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TMDL IMPLEMENTATION PLAN

For

Nitrogen and *Escherichia coli*

Tonto Creek & Christopher Creek

Gila County, Arizona

HUC Reaches: 15060105-013A, 15060105-013B, 15060105-353

Arizona Department of Environmental Quality

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1.0 INTRODUCTION

1.1 Total Maximum Daily Load Implementation Plan

Pursuant to Arizona Revised Statute § 49-234 (G), (H), & (J), the Arizona Department of Environmental Quality (ADEQ), in collaboration with interested stakeholders, is required to develop and establish a Total Maximum Daily Load (TMDL) implementation plan for those impaired surface waters requiring TMDL analysis in accordance with Section 303(d) of the federal Clean Water Act. The TMDL implementation plan explains how the allocations and any reductions in existing pollutant loadings will be achieved and the time frame in which attainment of applicable surface water quality standards is expected to be achieved.

The purpose of the Tonto and Christopher Creeks TMDL Implementation Plan is to provide an action plan for the implementation of management measures designed to achieve the pollutant load reductions identified in the *Escherichia coli* (*E. coli*) TMDL developed for both Tonto and Christopher Creeks and the nitrogen TMDL developed for Tonto Creek. This implementation plan is a dynamic document that supports revision and improvements of management measures based on applied lessons learned. Plan revisions will be administered by ADEQ staff with stakeholder involvement and contribution.

1.2 Summary of the TMDL Process

Section 305(b) of the federal Clean Water Act requires each state to submit a water quality assessment report describing the status of state waterbodies in relation to state water quality standards. Based upon review of the 305(b) Report, states generate a list, the 303(d) List, of surface waters identified as impaired due to exceedances of applicable surface water quality standards. TMDL analyses are required for waters identified as impaired on the 303(d) List. TMDLs determine the amount or load of the pollutant(s) that a waterbody can receive without exceeding surface water quality standards. TMDLs are pollutant specific and identify source(s) and critical conditions which cause exceedances. For waterbodies with multiple parameter exceedances, TMDLs for each parameter will be developed. Review of TMDL analyses and watershed characteristics will aid in determining efficient and effective implementation actions that will improve water quality.

2.0 BACKGROUND

2.1 Tonto and Christopher Creeks Project Area Description

Tonto Creek and Christopher Creek are located within the northeastern portion of the Tonto National Forest in Gila County, Arizona at the foot of Arizona's Mogollon Rim (Figure 1). The closest town is Payson, Arizona. Tonto Creek's perennial headwaters begin at Tonto Springs. Tonto Creek's foremost sources are its headwaters spring and its confluence with perennially flowing Christopher Creek. The elevation of the project area ranges from approximately 6,500 feet (ft) at Tonto Springs to just below 5,000 ft near the Bear Flat development of cabins along the creek. Tonto and Christopher Creek contain both ephemeral and intermittent tributaries. The major tributaries are Hunter Creek, which feeds Christopher Creek, and Horton and Dick Williams Creeks, which feed Tonto Creek. Located within the Salt River watershed, the Tonto and Christopher Creek systems are major sources of water to Theodore Roosevelt Lake, a Salt River reservoir created from the Roosevelt Dam construction in 1911. The Tonto and Christopher Creek watershed is primarily composed of densely wooded forest land, dotted by creek-side developments of cabins, lodges, stores, and restaurants available to seasonal visitors and full time residents.

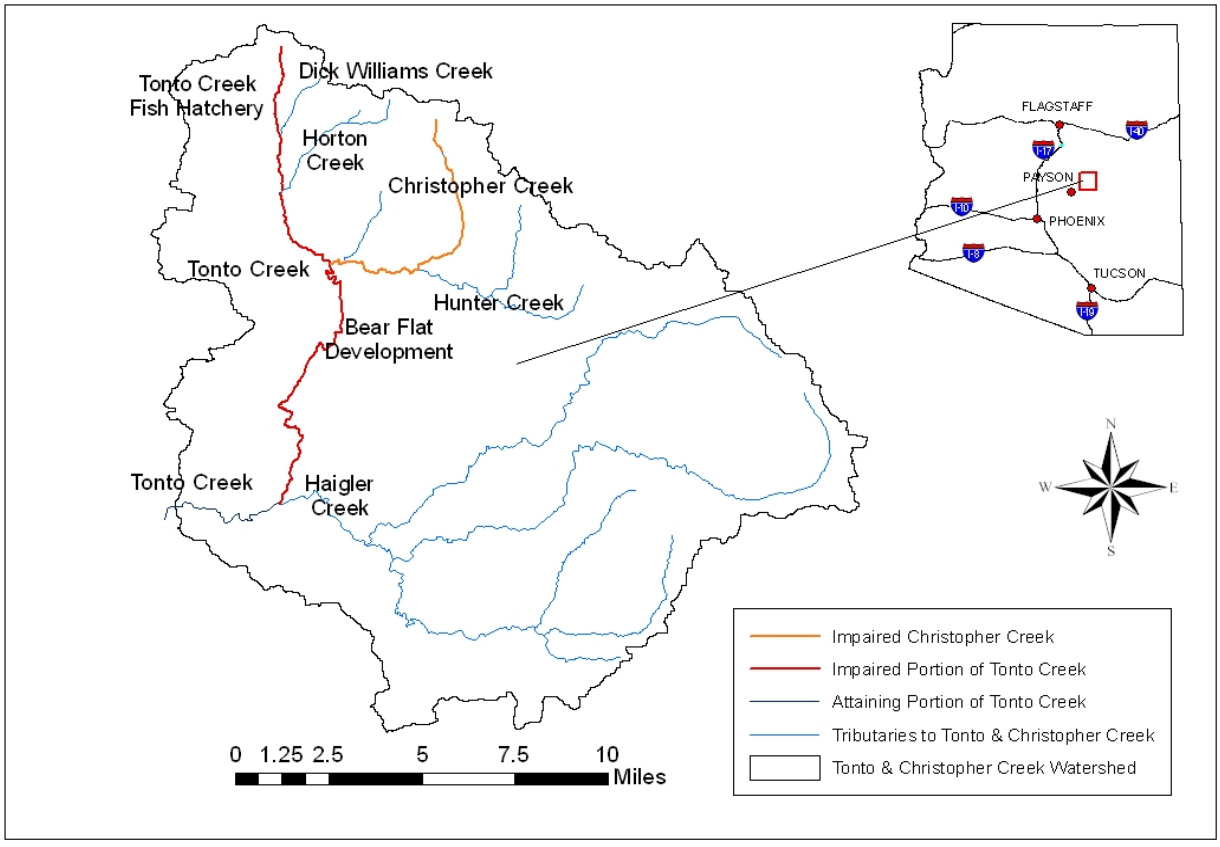


Figure 1. Location and major tributaries of the Tonto and Christopher Creeks Watershed

2.2 TMDL Background

Concerned that heavy summertime and recreational use may be contributing excessive nutrients and bacteria to the Upper Tonto Creek Basin, ADEQ initiated a two-phased Intensive Survey of water quality monitoring and assessment in the upper reaches of Tonto Creek and Christopher Creek, from 1994 to 1996. In addition to recreational uses, the Arizona Game and Fish Department's Tonto Creek Fish Hatchery, residential areas, and camp facilities were evaluated to determine potential water quality impacts on the creeks.

