surface and ground water.

TMDL Monitoring

MONITORING OBJECTIVES

Waterbodies not meeting state water quality standards 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 models to represent complex systems which may require special studies and specialized data collection for model calibration and validation.

Objective 1: Provide sufficient data for the development of Total Maximum Daily Loads and associated implementation strategies for improvement of water quality and biological integrity.

MONITORING 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 chosen for compliance monitoring or source loading. 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. Historically, all monitoring activities were performed by monitoring section staff. Recently, management has realized that in order to meet all the programmatic needs of the various sections additional staff must be involved in the regular business of collecting data. To this end, monitoring staff have been assigned to watershed management units that correspond with TMDL staff responsibilities to coordinate monitoring activities. In addition, TMDL staff will be trained to carry out monitoring activities within their watersheds which may include synoptic sampling four source identification, sonde deployment for measuring diel fluctuation of dissolved oxygen, routine E. coli measurement for assessment of contact recreation, and intensive lake monitoring. For instance, monitoring staff have been working with TMDL coordinators to develop the necessary datasets for a QUAL2K model for the Jordan River which involves intensive synoptic sampling of chemical parameters, sonde deployment, sediment oxygen demand measurement, and microbial source tracking techniques to identify sources of bacteriological contamination. Planned activities for this project include detailed benthic chlorophyll a sampling, shading estimates, and determination of limiting nutrients using nutrient diffusing substrates. 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 has been coordinating with various land management agencies through the cooperative monitoring program to assist them with data collection and development of TMDLs. The most significant of these projects was the development of TMDLs by the Wasatch-Cache Nation Forest for a number of lakes within National Forest boundaries across the state. DWQ will seek to enhance these monitoring activities and empower land mangers 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, in order to distribute laboratory and equipment resources, the data needs of the TMDL section and cooperators will be coordinated for inclusion into the annual plan.

CORE AND SUPPLEMENTAL INDICATORS

The core and supplemental indicators for TMDL monitoring are determined through the assessment and TMDL listing process. TMDL monitoring will be specifically designed to address the indicators identified on the 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. Please refer to the Targeted Monitoring tier for a full list of potential indicators.

DATA ANALYSIS AND ASSESSMENT

Although each study of impaired waterbodies is unique data analysis for Total Maximum Daily Load development 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, the initial step of data evaluation may result in the design of sampling plans to provide additional data to parameterize models or perform loading analysis.

There are several aspects of the TMDL process common to most of the studies that have been completed statewide. The most basic analysis is the development of pollutant loads combining flow (volume/time) and a given pollutant concentration (mass/volume) to generate a daily load (mass/day) at a sampling location of interest. In order to estimate load reductions, the existing load analysis is compared to target loads often developed by applying a target concentration to the hydrologic dataset to simulate a loading condition where water quality criteria are met. Often, this is accomplished by developing load duration curves (Fig. 4) which are a useful tool for not only estimating target load reductions, but identifying potential causes of pollution.

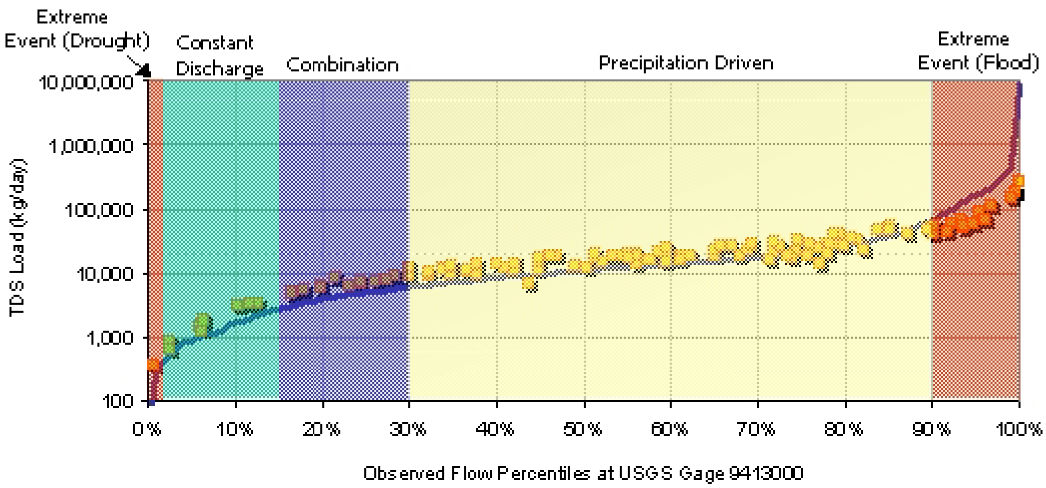


Figure 4. Example of a Load Duration Curve

In this case, stream loading and target loads based on numeric criteria are graphed against flow data grouped by flow percentiles. The area between the actual loading and target loading within each percentile becomes the load reduction for the TMDL. These curves are also illustrative of the source of pollutant loading since concentrations can be graphed across the flow percentiles. High concentrations during low flow periods indicate a continuous point source or groundwater source, while high concentrations during peak discharge suggests pollution sources linked to storm or runoff events.

Allocations of pollutant sources are then identified based on a combination of loading information from tributaries, point source discharges and estimates of nonpoint source pollution. Often watershed-scale models are employed to estimate the relative contributions of various pollution sources and determine load reductions for individual categories.

These level of analysis necessary to develop loading and target load reductions vary widely depending on the parameter of concern. In the case of conservative constituents, such as TDS, the above approach is often sufficient for developing targets and allocations. However in the case of parameters such as nutrients and dissolved oxygen, it is often necessary to utilize models to understand the complicated interaction of physical, chemical and biological interactions affecting the concentrations of a parameter like dissolved oxygen. The QUAL2K model is one example of a model employed to evaluate these relationships and develop load reductions.

REPORTING

The Total Maximum Daily Load 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. With the implementation of this new tiered approach these DERs will play a critical role in defining the targeted data collection to meet the TMDL study needs. The main reporting function of the TMDL program is the submission 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 the Divisions website or printed copies upon request. Public notice for the draft report comment period is published in local and statewide newspaper outlets. Final reports approved by EPA are published and maintained on the Division's website.

PROGRAMMATIC EVALUATION

Develop Capacity to Obtain Measures of Discharge at Larger Rivers

DWQ routinely measures stream discharge at all water quality stations whenever it is safe to wade across the stream. However, for many sites with deep or swift flows, discharge cannot be measured using standard methods. As a result, we generate water quality data without associated discharge. One way to solve discharge data gaps is to establish stream gages that will allow us to measure discharge by monitoring water depth. This requires development of stage-discharge relationships that are created by simultaneously measuring discharge and depth over a range of flow conditions. Once this relationship is established discharge can be derived from a measurement of depth. Depth measurements are easily obtained on large streams or during high flow events. DWQ proposes establishing stream gages and generating stage-discharge relationships at 50 high-priority sites throughout the Utah. At each site DWQ will install a pressure transducer that will measure water depth at regular intervals or a staff gage if site conditions are not appropriate for transducer installations. An Acoustic Doppler Current Profiler (ADCP) will be purchased and used to accurately measure discharge at the gage locations and other sites where flow can't be measured by wading the stream. Initially, these stations will be installed as part of the intensive monitoring in each basin and critical gages will remain and maintained based on data needs. This will greatly aid the TMDL section in determining the pollutant loading and developing load duration curves for water quality studies.

Development of Library Independent Tools for Microbial Source Tracking

In anticipation for the identification of impairments due to E. coli contamination, DWQ staff has been evaluating procedures for identifying and potentially quantifying sources of E. coli in surface waters. Library-dependent methods for source tracking involve the development of a library of E. coli genetic material for individual species (via scat collection) within a watershed for comparison with E coli present in water samples. This approach can be prohibitively time and resource consuming since it involves the collection and analysis of all potential source material in the watershed. In addition, identification may not be definitive. As part of the ongoing Emigration Creek TMDL, Dr. Ramesh Goel at the University of Utah is evaluating the use of library independent methods for identifying host species of bacteriological contamination. This research is currently focusing on host-specific genetic markers identified for Bacteroides. Initially, this effort is focusing on human markers due to the suspected source of septic systems in this relatively populous canyon environment. However additional bovine, canine, swine, and other markers are under development and evaluation elsewhere. The use of Bacteroides promises to be an effective and affordable tool for to identify sources and assist with TMDL development and building the capacity for this analysis at a local laboratory has been a primary focus of the pilot study in preparation for the potential impairments resulting from the statewide E. coli surveys underway.