Exceedances of nitrogen and *E. coli* surface water quality standards were determined in samples collected from the upper reaches of Tonto Creek and at the mouth of Christopher Creek resulting in the impairment and subsequent placement of these reaches on Arizona's 303(d) List of impaired waters (discussed later in Section 3 and described in Table 1). TMDL load analyses were scheduled to determine the sources of impairments and establish load allocations for nitrogen and *E. coli* in Tonto Creek and *E. coli* in Christopher Creek.

The *E. coli* and nitrogen TMDL studies approved in 2004 and 2005, respectfully, considered the uppermost 10 miles of Tonto Creek from its headwaters to just below the Bear Flat development and Christopher Creek. The hydrologic unit codes (HUC) considered during the TMDL process and TMDL implementation plan for Tonto Creek are identified as HUC #15060105-13A (from headwaters to un-named tributary at 34° 18′ 10″/111° 04′ 14″) and HUC #15060105-013B (from un-named tributary at 34° 18′ 10″/111° 04′ 14″ to Haigler Creek). The Christopher Creek reach considered is HUC # 15060105-353 (headwaters to Tonto Creek).

2.3 Tonto Creek Fish Hatchery

Located below Tonto Springs is the Tonto Creek Fish Hatchery, which is owned and managed by the Arizona Game and Fish Department (AGFD). Established in 1938, the Tonto Creek Fish Hatchery diverts the initial 700 gallons per minute of spring water into the hatchery operation that produces and stocks 165,000 rainbow trout; 400,000 brook and cutthroat trout; and 150,000 of Arizona's state fish, the "threatened" Apache trout. Wastewater from the hatchery progresses through a sequence of treatment ponds designed to reduce nutrients before the discharge is returned to Tonto Creek, as authorized by the hatchery's Arizona Pollutant Discharge Elimination System (AZPDES) permit (AZ0021211).

In the 2000 and 2005 AZPDES permits, the AGFD was granted variances for both nitrogen and phosphorus concentrations in the hatchery discharge. These variances were granted for the purposes of enabling the permittee, AGFD, to perform facility upgrades at the hatchery that would improve the water quality of the discharge. In 2005, ADEQ renewed the variance with a special condition that ADEQ would re-open, review and modify the permit as necessary upon completion and approval of the Tonto Creek Nitrogen TMDL and the Tonto and Christopher Creeks TMDL Implementation Plan. The nitrogen TMDL study was completed and approved by the EPA in July 2005. Upon completion and approval of the Tonto and Christopher Creeks TMDL Implementation Plan, the discharge permit will be re-opened.

3.0 REVIEW OF WATER QUALITY

3.1 Surface Water Quality Standards

Surface water quality standards for the state of Arizona are established to protect each waterbody's designated uses (A.A.C. R18-11-101 through R18-11-123). The designated uses for both Tonto and Christopher Creeks are listed below.

Designated Uses:
A&Wc - Aquatic and Wildlife cold water (above 5,000 ft elevation)
A&Ww - Aquatic and Wildlife warm water (below 5,000 ft elevation)
FBC - Full Body Contact
FC - Fish Consumption
AgL - Agricultural Livestock watering
AgI - Agricultural Irrigation

According to the surface water quality standards (A.A.C. R18-11-101), the portions of Tonto Creek and Christopher Creek occurring at elevations above 5,000 feet are classified cold water while the portion of Tonto Creek occurring below 5,000 feet in elevation, located near the Bear Flat development, is classified warm water.

The Full Body Contact (FBC) designated use for both Tonto and Christopher Creeks continues to be impaired due to *E. coli* exceedances. The applicable standard for *E. coli*, based on the FBC designated use, is the single sample maximum of 235 colony forming units per 100 milliliters (235 cfu/100 mL). The geometric mean standard of 126 cfu/100 mL was not used in the assessment due to insufficient data to support the required collection of 4 samples from the same point within a 30 day period (A.A.C. R18-11-6, Impaired Water Identification Rule Revisions). Therefore, the Tonto and Christopher Creek TMDL is based

upon the single sample standard with the numeric target of 235 cfu/100 mL. Exceedances of the *E. coli* single sample standard in both creeks prompted the TMDL study to determine the sources and calculate the necessary load reductions to support the FBC designated use. The *E. coli* TMDL study was completed and approved by the EPA in June 2004. (TMDL data is summarized in Appendix A-1).

The nitrogen standard is not tied to a particular designated use. Rather, the standard is designed to prevent eutrophication in the Roosevelt Lake reservoir located at the mouth of Tonto Creek on the Salt River (ADEQ, 1981). Specific numeric water quality standards for total nitrogen have been established by ADEQ for Tonto Creek and its tributaries (A.A.C. R18-11-109(F)(2)). The single sample maximum is 2 milligrams per liter (mg/L) and the annual mean standard is 0.5 mg/L. Exceedances of the annual mean standard resulted in the impairment of Tonto Creek for nitrogen and prompted TMDL analysis. The nitrogen TMDL was completed and approved by the EPA in July 2005. (See Appendix A-2 for a summary of the TMDL data.)

A variance to a surface water quality standard may be granted in an AZPDES permit if the discharger demonstrates that treatment, more advanced than that required to comply with technology-based effluent limitations, is necessary for compliance with applicable water quality standards and additional treatment is prohibited by costs or technological developments (A.A.C. R18-11-122). In 2000, ADEQ granted temporary variances for nitrogen and phosphorus concentrations in the discharge from the Tonto Creek Fish Hatchery to enable AGFD to upgrade the existing waste treatment technology at the hatchery to a level sufficient for the discharge to meet water quality standards for nitrogen and phosphorus. The total nitrogen and phosphorus concentration variance limits established for the hatchery discharge were derived from the 90^{th} percentile monthly mean values of 1.0 mg/L and 0.2 mg/L, respectively (A.A.C. R18-11-109(F)(2)).

3.2 303(d) Listing History

As previously mentioned, Section 303(d) of the Clean Water Act requires each state to submit a list of its impaired surface waters, where one or more surface water quality standards are not being met. Each state must submit this updated list every two years to the United States Environmental Protection Agency (EPA). Table 1 outlines the 303(d) Listing History for the impaired segments of Tonto and Christopher Creeks identified by their unique hydrologic unit code (HUC). The table describes the parameters causing the impairments and the year the segments were placed on the 303(d) List.

Table 1. Tonto and Christopher Creeks 303(d) listing history

Surface Waterbody	1996	1998	2002	2004
Tonto Creek HUC #15060105-13A HUC #15060105-13B	nitrogen phosphorus	nitrogen phosphorus *E. coli*	turbidity[a] (*E. coli* placed on Planning List)	nitrogen dissolved oxygen[b] *E. coli* TMDL completed, water remains impaired
Christopher Creek HUC # 15060105-353		nitrogen	turbidity[a] (*E. coli* placed on Planning List)	*E. coli* TMDL completed, water remains impaired

a :Turbidity was delisted in 2004 due to standard change
b: Low dissolved oxygen levels resulted in the impairment of HUC #15060105-013A only.