Surface Water Permitting and Compliance Monitoring

MONITORING OBJECTIVES

The State of Utah DEQ maintains the Utah Pollution Discharge Elimination System (UPDES) which permits discharges to waters of the State of Utah. As part of the permit requirements, facilities must submit Discharge Monitoring Reports to the Division to ensure compliance with permit limits. 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 establish wasteload discharge limits and to ensure that endpoints developed as part of the Total Maximum Daily Load program are met. The Division will continue to perform compliance monitoring in an adaptive manner to better serve these programs. Discussed in detail in the Monitoring Design section, the proposed improvements will include less frequent random audits, split sampling, and targeted monitoring for TMDL and wasteload development.

Objective 1: Ensure permittees are meeting effluent limits included in UPDES permits.

Objective 2: Consistent development and application of wasteload analyses for permitted facilities to protect water quality and ensure compliance with approved TMDLs and water quality standards

MONITORING DESIGN

Currently, the DWQ requires permitted facilities to submit Discharge Monitoring Reports (DMRs) to the Division to ensure compliance with water quality discharge limits set forth in their individual permits. Historically, DWQ also visited these facilities during the ambient monitoring runs every 6-8 weeks and as part of the intensive monitoring every 5 years. With the shift to a 6-year rotating basin approach and the cessation of the ambient monitoring, these facilities will no longer be monitored regularly. In order to ensure compliance with permit limits and to audit reporting submitted as DMRs, DWQ staff will conduct random sampling at facilities for compliance purposes. During these audits, DWQ will collect split samples with the facilities and ensure that the facility operators are properly conducting their monitoring activities. This will not only provide a quality control check on their procedures, but provide comparisons between lab analyses.

In cases where additional data is necessary to develop wasteloads and permit limits, DWQ staff will collect more frequent targeted data above and below facilities for integration into water quality models. Additionally, datasets at facilities and their receiving waters will be generated as part on the intensive basin monitoring every 6 years. Currently, DWQ is proposing the use of QUAL2K for the development of wasteloads and assessing the data

CORE AND SUPPLEMENTAL INDICATORS

Table 7. Core and Supplemental Indicators				
Permitting Compliance Monitoring				
Beneficial Use Assessment Categories				
Indicators	Aquatic Life & Wildlife	Recreation	Drinking Water	Agriculture
Core Indicators	Dissolved oxygen	Pathogen Indicators (E. coli)	Trace metals	Trace metals
	Temperature	pH	Pathogens	Total dissolved solids
	pH		pH	pH
	Ammonia			
	Trace metals		Nitrates	Gross alpha
Supplemental Indicators	Sediment			
	Nutrients (N, P)			

DATA ANALYSIS AND ASSESSMENT

Traditional use of compliance monitoring has focused on supplementing datasets from Discharge Monitoring Reports submitted to the division by permitted facilities. These data were occasionally 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 will provide staff with quality control measures for evaluating the facilities collection and laboratory analysis.

REPORTING

The primary reporting mechanism for the Permitting and Compliance monitoring is the development of UPDES permits. 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.

PROGRAMMATIC EVALUATION

Increased Discharge Monitoring Reporting

DWQ staff is assessing the feasibility of requiring that data from receiving water at selected permitted facilities be included along with DMRs to facilitate model development. In some cases, this may be readily accomplished, especially at the larger wastewater facilities. In the case of smaller dischargers that require the development of WLAs, DWQ staff will coordinate with those facilities to collect the necessary data. Since this approach has not been fully evaluated and it may be some time before implementation, staff should perform a review of immediate data needs for WLAs so an appropriate interim monitoring plan can be implemented.

QUAL2K Model Development

DWQ uses water quality models to develop effluent limits for municipal and industrial discharges. Procedures are under development to transition from current modeling approaches to QUAL2K (http://www.epa.gov/athens/wwqtsc/html/qual2k.html), which will provide defensible estimates of the fate and transport of pollutants in the discharge. QUAL2K models are particularly useful for evaluating the effects of nutrients, which are among the most important parameters of concern, especially below wastewater treatment facilities. Numerous data are required to calibrate these models, for instance typical model calibration parameters include: Biological Oxygen Demand (BOD), nutrients, Total Suspended Solids (TSS), Volatile Suspended Solids (VSS), 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. Sensitivity analyses are currently being conducted to determine the critical parameters to populate the models will be performed in order to develop an efficient monitoring program for model calibration. These analyses will be used to establish the specific data requirements for QUAL2K calibration under different management scenarios. It is anticipated that yearly monitoring plans will be developed based on pending permit renewals and that monitoring fro 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.

Groundwater

MONITORING OBJECTIVES

The State of Utah is experiencing continuous and 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 U.S. Geological Survey 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 adding additional stress on existing water supplies. Water quality in some area of the State may be more of a limitation in developing additional water supplies than water quantity (www.waterquality.utah.gov/WQAssess/PreviousIR.htm).

On May 26, 1989, Utah adopted ground water quality protection regulations (UAC R317-6) that help establish the foundation for a management program that emphasizes the prevention of ground water pollution. Nearly 20 years later, ground water permit compliance monitoring is being conducted at 32 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 ground water monitoring network has been recently reestablished in cooperation with the U.S. Geological Survey.

The objectives of the ambient ground water monitoring network are outlined below.

Objective 1: Provide an overview and identify trends of the ground water conditions in Utah's four major aquifer types.

Objective 2: Integrate ground water monitoring data where TMDLs have been developed or are under development.

Objective 3: Evaluate the long-term effectiveness of the Clean Water Act program activities in protecting ground water in Utah.

Objective 4: Support Ground Water Aquifer Classification System.

Objective 5: Allow for the detection and tracking of ground water contamination through ambient and site-specific monitoring.

MONITORING 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. Monitoring ground-water quality for assessment of Total Maximum Daily Loads (TMDL), 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. Results of the analyses will be included in the Annual Ground Water 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.

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 ground-water quality for assessment of Total Maximum Daily Loads (TMDL), 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. Results of the analyses will be included in the Annual Ground Water 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.

CORE AND SUPPLEMENTAL INDICATORS

The ground water classification system is based on the ambient ground water quality of the aquifer. The quality of the ground water determines its beneficial use. Existing use on the other hand may not reflect the highest potential beneficial use that can be made of the water. Total dissolved solids (TDS) concentration is the primary constituent of concern. TDS is a widely accepted and utilized measurement of ground water quality reflecting the dissolved minerals such as sodium and calcium carbonates, bicarbonates, chlorides and sulfates present in the water. The lower the TDS, the better the water quality. Most drinking water has a TDS concentration under 1000 milligrams per liter (mg/l). Water with TDS concentration over 10,000 mg/l is saline and not suitable for many uses unless substantially treated to improve the water quality. The Utah Ground Water Qualilty Protection Regulations (UAC R317-6) established four major classes of ground water, Class IA, II, III, IV, and two special classes, Class IB and IC.

Class I A – Pristine Ground Water – Highest quality ground water with TDS less than 500 mg/l and no contaminant concentrations greater than ground water quality standards. It is suitable for all beneficial uses.

Class IB – Irreplaceable Ground Water - Good quality ground water that is a source for a community public drinking water system for which no reliable supply of comparable quality and quantity is available because of economic or institutional constraints.

Class I C – Ecologically Important Ground Water – ground water is a source of ground water discharge important to the continued existence of wildlife habitat. Class I C designation depends on establishing the source of discharge, utilization and importance for wildlife habitat.

Class II – Drinking Water Quality Ground Water – high quality ground water with TDS greater than 500 mg/l and less than 3000 mg/l and no contaminant that exceed ground water quality standards.

Class III – Limited Use Ground Water – Ground water that has a TDS between 3000 and 10,000 mg/l or has one or more contaminants that exceed the ground water quality standards.

Class IV – Saline Ground Water – Ground water with TDS over 10,000 mg/l composes this class. Class IV ground water is addressed by this regulation on a case-by-case basis.

Table 8. Groundwater Assessment and Evaluation

Beneficial Use Assessment Categories					
Indicators	Aquatic Life & Wildlife	Recreation	Drinking Water	Fish / Shellfish Consumption	Agriculture
Core Indicators	NA	NA	Total Dissolved Solids	NA	Total Dissolved Solids
			Trace Metals		Trace Metals
			Nutrients		Nutrients
			Major Cations & Anions		Major Cations & Anions

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 at http://ut.water.usgs.gov/publications/pubsgw.html.

Analytical results associated with water samples col¬lected from each area of ground-water development were compared to State of Utah maximum contaminant levels (MCLs) and secondary drinking-water standards of routinely measureable substances present in water supplies. The MCLs and secondary drinking-water standards can be accessed on the internet at http://www.rules.utah.gov/publicat/code/r309/r309-200.htm#T5. A comparison of MCLs and secondary drinking-water standards with results of analyses is included in the text of the USGS reports.

REPORTING

The approved data used for project analysis are archived in the USGS National QWDATA water-quality database and in the DEQ database. Progress updates will be made to the Department of Environmental Quality 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. These reports can be found at the Utah USGS website at http://ut.water.usgs.gov/publications/pubsgw.html

The Utah Ground Water Quality Protection Regulations contain a provision for classification of entire aquifers or parts of an aquifer s a method for maintaining ground water quality in these areas. An aquifer classification may be initiated either by the Utah Water Quality Board or by a petitioner. Section R317-6-5 of the Ground Water 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.

Groundwater Compliance Monitoring

The Ground Water Protection Section administers 35 Ground Water Quality Discharge Permits under the Utah Administrative Rules for Ground Water Quality Protection to protect beneficial uses of ground water quality from degradation. In addition, the Ground Water Protection Section administers 6 Underground Injection Control (UIC) 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 Ground Water Compliance Monitoring Reports for Ground Water 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 ground water protection levels based on site-specific background concentrations and the federal maximum contaminant levels of UIC Permits.

Ground Water Permit Compliance Monitoring

Regulatory compliance monitoring established the building block to a formal State Ground Water Permit Program to protect the present and future beneficial uses of ground water in Utah. Utah has adopted an antidegradation policy for ground water protection. Broadly, this policy provides for the maintenance and protection of current and probable future beneficial uses of ground water; protection of higher quality water at their existing water quality; and prevention of degradation of water quality that would be injurious to existing or potential beneficial water use. Antidegradation incorporates many beneficial characteristics of both the effects on ground water from man's activities but limits those effects to acceptable levels. It provides a greater degree of protection of higher quality ground water. However it does not rule out man's economic, social or recreational activities as a strictly- applied non degradation policy might.

MONITORING OBJECTIVES

The objective of ground water permit compliance monitoring is to protect current and future beneficial uses of ground water resources by applying ground water protection levels based on site-specific background ground water 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 ground water contamination events. This approach, prevention and early detection and correction, versus after-the-fact cleanup, is preferable both for the longterm utilization of the ground water resource and the avoidance of the considerable expense of ground water remediation.

MONITORING DESIGN

Ground water monitoring is currently done to obtain data for oversight of municipal and industrial ground water discharge permit requirements. Compliance monitoring points must be 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. Traditionally, at least one compliance point will be located up-gradient to the discharge point. Periodically, DWQ will monitor wells in coordination with the permittees to evaluate their ongoing compliance monitoring.

CORE AND SUPPLEMENTAL INDICATORS

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

DATA ANALYSIS AND ASSESSMENT

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.

Underground Injection Control Program

MONITORING 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 total dissolved solids (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, nor 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 Underground Injection Control (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 R317-7-5.3 and 40 CFR 144.12(a). Excerpt from 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."

Objective 1: To ensure compliance with UIC permit limits.

Objective 2: 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.

Objective 3: Assess the effectiveness of UIC BATs and BMPs in protecting USDWs

MONITORING 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 exceedences 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 the Utah Division of Water Quality, Quality Assurance (QA) Plan for the Underground Injection Control (UIC) Program (July 5, 1990).

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 internal use.

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 would like to have this option available to us in the near future.

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. Analytical results are entered into STORET for data management.

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.

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.

PROGRAMMATIC EVALUATION

Although the UIC Program has not pursued this yet, we 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 storm water 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 projects, to name one.

Nonpoint Source Monitoring

MONITORING OBJECTIVES

The mission of the Utah Nonpoint Source Pollution Management Program is to conserve protect, maintain, and improve the quality of the waters of the state for public water supplies, species protection and propagation and for other designated uses and to provide for the prevention, abatement and control of new or existing sources of polluted runoff. In addition, the state of Utah maintains a State Revolving Fund Nonpoint Source

Grant and Loan Program intended to support similar water quality projects. 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 (citation) 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.

Objective 1: Perform effectiveness monitoring for nonpoint source water quality projects.

Objective 2: Foster and develop efficient and effective methods for assessing nonpoint source projects.

MONITORING DESIGN

Increasingly, states are asked to monitor Best Management Practices (BMPs) and restoration activities to address nonpoint source pollution under the 319 program. This reporting requirement is intended to demonstrate individual project effectiveness, track implementation plan goals, and determine load reductions intended to meet TMDLs. Historically, the effectiveness of restoration projects funded through Utah's Nonpoint Source (319) Program was monitored by Utah's Interagency Nonpoint Source Monitoring Workgroup. While this group and the data they collected supplied the necessary reporting information for a number of NPS projects, the monitoring approach and coordination of multiple agency staff and resources proved unwieldy. As more restoration is implemented around the state, monitoring individual projects is becoming more difficult to perform. The majority of 319 projects in Utah address impacts to stream and riparian habitats in order to restore aquatic life beneficial uses. Often, these projects substantially reduce erosion and inputs of nutrients to streams and rivers, in addition to improving the localized conditions of aquatic habitats. Unless restoration is widespread and inclusive of a large portion of a watershed, it is often difficult to document improvements in ambient water quality trends given the resources available. Therefore, two improvements to the monitoring of nonpoint restoration projects are proposed.

The first of these monitoring approaches involves the direct measure of the aquatic communities affected by restoration utilizing UCASE protocols in a BACI (Before-After-Control-Impact) approach. DWQ staff have already performed UCASE monitoring at sites where restoration projects are planned and linking them to sites of similar condition not anticipating management or restoration changes (Before-Control). In coming years, those same sites will be visited again to assess the changes from restoration activities (After-Impact). The BACI design provides statistically rigorous comparisons between the control site(s) with the restored site (impact) to quantify changes in biological and physical parameters that have occurred since the restoration was conducted. In reality, grab samples of chemistry are sufficiently variable that even statistically rigorous approaches like BACI may not demonstrate discrete changes in the chemical composition of surface waters following restoration activities. However, similar analyses will be conducted for measures biological composition, which may help demonstrate relatively rapid improvements that result from remediation activities. Measures of biological composition are also useful because they directly measure improvements of the biological designated uses the numeric criteria are intended to protect. Of course, measures of both biological and chemical improvements will be dependent on the relative size of the watershed and restoration activity.

Another proposed improvement to monitoring nonpoint source projects on a watershed or sub-watershed scale is the installation of long-term continuous monitoring stations. Depending on the parameters of concern and the nature of restoration activities, these automated stations could measure a variety of constituents, including dissolved oxygen, specific conductivity, pH, turbidity and discharge. Since these probes collect a limited set of water quality parameters, surrogate measures may be used and additional water chemistry monitoring implemented to develop relationships between parameters of concern and the surrogate measures. For instance, positive relationships may be developed between continuous turbidity data and chemistry data such as nutrients to provide the necessary linkage between changes at long-term stations and project effectiveness. While the installation of long-term stations isn't feasible for the assessment of individual projects on a small scale, they could be used to document the effects of a number of projects implemented as part of a watershed-scale implementation strategy as in the case of irrigation efficiency projects to reduce TDS or range improvements to reduce TSS (turbidity).

This approach is driven primarily by the difficulty of reporting on the effectiveness of BMPs. Too often, the parameters of concern identified in the TMDL and Project Implementation Plans (PIPs) simply cannot be measured on the timescale driven by reporting requirements, nor given the cost associated with sampling and lab analysis. 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. As in other tiers, these indicators will be selected each year and integrated into the Annual Monitoring Plan. By integrating these enhancements, the monitoring of implementation activities will be designed on the appropriate scale, both over time and space. UCASE monitoring in a BACI design will address the direct improvements to aquatic habitats and the biological communities that are likely to respond to its improvement. Alternately, the station approach will more effectively assess the long-term and integrated effects of a number of projects in a watershed area.

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 Quality Assurance Project Plans. As mentioned above, surrogates may be identified and collected for the assessment of watershed PIP effectiveness where appropriate. The following table lists potential indicators which may be employed under this program element.