The Tonto Creek reaches identified as HUC #15060105-13A and HUC #15060105-013B both share the same 303(d) history with the exception of year 2004. In 2004, exceedances of the nitrogen standard were measured in both HUC #15060105-13A and HUC #15060105-13B. In the same year, only HUC #15060105-013A was listed for impairment due to dissolved oxygen.

Exceedances of *E. coli* measured throughout the sampling events beginning in 1994 through 2002 prompted placement of the Tonto and Christopher Creek reaches described in Table 1 on the Planning List for *E. coli* TMDL development in 2002. The *E. coli* TMDL analysis was completed in 2004.

3.3 Sources of Impairment

Potential sources of *E. coli* and nitrogen pollutants within the Tonto and Christopher Creek watershed include both point source and nonpoint source contributions. Point sources are pollutant loads discharged at a single location. Discharge from a point source of any pollutant into surface waters of Arizona requires an AZPDES permit. The only AZPDES permitted point source discharge facility within the Tonto and Christopher Creek watershed is the Tonto Creek Fish Hatchery which is known to be a source of nitrogen.

Nonpoint source pollution is polluted runoff from diffuse sources on the landscape rather than an obvious single source. Nonpoint sources of *E. coli* and nitrogen within Tonto and Christopher Creek watershed are from both recreational and residential activities.

3.3.1 Sources of *E. coli* Impairment

Analysis of historical sampling data indicated high bacteria levels appeared to correlate with high recreation periods, i.e., summer months, holidays and weekends. Based on this analysis, ADEQ conducted source identification sampling during the summers of 2000, 2002, 2003, the fall of 2003 and the Memorial Day and Labor Day weekends of 2000. Bacteria levels increased with downstream distance suggesting heavy recreational uses. Bacteria levels in the waterbodies also increased over the summer season suggesting an increase due to accumulation in sediments, an increase in recreational use, or both. The data do not suggest a relationship between bacteria and the hatchery discharge.

Stream reaches of Tonto and Christopher Creek requiring the largest *E. coli* load reductions are located near the Bear Flat development, Kohl's Ranch, Tonto Rim Baptist Camp, R-Bar-C Boy Scout Ranch, and Camp Tontozona, an Arizona State University retreat center and sports training camp. All of these developments and camps are on septic systems. Additionally, the R-Bar-C Boy Scout Ranch is equipped with a mixture of septic, vault toilets and also maintains a central waste collection and processing system. From mid-May to mid-September, these areas are heavily populated due to camping, picnicking and fishing, thus, this time period constitutes the critical conditions outlined in the TMDL reports. The TMDL allocations and load reductions apply to all flows $\leq$ 100 cubic feet per second during this time.

Other heavily populated recreation areas and campgrounds have been identified as additional sources of bacteria and nutrient loading in Tonto and Christopher Creeks. These include Tonto Creek near the Bear Flat campground, and Christopher Creek near recreation sites close to See Spring and Box Canyon where human contact with the water, picnicking, and fishing are common. Water recreation at popular swimming areas within the Tonto National Forest and Box Canyon may contribute to bacterial loads as described in the *E. coli* TMDL report.

3.3.2 Sources of Nitrogen Impairment

Nitrogen levels remained relatively constant over the summers sampled from 2000 to 2003 suggesting accumulation is not an issue. Elevated nitrogen loads corresponded to the increased use of particular reaches, i.e., the Tonto Creek Fish Hatchery and the more heavily used recreation and development areas, while the nitrogen levels decreased downstream of these heavily used areas. The reaches of Tonto Creek located near the Tonto Creek Fish Hatchery, the recreation area located below Christopher Creek, and the Bear Flat development area were identified by the nitrogen TMDL as critical segments requiring the largest nitrogen load reductions.

4.0 EXPECTED LOAD REDUCTIONS

The *E. coli* and nitrogen load reductions calculated during the TMDL process were assigned to critical segments of the Tonto and Christopher Creeks. The targeted percent reductions of loads and locations are listed in the following tables. As load reductions are achieved, water quality standards will be met.

Table 2. Targeted *E. coli* Load Reductions for Tonto Creek

Critical Area	Existing Load (cfu/100 mL)	Targeted Load Allocation (cfu/100 mL)	Targeted Reduction	
			kg/year	%
Kohl's Ranch & Tontozona – septic	297	203	94	32
Below Christopher Creek	317	203	114	36
Bear Flat - septic	338	203	135	40

Table 3. Targeted *E. coli* Load Reductions for Christopher Creek

Critical Area	Existing Load (cfu/100 mL)	Targeted Load Allocation (cfu/100 mL)	Targeted Reduction	
			kg/year	%
R-Bar-C Scout Ranch – septic	403	203	200	50
Mouth of Christopher Creek	256	203	53	21

Table 4. Targeted Nitrogen Load Reductions for Tonto Creek

Critical Area	Existing Load (kg/year)	Targeted Load Allocation (kg/year)	Targeted Reduction	
			kg/year	%
Tonto Creek Fish Hatchery	934	814	120	13
Below Christopher Creek-recreation	2081	1475	606	29
Bear Flat - septic & recreation	1945	1639	306	16

Schematics depicting the Tonto and Christopher Creek critical segments are illustrated with corresponding *E. coli* and nitrogen load reductions in Appendix B (B -1 through B-3).

5.0 IMPLEMENTATION ACTIONS

The Tonto and Christopher Creek TMDL Implementation Plan outlines implementation actions or management measures based on the point and nonpoint source pollutant contributions. To ensure implementation actions are efficient and effective in addressing all impairments of Tonto and Christopher Creek, the *E. coli* and nitrogen load reductions will be considered together during the development and implementation of management measures. As previously stated, the implementation plan is an adaptive strategy, with provisions for improvements and revisions to management policies and practices through applied lessons learned.

5.1 Point Source Management

The Tonto Creek Fish Hatchery is the only permitted point source contribution to the Tonto and Christopher Creek watershed. Management measures for the Tonto Creek Fish Hatchery require compliance with the hatchery's AZPDES discharge permit that contains variances for nitrogen and phosphorus concentrations. In 2005, renewal of the variance was requested by the AGFD to continue efforts in facility upgrades, nutrient management implementation, and effectiveness monitoring.

From 2002 to 2003, AGFD secured funding approved by the Arizona legislature for the purposes of facility improvements at the Tonto Creek Fish Hatchery. Due to budget constraints, improvements at the fish hatchery have been completed one at time on a priority basis. As of 2004, three wetlands were constructed at the hatchery in efforts to improve de-nitrification and phosphorus removal efficiency before discharge. The wetlands were damaged shortly after being constructed by a major forest fire in the watershed. The ponds have since been renovated, replanted, and a fourth wetland constructed. Water control structures were placed in the ponds to prevent channelization and promote equal distribution of water through the wetlands.

Plans to construct a second settling basin at the hatchery have been contracted to commence in 2007. The current settling basin is undersized and during sediment removal, raceway cleaning must be suspended until the basin is placed back on line. A second parallel settling basin will allow for increased capacity and retention time of effluent.