Table 8. Core and Supplemental Indicators					
Beneficial Use Assessment Categories					
Indicators	Aquatic Life & Wildlife	Recreation	Drinking Water	Fish / Shellfish Consumption	Agriculture
Core Indicators	Dissolved oxygen	Pathogen Indicators (E. coli)	Trace metals	Waterfowl and fish consumption advisories	Trace metals
	Temperature	pH	Pathogens		Total dissolved solids
	pH		pH		pH
	Trace metals		Nitrates		Gross alpha
	Condition of benthic macroinvertebrates community				
	Periphyton (TBD)				
	Fish (TBD)				
Supplemental Indicators	Sediment				
	Nutrients (N, P)				
	Habitat assessment				

DATA ANALYSIS AND ASSESSMENT

Data analysis for evaluating the effectiveness of nonpoint source projects will vary depending on the type of project and the available data sources. Biological monitoring will provide background condition of the biotic community for both the "Before" and "Control" collection events. Once implemented, projects will be assessed by revisiting the "Control" and "Impact" site. Data will be compared using similar tools described in the biological monitoring component of the probabilistic and targeted assessments. Scores of biological condition can be evaluated for the "Impact" or restoration site (Before vs After) in conjunction with the "Control" site not receiving treatment (Before vs. After). In this way, changes in the biological condition can be evaluated against year-to-year variability.

Methods for long-term trend analysis have yet to be developed. However, these sites will likely utilize a combination of continuous monitoring data coupled with water chemistry to establish a relationship between the surrogate measures and chemical parameters of concerns linked to PIPs and TMDLs. For example, correlations can be readily established between total dissolved solids collected by grab samples and specific conductance as measured by probe sensors. Continuous monitoring datasets are sufficiently large enough to perform trend analysis with a level of confidence not possible through periodic grab sampling. Developing correlations between probe data and other parameters such as nutrients and sediment prove more difficult than the above described scenario. In these cases, measures for dissolved oxygen, turbidity or other surrogates may need to be evaluated. As mentioned above, Specific monitoring plans will be developed individually for implementation strategies and QAPPs and subsequent reporting documentation will detail specific data analysis for each project.

REPORTING

For specific Project Implementation Plans (PIPs) there are two types of reporting required for submission to the Section 319 Grants Reporting and Tracking System (GRTS). These include annual and semi annual reports on PIP implementation and progress in meeting water quality objectives. In addition a final report is also required once the goals of the PIP are met for inclusion into GRTS (guidelines for the final report can be found at http://www.epa.gov/owow/nps/sec-391.pdf).

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.

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 Project Implementation Plan is unique, DWQ will continuously review its NPS monitoring strategy with EPA to ensure it meets critical 319 program reporting requirements.

Mercury in Fish Tissue

MONITORING OBJECTIVES

In an effort to assess the extent and distribution of mercury in fish tissue and protect human health, Utah DWQ has implemented a statewide mercury in fish tissue monitoring program undertaken in cooperation with the Utah Department of Health (DOH) and the Utah Division of Wildlife Resources (DWR). This interagency program has included a statewide mercury work group formed with stakeholder representatives from a variety of agency and public groups. A list of the Mercury Work Group participants and their objectives can be found at htt://www.deq.utah.gov/Issues/Mercury/workgroup.htm. The main portal for statewide mercury information can be accessed at http://www.mercury.utah.gov/ which provides links to the Mercury Work Group, the fish advisories and provides background information such as sources of Mercury and public health effects. The DWQ monitoring section's role in this process is to provide an annual sampling plan, coordinate collection with the DWR, obtain the necessary data and maintain quality assurance and standard operating procedures for this program.

Objective 1: Provide an annual sampling plan and coordinate collection efforts with DWR

Objective 2: Maintain quality assurance and standard operating procedures in fish tissue collection and analysis.

MONITORING DESIGN

Prior to 2005, fish tissue collection for the analysis of mercury occurred as part of the EMAP national survey. Since then, DWQ in partnership with DWR collects fish tissue to identify waterbodies where game species of fish may contain unsafe levels of mercury. Figure 5 summarizes the yearly sampling frequency of fish collection since 1999.

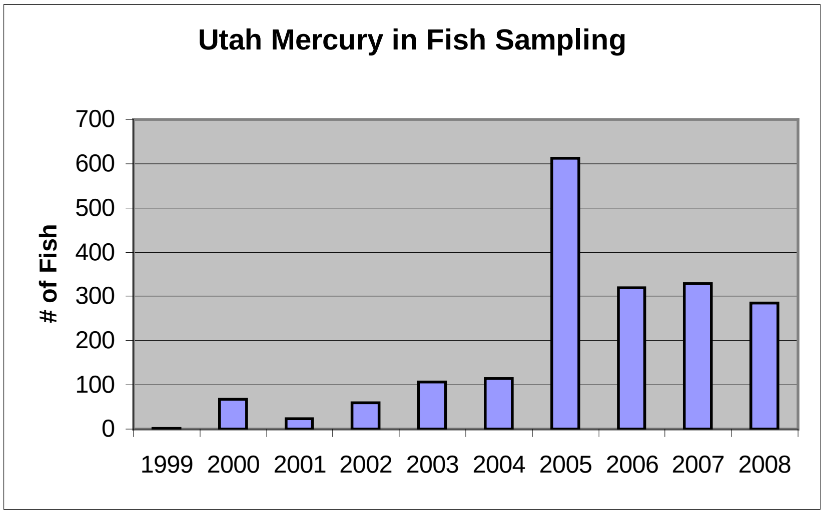


Figure 5. Utah Mercury in Fish Sampling

Each year, DWQ devises a sampling plan based on the previous year's results. DWQ coordinates with the DWR monitoring program who supplies the majority of fish tissue for the advisory program. The 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 mercury in fish populations. DWQ will continue its annual efforts and maintain and update quality assurance plans and standard operating procedures. Please refer to Appendix (Standard Operating Procedures for Collection and Preparation of Fish Tissue Samples for Mercury Analysis)

CORE AND SUPPLEMENTAL INDICATORS

The core indicator for this program is mercury content of fish tissue from a variety of individual game fish species. DWQ has also participated in surveys analyzing waterfowl species on some areas of the Great Salt Lake. A full list of the target species can be found on the DWQ website at http://www.fishadvisories.utah.gov/

DATA ANALYSIS AND ASSESSMENT

Once lab results are received by DWQ staff, the average concentration per species at a site are compared to the EPA screening value of 0.3 ppm and a power analysis is performed to assess appropriate sample size for statistical analysis. The following figure diagrams the process of assessment of mercury in fish tissue prior to issuing health advisories (Fig 6.)

Once data are analyzed and there is an adequate sample size a number of steps are taken to issue health advisories. In consultation with DWR and DOH, sites exceeding the threshold for mercury are selected for analysis of fish tissue consumption limits to be determined by the DOH Environmental Toxicology coordinator.