A new Hatchery Management System of growth and feed models was developed in an attempt to reduce the amount of feed necessary to meet growth expectations, thereby reducing the amount of nutrients in the discharge. The revised system was determined to be successful in meeting growth expectations and is now implemented at the Tonto Creek Fish Hatchery. A "phased process" is recommended to achieve the load reductions associated with the

Tonto Creek Fish Hatchery. This "phased approach" designates the reopening and review of the discharge permit to include equipment installation, data collection and effectiveness monitoring. The hatchery's monitoring program will collect data throughout the year at selected sites to provide information regarding nitrogen loads in the stream during moderate to high flows. Throughout the course of the Tonto Creek and Christopher Creek TMDL studies, Arizona experienced drought conditions resulting in below average precipitation. The drought conditions have decreased flows throughout the Salt River watershed including Tonto and Christopher Creeks. Additional information regarding nitrogen loads during moderate to high flows is necessary to determine whether or not dilution occurs at these flows.

The monitoring phase of the load reduction process will provide the opportunity to assess water quality data obtained from more diverse flow regimes and thus provide feedback on whether additional management measures will be necessary to assure that load allocations are met.

5.1.1 Nutrient Management

As previously mentioned, four wetlands were constructed to improve de-nitrification and phosphorus removal efficiency before hatchery discharge. To minimize discharge of nutrient rich accumulated solids from the settling ponds, improved procedures for routine cleaning of rearing units and improved procedures to minimize discharge of accumulated solids during the inventory and harvesting of fish in the production system may need to be implemented. Increasing the frequency and improving the methods of cleaning the wastewater settling basins will reduce the time and amount of nutrients exposed to surface water, sediment, and the water column. Approved chemicals may be used to reduce the release of nutrients from the sludge in the wastewater treatment system. Feeding practices can be managed by feeding fish by hand, rather than automated feeding systems, thereby minimizing wasted food. Another management strategy is feeding lower phosphorus food diets. Though phosphorus is an essential dietary nutrient for fish, dietary phosphorus can be reduced in commercial fish food without adversely affecting fish growth and health. This alternative is commercially available and currently in practice in similar trout hatcheries.

5.1.2 Structural Measures

AGFD completed installation of four wetlands designed to reduce nutrient loadings from the hatchery discharge. Plans to construct a second parallel settling basin to allow increased capacity and retention time of effluent is expected to be completed within the next two years. The discharge will enter the settling basin then exit this treatment system with improved results in water quality. Evidence of results could be achieved through sampling the pre- and post-treatment water quality. Monitoring of current water quality and cost evaluation should be researched to find the most affordable, efficient, and effective treatment system for hatchery discharge.

5.2 Nonpoint Source Management

Voluntary reductions in nonpoint source loads of *E. coli* and nitrogen in the Tonto and Christopher Creeks are grouped according to septic/waste and recreational/human induced contributions. Educational and monitoring management alternatives are also discussed.

5.2.1 Septic and Waste

Targeted load reductions for Tonto and Christopher Creek should include the inspection and repair or upgrade as necessary of all septic and waste systems in the basin. In 2005, ADEQ awarded a water quality improvement grant (ADEQ Project #7-005), through funds available under Section 319 of the Clean Water Act, to the Gila County Division of Health and Community Services in the amount of $252,467. The efforts of the Gila County project continue through the second grant awarded in 2006 for $258,300 (ADEQ Project #8-005). The projects aim to “protect and preserve groundwater in Gila County by replacing, repairing, and upgrading current wastewater systems, illegal cesspools, pit privies and structurally unsound/failing septic systems.” Implementing these practices will protect and enhance groundwater and surface water quality.

The above mentioned 319 funded projects target private failing waste and disposal systems in close proximity to the creeks, which pose high risk to contaminating the creeks. Special attention will be given to upgrading systems in stream reaches where load reductions are identified. Additionally, Gila County intends to assist low-income homeowners with inadequate septic systems. The County plans to develop an individual application process and collect appropriate documentation to determine the areas that will receive septic repair or replacement. Furthermore, cesspools and pit privies installed in the early 20th century will be targeted for remediation or removal.

The Boy Scouts of America Grand Canyon Chapter, R-Bar-C Boy Scouts, were also awarded a water quality improvement grant in 2006 for $162,300 (ADEQ Project #8-003). This project proposes to upgrade the R-Bar-C Boy Scouts' septic treatment and disposal facilities to alleviate possible water contamination in the adjacent Christopher Creek. The facilities to be upgraded include existing septic tanks systems, existing pit holes at camp sites, and an existing evapotranspiration bed that appears to be contributing to the contamination at this reach of the creek.

In the last few years, the U.S. Forest Service (USFS) has added or upgraded toilets with vault units at key recreational sites. The USFS may wish to determine usage statistics for the various recreation areas and design a system for controlling human impacts; e.g., installing more vault toilets, establishing hours of use, daily monitoring of bacteria levels, restrictions based upon discharge, etc. The USFS and the Gila County Health Department may wish to establish regular monitoring of total nitrogen and *E. coli* levels for the stream reaches most likely to show a problem in the future.

5.2.2 Recreation

The drainage areas of Tonto and Christopher Creeks are highly regarded as providing exceptional recreation opportunities. Many of these popular swimming and water recreational areas are contained within Tonto National Forest boundaries. Educational signs, literature, and interpretive demonstrations may be developed to educate park visitors concerning impacts of littering, proper swimming and hygiene, suitable fishing methods and techniques, and general information regarding bacteria and *E. coli* are topics to be considered. These educational efforts should be concentrated in higher impact areas such as popular swimming areas, camping, and picnicking facilities.

The R-Bar-C Boy Scout Ranch may develop a monitoring plan and begin monitoring the bacteria levels at swimming areas on their property, along with popular recreation areas along the impacted creeks. Another monitoring activity that can be performed by Boy Scouts is testing for optical brighteners, a common dye in laundry effluent. The presence of optical brighteners in the creeks may be an indicator of untreated or inadequately treated wastewater reaching the creek.

6.0 INFORMATION AND OUTREACH

The information, education, and outreach component of this implementation plan is an integral part of public relations, understanding, and community involvement for the future of Tonto and Christopher Creek. Outreach goals will be to provide an information/education component that will be used to enhance public understanding of the project and encourage their participation in selecting, designing, and implementing nonpoint source management measures.

Education and monitoring activities should be adopted at the R-Bar-C Boy Scout Ranch. This poses an excellent opportunity for scouts to employ community service projects. Scouts should be educated on water quality impacts and improvements within their watershed. Through this internal education, the Scouts would have the knowledge to manage their impact on the land and water, as well as, provide educational opportunities to recreational users in the watershed. The Scouts and USFS may organize educational workshops, interpretational walks, and organize or perform community cleanups involving local community groups and visitors to areas along Tonto and Christopher Creeks.

Gila County plans on partnering with other agencies (other Gila County departments, realtors, city and town building inspectors, adult and aging services) to provide public outreach through community presentations, interagency meetings, and various media communication (website, newsletters). The information and outreach goals of this plan will lead to improved water quality in the Tonto and Christopher Creek watershed.