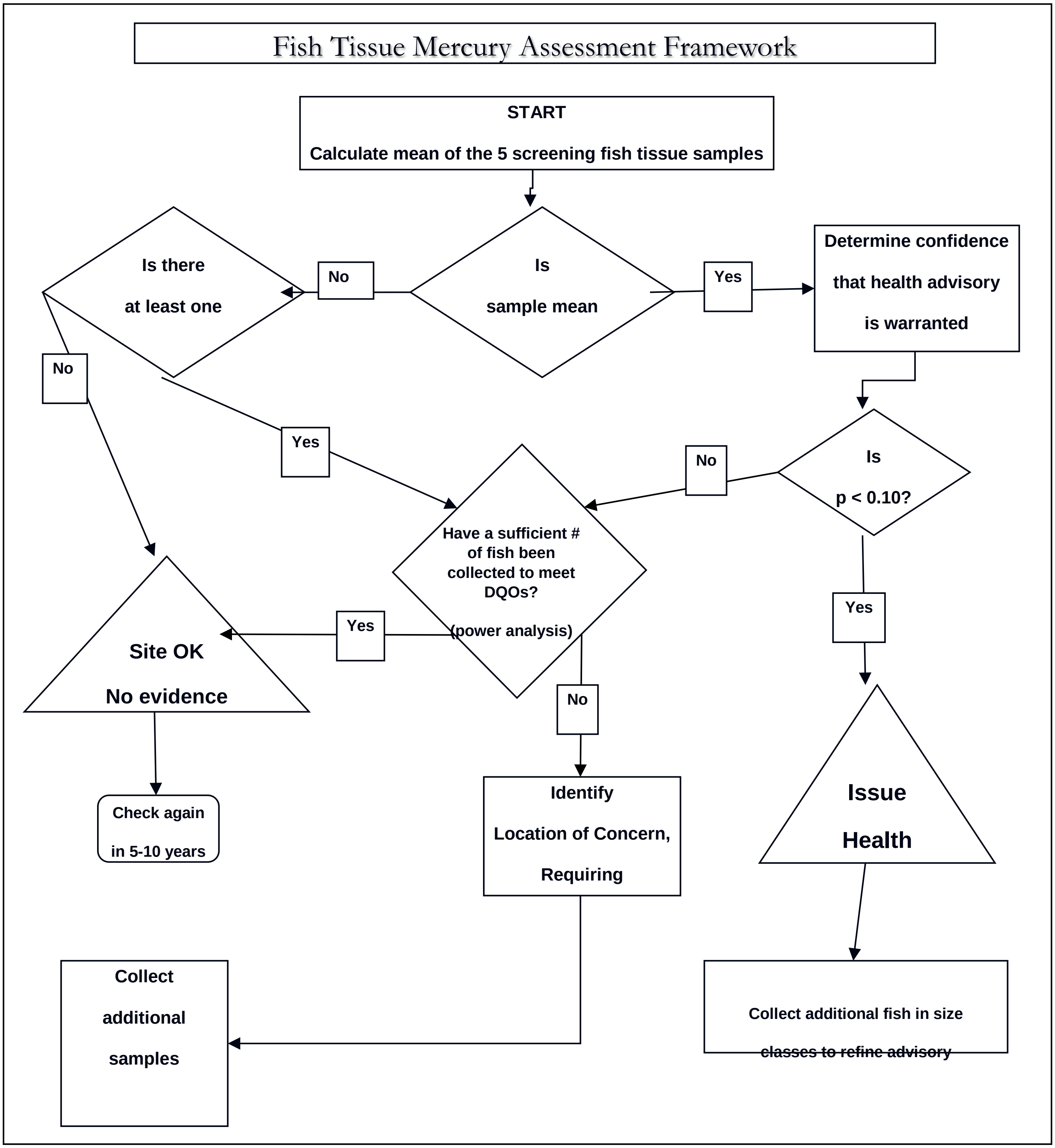


Figure 6. Fish Tissue Mercury Assessment Framework

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/

PROGRAMMATIC EVALUATION

As mentioned above, source identification will be an important component of the mercury monitoring program as areas with high concentrations are identified and isolated. Approaches to identifying and quantifying sources have not been identified to date. While DWQ and DWR staff have the capacity to collect target species for testing, much of the lab analysis is dependant on funding.

Cooperative Monitoring / Utah Monitoring Council

MONITORING OBJECTIVES

Utah DWQ is dedicated to increasing the capacity of cooperators and volunteer monitoring groups 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 Forest Service, Bureau of Land Management and National Parks Service to facilitate the assessment of waterbodies on federal lands and to meet the partner's program needs. 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's, watershed coordinators, or other cooperative monitoring participants to ensure we meet data needs to properly assess recreational uses. Statewide a number of entities have promoted volunteer monitoring for education and stewardship, creating a network of motivated citizens who could provide valuable data with proper equipment, coordination, and training.

Objective 1: Enhance the network of cooperative and volunteer monitoring by providing training, supplies, equipment, and lab analysis.

Objective 2: Create a statewide Utah Monitoring Council to coordinate monitoring activities and administer quality assurance and standard operating procedures for participating agencies, groups and citizens.

MONITORING DESIGN

The DWQ's Monitoring Program has fostered on the collection of water chemistry through cooperative agreements with the Forest Service, Bureau of Land Management, and the National Parks Service., both to generate assessment data for 305(b) and 303(d) reporting as well as assisting land management agencies with their specific assessment needs. While there are additional entities collecting water quality and biological data statewide, including the USGS, DWR, and a number of university researchers, limited attempts have been made to integrate the information gathered through these activities by the Division. Most of the cooperation with these entities occurs in conjunction with monitoring of the Great Salt Lake and associated wetlands. To date, very limited volunteer monitoring data has been accepted by the Division. In an effort to enhance water quality and biological monitoring among the diverse groups, agencies and researchers statewide, the Division will develop a statewide monitoring council to coordinate monitoring activities.

Many states nationwide have developed statewide monitoring councils to facilitate collection of data and create networks of volunteers and agency staff to provide data for assessments, pollution source identification and long-term trend analysis. Indeed, some states receive a considerable amount of their assessment data from volunteer citizen monitoring. A major challenge in maintaining these monitoring networks will lie in 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 will dedicate a full time staff member to coordinate the formation of a statewide monitoring council and facilitate the collection of data by citizen groups and other agencies. 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 hopes to increase its capacity to perform assessments, develop TMDLs, and monitor lakes and streams for long term trends and restoration effectiveness.

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 and bacteriological monitoring 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. A summary of typical parameters of concern are presented in Table 9 for reference purposes only.

Table 9 . Core and Supplemental Indicators

	Beneficial Use Assessment Categories				
Indicators	Aquatic Life & Wildlife	Recreation	Drinking Water	Fish / Shellfish Consumption	Agriculture
Core	Dissolved oxygen	Pathogen	Trace	Waterfowl and fish	Trace

Table 9 . Core and Supplemental Indicators					
Indicators		Indicators (E. coli)	metals	consumption advisories	metals
	Temperature	pH	Pathogens		Total dissolved solids
	pH		pH		pH
	Trace metals		Nitrates		
	Condition of benthic macroinvertebrates community				
	Periphyton				
	Fish				
Supplemental Indicators	Sediment				
	Nutrients (N, P)				
	Habitat assessment				

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 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.

PROGRAMMATIC EVALUATION

The formation of a Utah Monitoring Council will provide the framework for the coordination, training, and funding mechanisms for maintaining a successful cooperative monitoring program. Through this collaborative program, participants will evaluate and improve upon monitoring strategies with DWQ to better meet the program requirements of all participants. While the Council is planning its first meeting for the winter of 2009 and has yet to identify immediate needs the following enhancements will be critical.

Quality Assurance

Developing quality assurance plans with a wide variety of participants will be a major challenge and priority for the Council. This element will be addressed as part of DWQs revision of its Quality Assurance (QA) program elements as discussed in that section. Already, DWQ has developed an E coli Standard Operating Procedure and a Demonstration of Capability (DOC) to ensure monitors are correctly using the Colilert test. 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.

As part of this emerging program, DWQ may require participants in the cooperative monitoring program to submit Sampling and Analysis Plans each year for inclusion into the Annual Monitoring Plans (SAPs). To facilitate these activities, the Council coordinator will assist with the development of SAP templates and QA documentation.

Interagency Cooperation

A number of other agencies have collected data at candidate reference sites throughout Utah. However, due to difference among collection protocols, these data may not be directly comparable to those collected by DWQ. Comparability studies are needed to establish the extent to which these data can be combined with collections made by DWQ into the reference database.

Standards Development

MONITORING 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 constantly being revised to address emerging water quality concerns. Any change to water quality standards must scientifically demonstrate that the changes will sufficiently protect designated uses. Often, the documents that justify the standards changes require extensive analyses of water quality data and must undergo rigorous review by DWQ, EPA, and our stakeholders. As a result, much of DWQs 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 un progress. It is not practical to develop long-term monitoring strategies in support of water quality standards that have not yet been developed or adaopted Nonetheless, this report includes a generalized long-term monitoring strategy that describes how monitoring will be conducted to support of future proposed changes to water quality standards

The Clean Water Act requires that standards be opened for revisions at least every three years. When these triennial reviews occur, DWQ will continue to solicit our stakeholders for recommended changes to our standards. Additional monitoring needs are frequently identified through this process, which will be addressed as they arise.

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 criteria is either too restrictive or too lenient for a specific waterbody. In these cases a site-specific standard can be created. The process of creating site-specific criteria represent 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 standard 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 (see separate section of this report), which will require extensive monitoring due to the unique physical and chemical characteristics of this waterbody.

MONITORING 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 for to develop an appropriate monitoring design for all standards changes:

1. Evaluate existing monitoring data to ensure that a need for a standard change exists and to begin to justify the need for the changes.

2. Present the justification and data to DWQ staff and outside stakeholders to identify potential concerns with the proposed changes and key data gaps.

3. 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.

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 this section of the report 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 setting to help put laboratory toxicology data in context with conditions observed in natural settings.

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, standards changes often require that analyses be rigorously compared to other studies to demonstrate the need for the change or support of the designated use.

Reporting

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

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.

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 data also require monitoring information that describes any human-caused pollution sources.

Technical reports or Papers

Some standards changes require research to be conducted to scientifically defend the proposed changes. Monitoring information collected to address specific research questions is summarized in technical reports and papers. These reports provide supporting information and accompany the proposed standards changes through public and EPA review.

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.