7.0 TECHNICAL AND FINANCIAL ASSISTANCE

For the successful execution of the Tonto and Christopher Creek Implementation Plan, the following agencies and organizations will need to continue their valuable technical assistance: ADEQ's TMDL Unit, USFS, Gila County Health Department and the Boy Scouts of America (R-Bar-C Boy Scouts).

Funding for Tonto Creek and Christopher Creek remediation projects can be obtained through competitive grant application processes. Many stakeholders and public/environmental interest groups would like to apply for grant money but lack the proper resources to do so. There are resources available to those who seek technical assistance through organizing grant materials and submitting grant proposals.

ADEQ's Water Quality Improvement Grant program provides annual grant workshops that act as "fact finding" and "information gathering" sessions for potential applicants. Attendance at grant workshops will provide the most up-to-date information pertinent to the

year's grant cycle. The Water Quality Improvement Grant program provides customer service and technical assistance if further explanation of 319 grant policies and procedures is necessary. ADEQ's Water Quality Improvement Grant program's web address is

www.azdeq.gov/environ/water/watershed/fin.html

The following websites provide tools that will help interested parties complete grant applications successfully and effectively, as well as, find additional funding for environmental restoration projects.

www.earthwrites.com/index.html
www.ericfacility.net/ericdigests/ed359067.html
www.fundsnetservices.com/environ.htm

8.0 IMPLEMENTATION SCHEDULE

The implementation schedule includes a timeline of annual goals for implementation actions. The schedule was developed based on the availability of human resources, funding sources, and regulatory requirements.

Table 5. Tonto and Christopher Creeks TMDL Implementation Schedule

	Implementation Milestone	Year
Point Source - Tonto Creek Fish Hatchery	AZPDES Permit Renewed	2005
	AZPDES re-opener (for the purposes of including installation of monitoring equipment and data collection)	2006-2010
	Ongoing data collection and assessment	2006-2010
	TMDL effectiveness monitoring	2006-2010
	Further water quality implementation measures (if necessary) - nutrient management and structural measures	2010
Nonpoint Source	Gila County ground and surface water improvement project	2006-2008
	R-Bar-C Boy Scout Ranch sewer facilities upgrade project	2006-2008
	Education, awareness and interpretation of recreational impacts on watershed	Ongoing
	R-Bar-C Boy Scouts internal education on human-induced bacteria effects and relationship to watershed	2006
	R-Bar-C Boy Scouts external education on human-induced bacteria effects and relationship to watershed and monitoring plan execution	2007

9.0 MILESTONES

In order to evaluate the effectiveness of the TMDL implementations at Tonto Creek and Christopher Creek, measurable milestones must be tracked. As selected management measures take effect in the Tonto Creek watershed, routine assessment of the project status and achievements is needed to determine reasonable assurance of successful implementation.

Milestones are interim and contingent on certain measures like funding, coordination, organization, schedules of stakeholders, timelines, communication, staffing/personnel, and temporal patterns. Initiations of some actions are dependent on the delivery of others. Therefore, milestones used to evaluate the Tonto and Christopher Creeks implementation plan will adapt as the project matures and deliverables are processed. The stakeholders and land owners at Tonto and Christopher Creeks will be responsible for tracking milestones and scheduling evaluations. Predetermined course of actions should be established in the event milestones are not met. Criteria to establish new milestones that did not meet expectations should be based on:

- proximity (time) to achieving milestone;
- sum of efforts equal total goal (how many tasks were achieved in process of meeting goal);
- whether the milestone is beneficial to completion of the project; and
- changes in plans or goals that will adversely affect the milestone.

10.0 IMPLEMENTATION AND EFFECTIVENESS MONITORING

Establishing a monitoring component to evaluate the effectiveness of the point and nonpoint source implementation efforts in the Tonto and Christopher Creek watershed will demonstrate project success. Implementation monitoring and effectiveness monitoring provide a comprehensive approach to evaluate water quality improvement. Creation of a volunteer monitoring group would be a valuable resource for conducting implementation and effectiveness monitoring.

10.1 Implementation Monitoring

Implementation monitoring is used to determine whether activities and management measures are being carried out as planned and how effective the activities have been. This is done by careful tracking and evaluating the execution of the chosen management alternatives. Implementation monitoring will evaluate progression of management goals, milestones and schedules, among other factors. Tracking and evaluating the information revealed through implementation monitoring provides criteria to measure the effectiveness and progression of water quality improvement projects.

10.2 Effectiveness Monitoring

Effectiveness monitoring involves in-stream monitoring to evaluate water quality changes that occur after the implementation of chosen management measures. Effectiveness monitoring provides data to assist in evaluating the status of the waters and the effectiveness of management measures implemented towards achieving load reductions and improving water quality.

ADEQ is required to revisit waters in which a TMDL study has been performed within five years (A.R.S. § 49-234(J)) to determine the effectiveness of water quality implementation plans and to gather additional data for Arizona's 305(b) Water Quality Assessment Report and 303(d) List of Impaired Waters. Assessing water quality data sampled within the Tonto and Christopher Creeks watershed will determine whether the waterbodies are attaining designated uses and meeting applicable water quality standards. This assessment, required under the Clean Water Act, is completed every two years and considers available surface water data collected within the last five years. Effectiveness monitoring data will provide ADEQ with the necessary water quality data to determine the success of these implementation initiatives.

10.3 Volunteer Monitoring

Volunteer organizations assist in determining the need for water quality improvements within a watershed. These groups provide skilled and trained volunteer labor for collecting water quality data and performing effectiveness monitoring after established management measures are in place. Volunteer monitoring resources are listed below.

10.3.1 Master Watershed Steward

Master Watershed Stewards (MWS) are trained volunteers working closely with the University of Arizona (U of A) Cooperative Extension and ADEQ to improve watershed health. Utilizing knowledge of hydrology and water quality monitoring, Master Watershed Stewards may be willing to donate time and skills for effectiveness monitoring. MWS training courses are being planned for Gila County in the city of Payson, Arizona, which is within the Tonto Creek watershed. For more information, please visit the MWS website:

www.ag.arizona.edu/watershedsteward/

10.3.2 Gateway Community College Water Monitoring Course

ADEQ will be collaborating with Gateway Community College (GCC) in Phoenix to train volunteers to conduct water quality sampling around the state. ADEQ is working closely with GCC to develop a modular water quality curriculum to train volunteers and others in proper sampling techniques, development of Sample and Analysis Plans and Quality Assurance Plans and care and maintenance of equipment. The goal is to have a curriculum that can be tailored to the specific needs of a group to provide valuable, useable water quality data. For more information, please visit the GCC website:

www.gatewaycc.edu/

10.3.3 USDA-Cooperative State Research, Education, and Extension Service

This water quality program is managed by the United States Department of Agriculture (USDA) Cooperative State Research, Education, and Extension Service (CSREES). CSREES brings university scientists, instructors, and UA Extension educators together for effective and efficient partnerships with Federal interagency priority programs to address water quality issues in agriculture. The Volunteer Water Quality Monitoring National Facilitation Project, administered by CSREES, is designed to build a comprehensive support system for extension volunteer water quality monitoring efforts across the country. The goal of CSREES is to expand and strengthen the capacity of existing UA Extension volunteer monitoring programs and support development of new groups. For more information, please visit the CSREES website:

www.uwex.edu/ces/csreesvolmon/

It is important for any parties interested in collecting samples to understand Arizona's "credible and scientifically defensible data requirements" as established in the Arizona Administrative Code, Title 18, Chapter 11, Article 6. Although ADEQ cannot require monitoring parties to follow these rules, data must meet these requirements to be included in Arizona's Integrated 305(b) Assessment and 303(d) Listing Report. These requirements include proper training of samplers, development of a sample plan, and use of a state certified laboratory for sample analysis. For more information, please visit the ADEQ website: www.adeq.state.az.us/environ/water/assessment/submissions.html