Programmatic Evaluation

The DWQ must open water quality standards at least every three years 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, this process is conduced through a Water Quality Standards workgroup (www.waterquality.utah.gov/WQS/workgroup/index.htm) with member representing the interests of industry and the environment. This workgroup meets on a regular basis to discuss proposed changes to standards and then ultimately makes recommendations of specific standards changes to Utah's Water Quality Board (WQB, www.waterquality.utah.gov/WQBoard/index.htm). Following public comment, the WQB ultimately votes on final changes to the water quality standards. Once the standard changes are formally adopted in Utah's Administrative Code, they are forwarded, along with supporting materials, to EPA for approval.

Sometimes changes to water quality standards merely clarify the intent of previously adopted rules, other changes take years to develop and often involve many targeted monitoring activities. A brief summary of water quality standards projects that are under development follows:

Nutrient Criteria Development

Both nationally and within Utah nutrient pollution is recognized as one of the primary threats to aquatic life. There have been several concerns with applying nutrient standards universally by EPA, State's and stakeholders alike. The effects of nutrients on specific waterbodies are influenced by regional and site-specific characteristics which makes determining criteria difficult. As a result DWQ does not currently have numeric nutrient criteria in its water quality standards. The DWQ is conducting the necessary monitoring and analyses to develop numeric nutrient criteria. The initial focus on these efforts is the development of nutrient criteria for streams, with the intent of later employing similar approaches for lakes and reservoirs.

The State of Utah has long assessed surface waters utilizing a water quality indicator for phosphorus and nitrate which, in conjunction with a weight of evidence approach integrating habitat, biological, and in some cases dissolved oxygen data, has resulted in a number of streams listed for impairment due to nutrients. The DWQ currently employs numeric criteria for ammonia nitrogen which is continually monitored due its toxicity to aquatic life. Research efforts are currently underway to address numeric nutrient criteria, each of these efforts continues to require different monitoring approaches, which are discussed below.

Stream Classification: Accounting for Natural Variability: Nutrients vary naturally due to varying physiochemical characteristics such as watershed geology, soil structure and hydrology. Failure to account for these natural gradients in standards development may result in over or under-prtection of biota. To minimize natural variability, 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 phosphorous. Once these groups are established, numeric nutrient criteria will be generated and applied to each stream class.

Numeric Criteria Development: Multiple Lines of Evidence: Utah is exploring several methods that have been proposed to establish nutrient criteria including: literature values from scientific investigations, distribution of reference site nutrient concentrations, and empirical evaluations of stream biota responses to increasing nutrients. Previous stakeholder responses to nutrient TMDLs suggest that two of these lines of evidence will be particularly pivotal in obtaining stakeholder support of proposed nutrient criteria. First, the distribution of reference site nutrient concentrations will be key in distinguishing between natural and human-caused nutrient inputs. Second, an analytical demonstration of biological degradation resulting from eutrophication will be needed to clearly link proposed criteria to aquatic life beneficial use support.

Evaluating Potential Costs and Environmental Benefits: Implementation of any numeric nutrient criteria will likely have far-reaching economic consequences, particularly with regard to upgrades to WWTPs that will ultimately be required. These will be evaluated with site-specific investigations of biogeochemical processes in receiving waters and mechanistic models to estimate future conditions. Demonstration of both costs and benefits will be critical in outreach efforts when numeric nutrient criteria are established.

Nutrient Reductions from Both Point and Nonpoint Sources: 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 implantation 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 regulate egregious non-point source polluters.

(TIMELINE NOTES: 2010: Monitoring to evaluate potential benefits of WWTP nutrient reductions; initial recommendations for streams. 2011: Proposed adoption of stream nutrient criteria; data collection efforts to support lake and reservoir nutrient criteria development. 2012: continued monitoring lakes and reservoirs. 2013: Adoption of lake and reservoir nutrient criteria

Development of Biological Condition Gradient (BCG)

Developing a BCG is an iterative process that requires continual review and modification of the monitoring plan to ensure sufficient data exists for development and calibration of a BCG. Data collection required for development such as stressor variables and biological conditions are historically extensive albeit unfocused. A review of pertinent, available data will reveal where data gaps occur. Initially, temperature has been identified as a regulated stressor that would benefit from improved data collection and possibly refined aquatic use classes. Most of Utah's waters are currently designated either as cold or warm water aquatic life. More refined aquatic life beneficial use classes such as Tiered Aquatic Life Uses (TALU) and associated standards for new classes would benefit monitoring and assessment efforts for a number of reasons: First, these classes would minimize errors in assessments by more clearly defining expected conditions. Second, refined classes would allow DWQ to better prioritize restoration areas and expectations of potential environmental improvements. Third, identified environmental indicators will help guide and focus DWQ's monitoring approach. Finally, tiered aquatic life uses would be a valuable communication tool to better convey the condition of Utah's waters to stakeholders. In order to better implement temperature standards throughout the State, an assessment of temperature regimes in Utah's rivers and streams will be conducted. While these comprehensive data sets will take a number of years to develop, data will be immediately available for analysis and standards revision as necessary. In addition, there are a number of ongoing TMDL studies which will augment the data set to better refine temperature standards. Methods or models to be utilized for data analysis have not been finalized, but will be detailed as part of the biennial reporting process and associated assessment framework. As the temperature stressor gradient is developed, additional stressors will be identified and monitoring strategies will need adjustment.

Development and Implementation of Water Quality Standards for the Great Salt Lake

The Great Salt Lake is a biologically and chemically unique and ecologically important ecosystem, yet only one numeric water quality criterion has been established for the lake. These unique characteristics have made development of numeric criteria difficult because without comparable waterbodies it is difficult to determine the extent to which contemporary conditions are natural or the result of human-caused activities. A hypersaline water of GSL further complicates monitoring efforts because unique laboratory methods are often needed to obtain reliable concentrations of pollutants.

Recently, DWQ proposed a numeric selenium criterion, based on concentrations in bird egg tissue (http://www.deq.utah.gov/Issues/GSL_WQSC/index.htm), as GSL's first numeric criterion. The social and scientific complexities that DWQ encountered through the development and adoption of the selenium criterion highlights the need for robust, site-specific monitoring plans as other pollutant concerns are addressed in the GSL ecosystem.

To develop the selenium criterion, DWQ brought together nationally renowned experts in selenium and toxicology, who conducted over 3-years of scientific investigations. Despite the efforts to ensure that the criterion was based in solid science, the criterion ultimately adopted by Utah's WQB remains controversial among stakeholders across the political spectrum.

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 highlights, moving forward with additional criteria will require the development on carefully considered monitoring and assessment programs.

Development and Implementation of Water Quality Standards for the Great Salt Lake

The 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 hypersaline 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 determine the extent to which contemporary conditions are natural or the result of human-caused activities. A hypersaline water of GSL further complicates monitoring efforts because unique laboratory methods are often needed to obtain reliable concentrations of pollutants.

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To develop the selenium criterion, DWQ brought together nationally renowned experts in selenium and toxicology, who conducted over 3-years of scientific investigations. These monitoring and research activities cost >$2 million, yet much scientific uncertainty remains. Nonetheless, the science panel felt sufficiently confident in the research to propose a numeric criterion. Despite the efforts to ensure that the criterion was based in solid science, the criterion ultimately adopted by Utah's WQB remains controversial among stakeholders across the political spectrum.

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 highlights, moving forward with additional criteria will require the development on carefully considered monitoring and assessment programs.

Standards for Ephemeral and Intermittent Streams

Utah, like other arid western states, has a preponderance of intermittent and ephemeral streams compared to perennial streams. To assess these stream types in the mountainous regions of the state may not be difficult, but those that are found in the arid, highly erodible regions of the state will be very difficult to assess. Several issues need to be addressed before this type of monitoring can occur. The DWQ needs to determine which streams are intermittent and those that are ephemeral streams. The National Hydrography Database does not have accurate identification of these stream types. Once identified, what beneficial use designations should be applied to these streams, and what current standards or new ones would need to be developed to assess these streams. The cost to complete this work may be so prohibitive that it is not feasible to do this work. Although this may be a long-term need within our program, at this time it will not be evaluated or defined in terms of resources, constraints or applicability to our program. However, the use of probabilistic sampling may provide an estimate of the stream miles for the ephemeral and intermittent streams within certain regions of the state and incorporation of these hydrological limited streams with generic criteria or as determined from episodic event monitoring may be a potential solution for identification and characterization of these waters.

As additional funding is available a strategy to provide an estimate of the stream miles that are intermittent or ephemeral in the arid, highly erodible regions of the state will be developed. One alternative strategy may be a probabilistic monitoring design to estimate the quantity of these streams in Utah. This would include the west desert, eastern and southeastern regions of the state. At a minimum a geographical spatial map will be produced that defines probabilistic sites to be analyzed. Sampling of these sites could occur as part of our routine basin rotational plan. The determination of how many sites could be selected will be determined based on additional resources that become available to include this type of monitoring. The objective of this type of probabilistic monitoring program will be to assist in the interpretation of long-term generalized statewide water quality conditions. No definitive date will be established for inclusion of this process at this time, but as part of the programmatic evaluation process for this strategy, DWQ will reevaluate inclusion of this program during successive cycles to determine when it would be viable to include it.

Quality Assurance

Without careful consideration of data quality, results obtained from monitoring activities can generate data that is unable to meet programmatic needs. DWQ has implemented a number of field and laboratory quality assurance procedures to ensure data quality. These procedures have been generated over the years to ensure that data are scientifically defensible and meet EPA guidance for the accuracy and precision of water quality data. The quality assurance measures developed for emerging monitoring activities will be reviewed and integrated into existing Quality Assurance Project Plans (QAPPs). DWQ's methods for conducting routine monitoring for the collection of water chemistry samples, field data, and discharge are encapsulated in an umbrella Quality Assurance Project Plan (QAPP) entitled the Monitoring Manual. Both DWQ personnel and program cooperators are trained on these procedures yearly to ensure consistent field data collections. On average, 20% of water chemistry samples are collected and analyzed to ensure data quality. Quality assurance samples include the collection of split samples and field blanks, which allow DWQ to test for sample contamination. At a minimum, these samples are analyzed quarterly and any problems noted are immediately addressed. Biological and physical habitat data for stream ecosystems are collected following a QAPP developed by the EPA entitled Environmental Monitoring and Assessment Program -Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams. This document outlines procedures detailed procedures for collecting habitat data, fish data, macroinvertebrate samples, and algae samples. All personnel are trained yearly on these protocols to ensure that these data are collected consistently among DWQ staff.

For ground water monitoring, the standard USGS protocols for collection and analyses will be initiated for all samples. In addition to utilization of standard protocols for data collection and analysis, standard quality assurance procedures also will be followed. Evaluation of the water-quality data will adhere to scientific principles and be subjected to a review by USGS and DEQ specialists in ground-water hydrology. On file is letter dated 7/20/2004 from Kris Jensen, U.S. EPA Region 8 Nonpoint Source Project Officer, approving the statewide USGS/DWQ ground water monitoring QAPP.

Laboratory Services

In general, all water chemistry process in conducted with EPA approved methods. Occasionally, a need for an analysis that is not yet approved by the EPA arises, in which case DWQ consults with Utah's Bureau of Laboratory Investigation (BLI) to ensure that the methods result in scientifically defensible data. Laboratory samples are routinely run by a certified lab, which is audited every 2-3 years to ensure that standard procedures are followed.

Laboratory results are forwarded from the State Health Lab to DWQ electronically. Before these data are uploaded to our database, they undergo a rigorous vetting procedure by DWQs Quality Assurance Officer.

Potential Enhancements

Revisions to Quality Management Plan

A high priority for DWQ over the next couple of years is a thorough review of all quality assurance procedures with the aim of developing a revised Quality Management Plan that can be forwarded to EPA for approval. This review will involve updates to the existing field procedures and the development of Sampling Analysis and Assessment Plans (SAPs). Many of these have already been revised and under review by Division staff. In addition, DWQ will work with EPA to develop a schedule for routine review and revisions to DWQs field procedures and Quality Assurance Plans.

QAPPs for Nonpoint Source Projects

In addition to routine monitoring activities, DWQ also conducts numerous monitoring activities to support the needs of various programs. Individual Quality Assurance Plans are developed for each of these studies before monitoring is conducted. For instance, QAPs are developed individually for nonpoint source projects to assess their effectiveness. Since the methods to measure project effectiveness have evolved over the last several years, it may be necessary to alter many of the existing QAPs for NPS projects to ensure timeliness and relevance to the, the abundance of NPS restoration projects implemented over the years precludes the ability to assess water quality effects, nor are project manager likely to detect improving trends on the project scale. Therefore these QAPs will be revised to address some of the changes proposed in the monitoring strategy such ad establishing long-term trend stations to detect watershed effects and utilizing UCASE protocols to gage improvements in aquatic communities.

Data Management

Historically, the Division of Water Quality has utilized a STORET database for the storage and management of its water quality data, biological data, and field parameters. This distributed STORET Database (including the STORET Data Entry Module, Reports Module, and STORET Import Module or SIM) has been the primary means of storing and submitting water quality monitoring data to EPA. In addition, several custom input and output functions have been developed over the years to assist staff in developing monitoring runs and managing incoming data for storage in the STORET database. Data sources stored in DWQ's STORET database include State Lab data and other sources submitted by cooperative monitoring entities. In addition, DWQ has entered historical biological data collected by the Forest Service, USGS and BLM into STORET. Data from DWQ's database has been uploaded regularly to the national STORET on a quarterly basis. It should be noted that approved ground water data is also archived in the USGS NWIS QWDATA water-quality database. The NWIS is the storage medium for water-quality, stream flow, well, and water-use information collected by the USGS.

In the fall of 2009, EPA is discontinuing support for data submissions via the distributed STORET database. EPA has been promoting the development of Exchange Network Nodes or Node Clients as part of the National Environmental Information Exchange Network for states to submit a wide range of environmental data to national repositories. The program node for the submission of water quality data is the Water Quality Exchange (WQX) which will provide a standardized data flow in XML (eXtensible Markup Language) format. To meet this requirement and to replace the distributed STORET database, the EPA organized an Integrated Project Team (IPT) to define and develop an environmental data management system that will meet the specific needs of these states. This IPT effort resulted in the development of a data storage solution with the WQX schema known as the Ambient Water Quality Management System (AWQMS). AWQMS was distributed to the members of the IPT in June of 2009. This Node 2.0 compliant database will assist Utah in the storage and submission of water quality, biological, physical, and fish tissue data. The AQWMS will include the following elements:

- Oracle database that supports the WQX Schema.
- Three-tier architecture that will allow for easier conversion to other database platforms in the future.
- Web-based batch loading tool to import water quality data into the database.
- Web-based user interface to view and edit data in the Database

Customization of AQWMS

DWQ is currently in the process of installing the AWQMS database and planning the migration of existing datasets. Once complete, DWQ will evaluate the built-in functionality to determine where additional programming needs exist. It was anticipated during the development process, that DWQ staff would require tools and functions associated with the AQWMS that were outside the scope of the original database development. To meet future requirements, DWQ secured and Exchange Network Grant to build additional functionality and develop analysis and reporting tools for populating the ATTAINs for IRing. Scoping for project design and procurement for contractual services will begin in the early fall of 2009. In an effort to complete data flows to EPA, cooperative agencies and the general public, Utah DEQ will the address the following elements as part of this Exchange Network Grant:

- Capability to create a WQX compatible XML file for submission to EPA via the Exchange Network.

- Create a suite of reporting, input and data management tools, QA/QC functions, mapping and data browsing interface.

- Onsite local integration with each organization's Node Software, installation, and technical support after delivery.

To date, WQX development has focused on data input and providing the database needs for submitting data to WQX. While these are important functions, they fall short of meeting state's needs to make data readily available to staff, partnering agencies and the general public. The Division of Water Quality has developed a web-based interface utilizing ArcIMS to provide map browsing capability and data filters to allow the user to refine the dataset, period of record and parameters of concern. Once the WQX database is implemented, this tool will need to be re-designed or modified to retain and enhance its current functionality and compatibility with map services employed by the State of Utah.

DWQ coordinates data collection statewide with a number of agencies including the Forest Service and Bureau of Land Management. Participating agencies and volunteer groups will need a consistent method of submitting their data to DWQ to minimize staff time and ensure quality data is submitted. This proposed enhancement will include the creation of web client for cooperative agencies to submit water quality data in XML format for incorporation to local WQX data base. Quality Assurance / Quality Control also presents challenges for data managers and this system upgrades will include a set of screening tools to ensure quality data is submitted to WQX. The initial outcomes of the AQWMS customizations as defined in the Exchange Network Grant are as follows:

1) Ability to submit water quality, biological, and habitat data to national WQX in XML format.

2) A single local database containing all of DWQ's water quality, biological and habitat data, including the capacity to store continuous monitoring datasets.

3) An updated map service and browsing tool with the ability to serve all forms of data to staff, partners, and the general public.

4) Screening tools for QA/QC to ensure data integrity.

5) Web client for partnering agencies and others to submit data to DWQ.

6) Monitoring sites and data indexed to the NHD for the creation of a geodatabase and the ability to build reporting and assessment tools.