11.0 PUBLIC PARTICIPATION

Development of the Tonto and Christopher Creeks TMDL included public participation in accordance with 40 CFR Parts 25 & 130.7. Public participation included review and input from stakeholder groups. A project presentation meeting was held by the ADEQ in February 2005. Property owners; environmental groups; representatives of local, state, and federal agencies; and other interested members of the public were notified and attended this meeting. A copy of this report is also available on the ADEQ TMDL Web site:

www.azdeq.gov/environ/water/assessment/tmdl.html

A notice regarding availability of the draft TMDL report was made in the *Payson Roundup & Advisor* and after a 30-day public comment period, only the Arizona Department of Game and Fish made comments. After a 45-day public notice period in the Arizona Administrative Register, which included comments and ADEQ responses; no additional comments were received. The development of the TMDL Implementation Plan follows similar review and input from stakeholders through public participation and public comment period.

REFERENCES

Arizona Administrative Code, Title 18, Chapter 11, Water Quality Standards

Arizona Revised Statute § 49-234 (G), (H), & (J), TMDL Implementation Plan

Arizona Department of Environmental Quality, 1995, Upper Tonto Creek Intensive Survey

Arizona Department of Environmental Quality, 1996, Christopher Creek Intensive Survey

Arizona Department of Environmental Quality, 1996-2004, Arizona's 1996-2004 305(b) Water Quality Assessment Report

Arizona Department of Environmental Quality, 2004, Tonto Creek and Christopher Creeks *E. coli* TMDL Report

Arizona Department of Environmental Quality, 2005, Tonto Creek Nitrogen TMDL Report

Arizona Department of Environmental Quality, 1981, Nutrient Levels in the Salt River Basin with Recommended Standards for Phosphorus and Nitrogen.

Code of Federal Regulations Title 40 Part 25, Clean Water Act

APPENDIX A – TMDL TABLES

APPENDIX A – 1

E. coli TMDL Summary

The following table was originally recorded as "Table 27" in the *E. coli* TMDL Report approved by the EPA in June 2005. The *E. coli* results are expressed cfu/100 ml. unless otherwise indicated. The Load Capacity = Standard = 235 cfu/100 ml. The natural background is measured at the natural background site and is applied to all other sites. The Tonto Creek natural background = 15 cfu/100 ml. The Christopher Creek natural background = 5 cfu/100 ml.

Tonto Segment/sources [1]	Sites (No. of Samples) [2]	Mean of all Measurements	MOS [3]	WLA [4]	LA [4]	**TMDL [5]**	Load Reduction [6]	Load Reduction (%) [7]
Natural Background - below spring [9]	73.00 (10)	15	2		15	**17**		
Fish Hatchery/hatchery, septic [8, 9]	72.66, 71.72 (21)	37	6	22	15	**43**	0	0%
Baptist Camp/septic	70.86, 70.00, 69.87 (23)	83	13		83	**96**	0	0%
Below Horton Creek	69.83, 69.80, 69.08, 68.95, 68.77 (37)	77	12		77	**89**	0	0%
Kohl's Ranch/septic	68.00 (17)	64	10		64	**74**	0	0%
Kohl's Ranch & Tontozona/septic	67.95, 66.90 (20)	297	32		203	**235**	94	32%
Below Christopher	66.80, 65.38 (38)	317	32		203	**235**	114	36%
Bear Flats/septic	64.22 (19)	338	32		203	**235**	135	40%

Christopher Segment/sources [1]	Sites (No. of Samples) [2]	Mean of all Measurements	MOS [3]	WLA [4]	LA [4]	**TMDL [5]**	Load Reduction [6]	Load Reduction (%) [7]
Natural Background - below spring	6.04 (11)	5	1		5	**6**		
Upper Reach	5.70, 4.47 (22)	23	4		23	**27**	0	0%
Christopher Creek settlement/septic	3.56 (17)	98	16		98	**114**	0	0%
Hunter Creek/septic	2.85 (22)	43	7		43	**50**	0	0%
Christopher Creek Campground [9]	2.26 (21)	204	32		203	**235**	1	0%
R-C Scout Camp/septic	1.49, 1.36, 1.24 (29)	403	32		203	**235**	200	50%
Box Canyon	1.23, 1.22, 1.21, 1.20, 1.19, 1.18 (12)	202	32		202	**234**	0	0%
Mouth	0.08 (10)	256	32		203	**235**	53	21%

1) All segments include natural background and recreational use. Recreational use includes hiking, biking, camping, picnicking, wading, fishing and hunting.
2) Stream mile portion of sample site name used to delineate segment. (Number of samples collected in segment.)
3) MOS = mean of all measurements from each segment x 16% or 32 cfu/100 ml if mean of measured + 16% is > 235.
4) WLA = mean of all measurements from each segment - natural background - MOS. LA = mean of all measurements from each segment - MOS.
5) TMDL = 235 cfu/100 ml. for segments where mean of all measurements + 16% exceeds standard of 235.
6) Load Reduction (cfu/100 ml) = WLA + LA - mean of all measurements.
7) Load Reduction (%) = Load Reduction divided by mean of all measurements.
8) Hatchery septic inputs cannot be differentiated from hatchery discharge; therefore, the WLA includes both.

APPENDIX A – 2

Nitrogen TMDL Summary

The following table was originally recorded as "Table 3: TMDL and Related Loads for Total Nitrogen Annual Mean" in the Nitrogen TMDL Report approved by the EPA in July 2005. The results are based upon the Annual Mean Standard of 0.5 mg/l. Units are kg/year and displayed as rounded to nearest whole number unless otherwise indicated. The natural background load = 72 kg/year. This natural background load is the nitrogen measured at the natural background site and applied to all other sites.

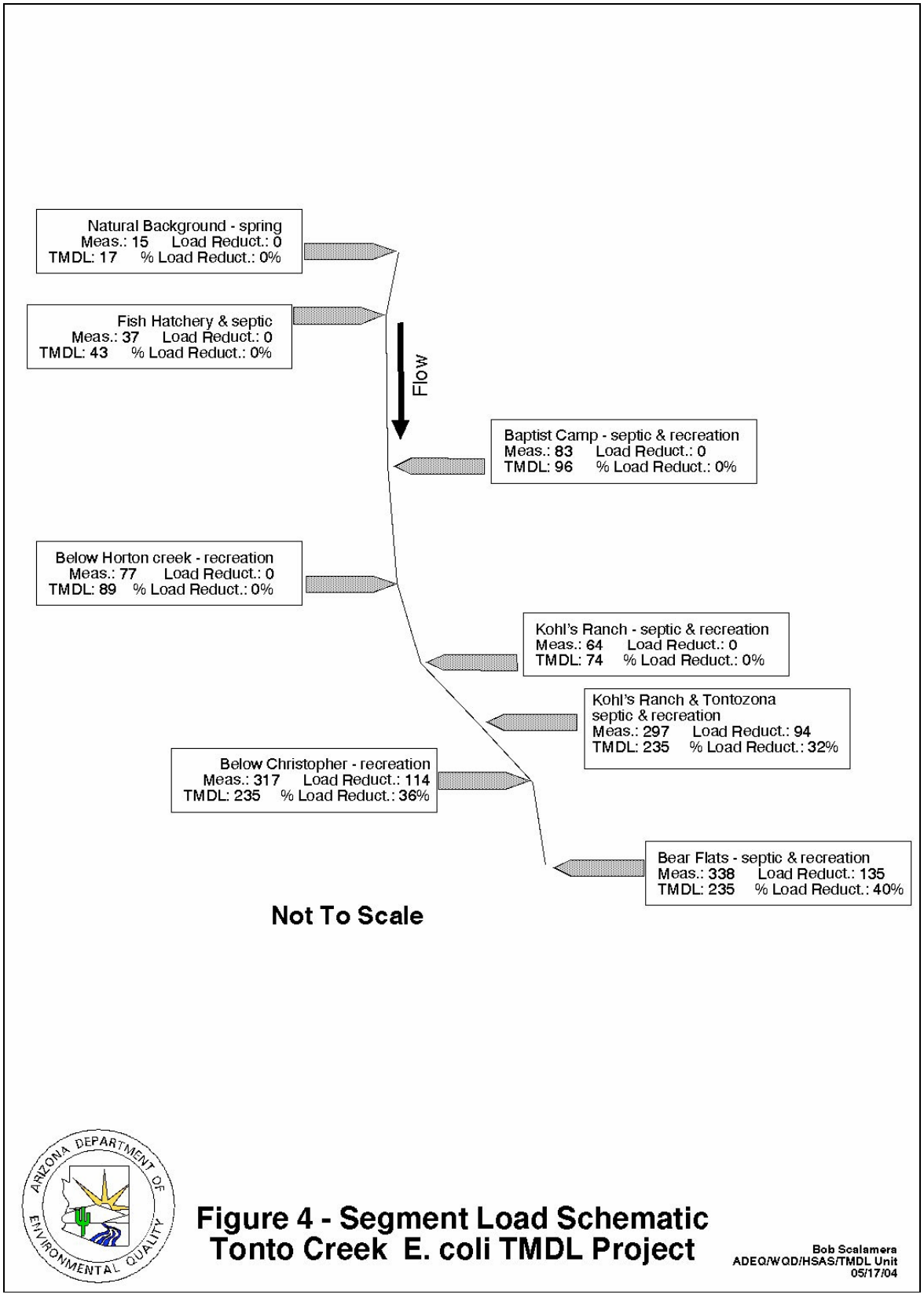
Segment - sources - sites [1]	Mean of measured [2] Discharge (cfs)	concentration (mg/l)	load	MOS [3]	Load Capacity [4]	WLA [5]	LA [5]	**TMDL [6]**	Load Reduction [7] kg/year	percent
Natural Background - spring Site: 73.00	0.67	0.12	72	7	299		72	**79**	0	0%
Fish Hatchery Sites: 72.66, 71.72	1.98	0.528	934	71	884	742	72	**884**	120	13%
Baptist Camp - septic & recreation Sites: 70.86, 70.00, 69.87	1.36	0.411	499	50	607		499	**549**	0	0%
Below Horton Creek - recreation Sites: 69.83, 69.80, 68.95, 68.77	1.14	0.304	309	31	509		309	**340**	0	0%
Kohl's Ranch & Tontozona - septic & recreation Site: 66.90	1.68	0.3	450	45	750		450	**495**	0	0%
Christopher Creek mouth - recreation Site: 0.08 [9]	1.63	0.338	492	49	728		492			
Below Christopher - recreation Sites: 66.80, 65.38	3.59	0.649	2081	128	1603		1475	**1603**	606	29%
Bear Flats - septic & recreation Site: 64.22	3.99	0.546	1945	143	1781		1639	**1781**	306	16%

1) All segments include natural background. Recreational use includes hiking, biking, camping, picnicking, wading, fishing and hunting.
2) Arithmetic mean of annual arithmetic means for each segment. Discharge and concentration from Table 2. Load = discharge x concentration x 892.97
3) If load + 10% > load capacity, then: MOS = 0.04 x 892.97 x discharge, else: MOS = mean of measured concentration x 0.1 x discharge x 892.97. (see MOS section of report for detailed explanation.)
4) Load Capacity = standard x discharge x 892.97 (conversion factor from cfs and mg/l to kg/year)
5) If the load + MOS > load capacity, then: WLA = 0.46 x discharge x 892.97 - natural background, else: WLA = mean of measured load - natural background. Likewise, if the load + MOS > load capacity, then: LA = 0.46 x discharge x 892.97, else: LA = mean of measured load. For the Fish Hatchery segment, the entire LA is natural background.
6) If mean of measured load + MOS exceeds load capacity, then: TMDL = Load capacity for segments, else: the TMDL = mean of measured load + MOS.
7) Load Reduction (kg/year) = Mean of measured load - WLA - LA.
8) Load Reduction (%) = Load Reduction divided by mean of measured load.
9) Christopher Creek mouth site included as a load source. A TMDL was not calculated for Christopher Creek; however, the TMDLs assigned to the two segments downstream of Christopher Creek assume the loading from Christopher Creek will not increase.