This last outcome will assist the DWQ in the development of reporting tools also included in the EN Grant. These proposed reporting tools will be discussed in the “Data Analysis” “Reporting” elements.

Electronic Recording of Field Data

Utah’s DWQ has made major steps forward with regard to developing procedures that facilitate data migration from the field to useable electronic formats. Nonetheless, with increasingly complex data and expanding programs our current methods are inefficient and sometimes lead to errors associated with data entry. DWQ proposes purchasing PDRs and programming them to calculate and record electronically much of our field data. Initially we plan to collect the following measures: field data, site visit notes, physical habitat characterizations, discharge calculations, and GPS locations of new sites. As DWQ integrates these units into our monitoring we will use these units to improve the quality of our data with ‘real-time’ checks for accuracy (i.e., outlier detection), alert functions for incomplete information, and easy electronic access to SOPs for field procedures. In addition, integration of the field PDR’s and associated datasets into the State Lab work flow and the AQWMS system will greatly facilitate the transfer and management of data in an efficient and paperless process. Although DWQ is currently in negotiation with the State Lab on this component, ideally, this would include a bar-coding system for tracking samples from the field to lab to minimize human error and create an efficient work flow.

ICIS

The DWQ also maintains an "Integrated Compliance Information System" (ICIS), a multi-media database with Federal information for air, water , and other environmental quality data. The database utilized by DWQ is the ICIS-NPDES which stores all the discharge monitoring reports (DMRs), Enforcement Actions, Inspections, Compliance Schedules, Narrative conditions, and Program Annual Reports, and associated administrative information for permitted discharges required in ICIS. In addition, CAFO Permits, SSOs, pretreatment, biosolids, and storm water industrial permits and construction permits with inspection information are entered into ICIS. Ultimately, the data contained in ICIS is transferred to EPA and made available to the public via Enforcement and Compliance History Online (ECHO). Headquarters uses the data in ICIS to rate our state with the State Review Framework and report to states and EPA if a permit is in violation for effluent problems or if they haven't submitted their DMR's.

GENERAL SUPPORT AND INFRASTRUCTURE PLANNING

Each year DWQ reviews its current Annual Monitoring Plan, and generates a monitoring strategy for the coming year that best meets programmatic needs. Development of this plan is a muli-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 manifold 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 strategy. DWQ then prioritizes incremental monitoring program improvements that can be accomplished over 1-3 years. For each prioritized projects, DWQ develops a workplan that includes a detailed budget and a timeline for project completion with incremental milestones. The yearly workplans will be published in DWQ's yearly monitoring plan beginning in FY2010.

This section summarizes the current monitoring and possible future monitoring for each of DWQ's monitoring programs. The funding estimates for each program are based on historic resource allocations which provide the basis for projected estimates for future monitoring activities. Beginning in 2009, considerable changes will be made to the historic monitoring program as DWQ implements the elements of the proposed monitoring design. The estimates provided here represent the cost of individual program activities based on the historic monitoring program, although every effort was made to project actual cost associated with implementing the proposed strategy. Implementation schedules are identified in Appendix A; however, these goals are subject to change when based on changes to programmatic priorities and available resources. The implementation of any new type of monitoring will depend upon 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.

Currently, the DWQ Monitoring Program has 7 permanent FTEs and 3 additional temporary FTEs to perform all the monitoring activities outlined in this strategy. While the 3 temporary FTEs are not guranteed positions and depend on grant funding, resources for the permanent FTEs are anticipated to remain constant. With recent budget shortfalls, state programs will need to rely on grant funds for continuation of these vital projects. Table 11 summarizes estimates for all existing monitoring activities under DWQ and cooperative monitoring programs and includes associated laboratory costs.

Table 11. Typical yearly cost estimates for DWQ's routine monitoring programs.		
		Cost
	Monitoring Program	Summary
State Programs		
Rotating Basin	Jordan River Intensive	$266,990
	Lake Monitoring	$34,036
	Waste Load Allocation	$75,790
	Non Point Source (reflects only watershed intensive surveys)	$3,389
	Groundwater Monitoring	$85,000
	TMDLs	$47,810
	GSL/Farmington Bay	$167,951
	DWQ Total	$742,680
Cooperative		
Programs		
	U.S. Forest Service	
	Ashley NFS	$18,625
	Dixie NFS	$8,278
	Fish Lake NFS	$16,555
	Manti-Lasal NFS	$14,486
	Uinta NFS	$16,555
	Wasatch-Cache NFS	$16,555

Table 11. Typical yearly cost estimates for DWQ's routine monitoring programs.		
		Cost
	Monitoring Program	Summary
	U.S. Forest Service Total	$91,054
	U.S. BLM	
	Cedar BLM	$14,486
	Escalante Watershed	$33,110
	Paria Watershed	$6,208
	East Fk Virgin R Watershed	$8,278
	Kanab Ck Watershed	$33,110
	Johnson Canyon/Kitchen Correl Ws	$10,347
	Kaiparowits / Lake Powell	$8,278
	Upper Sevier River Watershed	$4,139
	Moab	$27,724
	Price	$25,612
	Richfield	$0
	Lower Fremont	$0
	Vernal	$0
	BLM Total	$171,292

Table 11. Typical yearly cost estimates for DWQ's routine monitoring programs.		
		Cost
	Monitoring Program	Summary
	Salt Lake City	$24,833
	Canyonlands	$22,763
	Capitol Reef	$0
	JTAC Total	$0
	Davis County	$42,742
	DWR Hardware Ranch	$1,695
	Zion National Park	$4,400
	Other Totals	$96,432
	Total Water Chemistry and Bacteriological	$1,039,744
	Macroinvertebrate Sampling	$26,000
	Periphyton Sampling	$40,000
	Total	$1,065,744

The above table is merely an estimate of the annual expenditures of our monitoring program and is likely to change given the recent efficiencies identified through the revision of DWQs monitoring strategy. It should be noted that the above estimates include laboratory analysis at the Utah Public Health Lab which utilizes a system of Work-Time Units or WTUs to track lab allocation for the multiple divisions of the Department of Environmental Quality. On a typical year, DWQ utilizes approximately 90% of available WTUs. That allocation is likely to reduce in size with recent budget shortfalls and future allocations are by no means guaranteed. The tiered strategy was devised to assist in reducing our demand on this allocation. However unanticipated budget shortfalls may preclude DWQs ability to accomplish the water chemistry analysis to meet programmatic needs.

Table 12 summarizes estimated cost for enhancements or additions to DWQs existing programs. Monitoring enhancements that will be implemented with existing costs are not included because implementation of these efforts simply involves management reprioritization of work activities. Costs generally indicate one-time costs to initiate activities, but an asterisk indicates recurring costs that cannot be covered with existing funding. A double asterisk indicates expenses of know requirements, but additional expenses are anticipated. UNK indicates enhancements where projected expenses are not practical without development of a detailed project plans, which have not been completed.

Table 12. Estimated costs for implementation of proposed enhancements to monitoring efforts.

Activity Description	Analysis/Contracts	Equipment Costs	FTEs	Staffing Support Costs	Total
Tier 1 Monitoring					
Probabilistic Survey	$12,000		.5 ENV-3	$36,500	$48,500
Diatom Fish Indices	$15,000		.5 ENV-3	$36,000	$36,000
West Desert Assessment	$40,000		.5 ENV-3	$36,000	$76,000
Tier 2 Monitoring					
Wetland Monitoring Program	$35,000		1 ENV-3 1 ENV-2	$73,000 $ 59,000	$132,000
Selenium Monitoring	$7,500		.5 ENV-2	$29,500	$37,000*
Statewide E. coli monitoring	$10,000	$25,000*	.5 ENV-2	$29,500	$64,500*
Tier 3 Monitoring					

TALU	$25,000				$25,000
GSL Monitoring and Assessment Methods	UNK	UNK	UNK	UNK	UNK
Large River Discharge	$15,000	$57,000	.25 ES-2	$29,500	$86,500
Ground Water Monitoring	$85,000		Contract		$85,000*
Mercury Expansion of Capacity		$42,000			$42,000
Field Recording	$5,000	$28,000	.25 ENV2	$14,750	$47,750
NPS Effectiveness	$12,000		.5 ENV2	$36,000	$38,000
Long Term Trend	UNK	UNK	UNK	UNK	UNK
QUAL2K/WLAs	$8000	$5,000	0.5 ENV2	$36,000	$49,000
Intermittent and Ephemeral Streams	UKN	UNK	UNK	UNK	UNK
WQX Transition	$250,000				$250,00 0
Total	$519,500	$132,000	~6 FTE	$415,750	$830,750