APPENDIX B – LOAD SCHEMATICS

APPENDIX B – 1

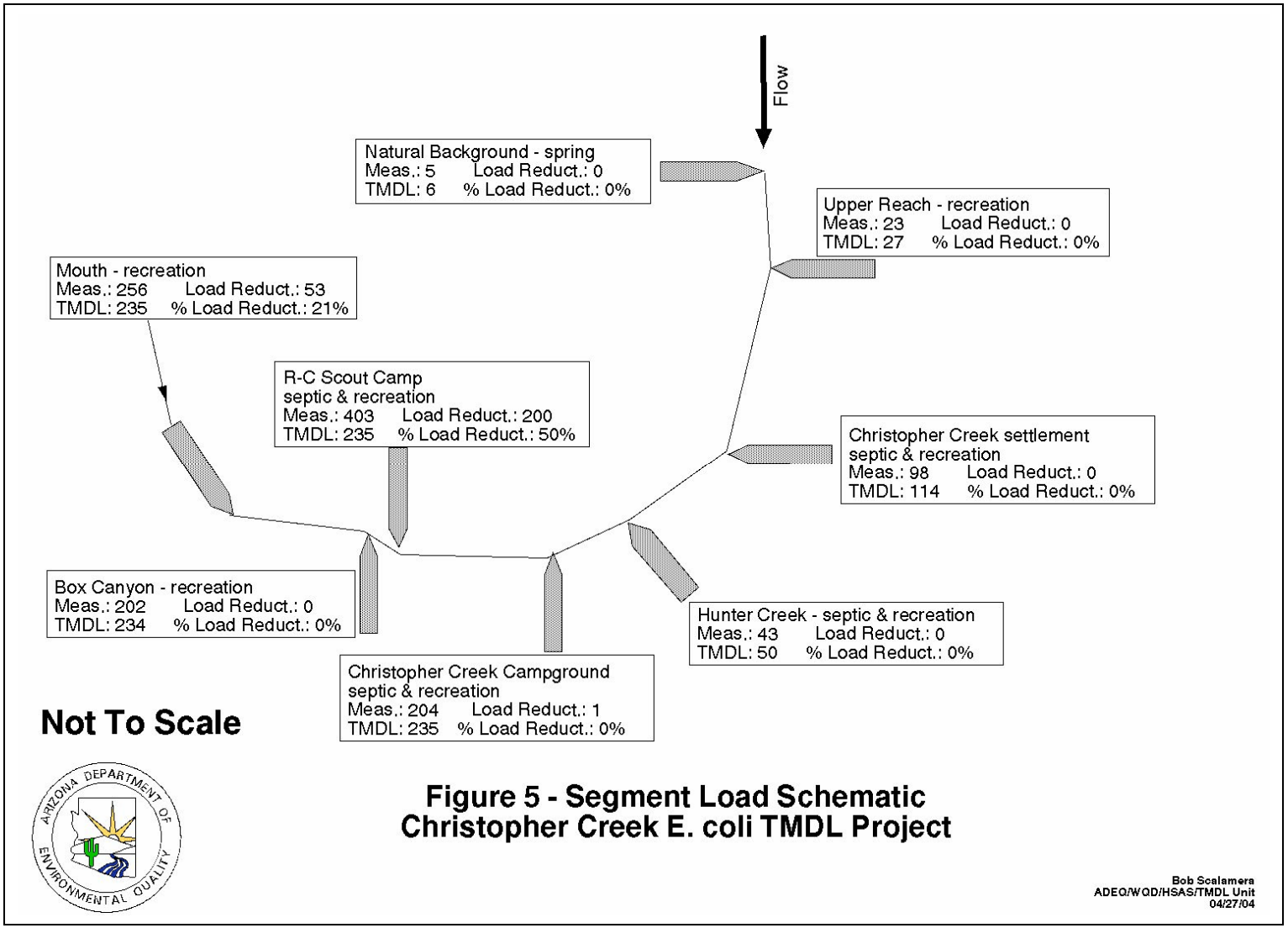
Tonto Creek *E. coli* Load Schematic



The above schematic was obtained from the *E. coli* TMDL Report, June 2005.

APPENDIX B – 2

Christopher Creek *E. coli* Load Schematic



The above schematic was obtained from the *E. coli* TMDL Report, June 2005.

APPENDIX B – 3

Tonto Creek Nitrogen Load Schematic

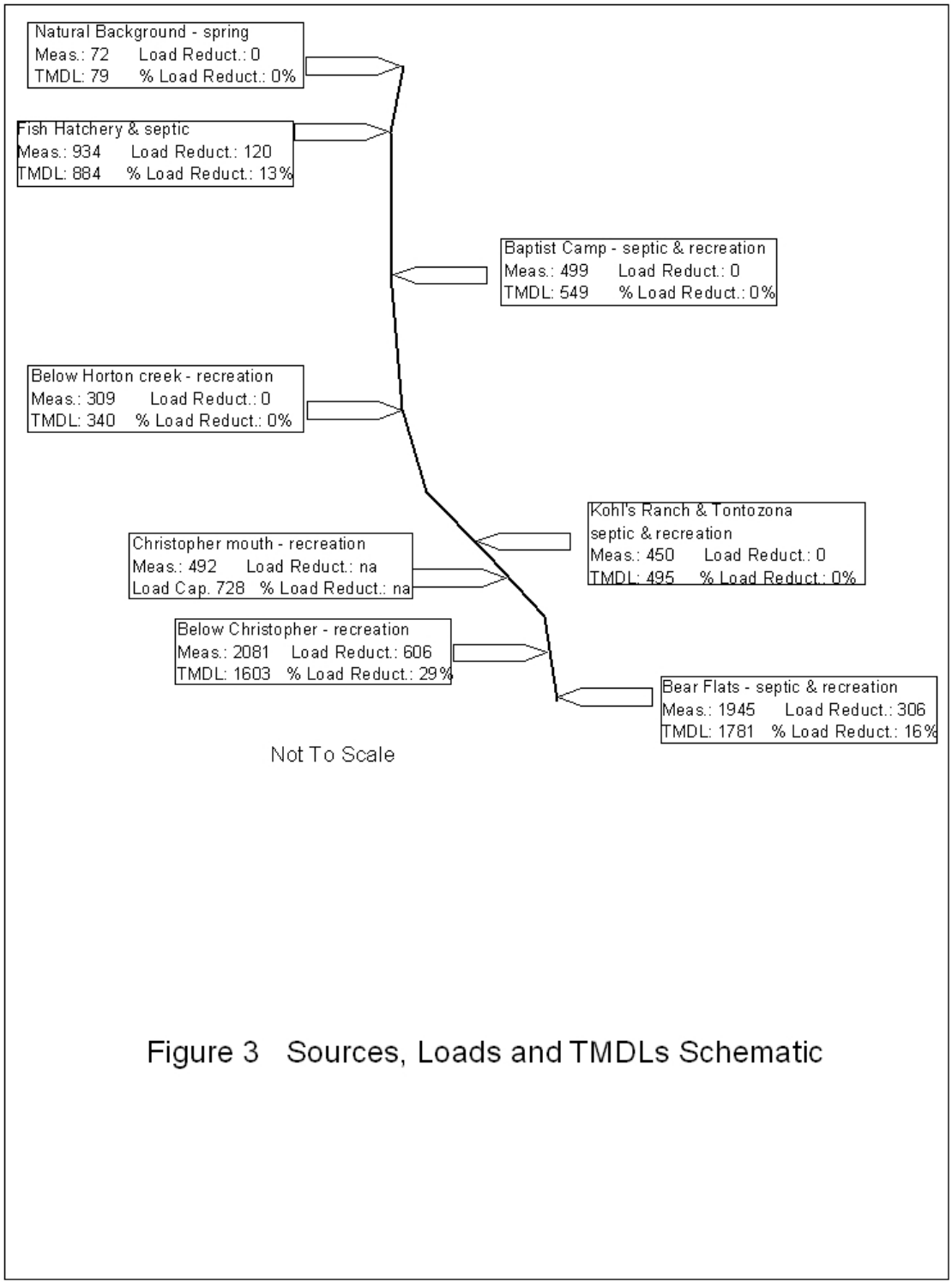


Figure 3 Sources, Loads and TMDLs Schematic

The above schematic was obtained from the Nitrogen TMDL Report, July 2005.