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Implementation Plan for One Total Maximum Daily Load for Bacteria in Guadalupe River Above Canyon Lake

Segment 1806

Water Quality Planning Division, Office of Water

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

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Acronyms and Abbreviations

AU	assessment unit
BMP	best management practice
cfu	colony-forming units
CIG	Conservation Innovation Grants
CRP	Conservation Reserve Program
DMR	Discharge Monitoring Report
E. coli	Escherichia coli
EPA	U.S. Environmental Protection Agency
ETJ	extraterritorial jurisdiction
ft	feet
GIS	geographic information system
I&I	inflow and infiltration
I-Plan	implementation plan
KSP	Kerrville Schreiner Park
LA	load allocation
LDC	load duration curve
LHP	Louise Hays Park
LF	linear feet
MM	management measure
mL	milliliter
MGD	million gallons per day
MOS	margin of safety
MS4	municipal separate storm sewer system
NELAC	National Environmental Laboratory Accreditation Conference
NPDES	National Pollutant Discharge Elimination System
NRCS	USDA Natural Resources Conservation Service
OSSF	on-site sewage facility
RC&D	Resource Conservation and Development Areas
SEP	Supplemental Environmental Project
SSO	sanitary sewer overflow
SWMP	storm water management plan
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TxDOT	Texas Department of Transportation
TSSWCB	Texas State Soil and Water Conservation Board
UGRA	Upper Guadalupe River Authority
USFWS	United States Fish and Wildlife Service
WLA	waste load allocation
WQMP	Water Quality Management Plan
WWTF	wastewater treatment facility

Implementation Plan for One TMDL for Bacteria in Guadalupe River Above Canyon Lake

Executive Summary

One Total Maximum Daily Load (TMDL) for Bacteria in Guadalupe River Above Canyon Lake (Segment 1806) was adopted by the Texas Commission on Environmental Quality (TCEQ) on July 25, 2007 and approved by the U.S. Environmental Protection Agency (EPA) on September 25, 2007. The TMDL addressed bacteria in two assessment units (AUs) within the City of Kerrville (AUs 1806_04 and 1806_06 based on the 2008 Texas Water Quality Integrated Report). The AUs are from the confluence of Camp Meeting Creek to one mile upstream of Flat Rock Dam inclusive of Kerrville-Schreiner Park and from Francisco Lemos Street inclusive of Louise Hays Park to one mile downstream.

The second part of the TMDL process is an Implementation Plan (I-Plan) which describes the strategy and activities the TCEQ and watershed partners will carry out to improve water quality in the affected watershed. The I-Plan will focus on the impaired AUs of the Guadalupe River Above Canyon Lake identified in the TMDL and the main tributaries of these AUs.

This I-Plan is based on the TMDL and its subsequent revisions, which are documented in updates to the state's Water Quality Management Plan (WQMP). The TMDL identified potential regulated and unregulated sources of the indicator bacteria *Escherichia coli* (*E. coli*). There is one regulated discharger in the Guadalupe River Above Canyon Lake watershed, a domestic wastewater treatment facility (WWTF), and the collection system infrastructure. Potential unregulated bacteria sources identified in the TMDL include urban storm water runoff, malfunctioning on-site sewage facilities (OSSFs), nesting birds at bridge crossings, livestock, direct human deposition (swimmers), and pet, wildlife, and unmanaged animal waste.

The goal of this I-Plan is the reduction of bacteria concentrations in the Guadalupe River Above Canyon Lake to levels that meet the contact recreation criterion defined in the Texas Surface Water Quality Standards. This plan documents six stakeholder developed management measures and one control action that will be used to reduce bacteria contributions.

Management Measures (voluntary activities)

1) Reduce bird feeding at Louise Hays Park and Kerrville-Schreiner Park.
2) Install bird exclusion/deterrent devices on bridges directly over the waterway.
3) Manage the waterfowl population at Louise Hays Park and Kerrville-Schreiner Park.
4) Reduce human contributions through ongoing lateral sewage line replacement, sewer inspection and rehabilitation, ongoing OSSF plan review and registration, mapping of the priority OSSF area, and an education program for OSSF owners.

5) Implement an education program for pet owners and install pet waste stations at public parks.
6) Reduce contributions from general urban runoff through street sweeping, river clean ups and storm water education programs.

Control Action (regulatory activities)

1) Monitor and report *E. coli* bacteria concentrations from the WWTF.

This I-Plan identifies the responsible parties, technical and financial needs, monitoring and outreach efforts, and a schedule of activities for each of the management measures and the one control action. It describes the process that the TCEQ and stakeholders will use to assess progress and adjust the plan periodically. The TCEQ will report results and evaluations from implementation tracking to stakeholders as needed.

Introduction

To restore and maintain water quality in impaired rivers, lakes, and bays, the TCEQ works with stakeholders to develop an I-Plan for each adopted TMDL. A TMDL is a technical analysis that:

- determines the amount of a particular pollutant that a water body can receive and still meet applicable water quality standards, and
- establishes water quality goals for different categories of sources that will result in achieving water quality standards.

This I-Plan is designed to guide activities that will achieve the water quality goals for Guadalupe River Above Canyon Lake as defined in the adopted TMDL. This I-Plan is a flexible tool that governmental and nongovernmental organizations involved in implementation use to guide their activities to reduce bacteria loads. The participating partners may accomplish the activities described in this I-Plan through rule, order, guidance, or other appropriate formal or informal action.

This I-Plan contains the following components:

1) A description of the control action and management measures[1] that will be implemented to achieve the water quality target.
2) A schedule for implementing activities (Appendix A).
3) The legal authority under which the participating agencies may require implementation of the control actions.
4) A follow-up tracking and monitoring plan to determine the effectiveness of the control action and management measures undertaken.
5) Identification of measurable outcomes and other considerations the TCEQ and stakeholders will use to determine whether the I-Plan has been properly executed, water quality standards are being achieved, or the plan needs to be modified.

[1] Control actions refer to regulated sources reduction strategies, generally TPDES permits. Management measures refer to strategies for reducing unregulated pollutants, generally through voluntary best management practices (BMPs).

6) Identification of the communication strategies the TCEQ will use to disseminate information to stakeholders.
7) A review strategy that stakeholders will use to periodically review and revise the plan to ensure there is continued progress in improving water quality.

This I-Plan also includes information about the causes and sources of the bacterial impairment, management measure descriptions, estimated potential load reductions, technical and financial assistance needed, educational components for each measure, schedule of implementation, measurable milestones, indicators to measure progress, monitoring components, and responsible entities. Consequently, projects developed to implement unregulated (nonpoint) sources that meet the grant program conditions may be eligible for funding under the EPA's Section 319(h) grant program.

Summary of the TMDL

This section summarizes sections of the Guadalupe River Above Canyon Lake TMDL. Additional background information, including the problem definition, endpoint identification, source analysis, linkages between sources and receiving waters, and seasonal variation can be found in the Guadalupe River Above Canyon Lake TMDL (TCEQ 2007). In addition, continuous and in-depth monitoring has continued to occur along the segment of the Guadalupe River. This additional data has helped refine further source identification.

Watershed Overview

In 2002, the Upper Guadalupe River was identified as impaired due to excessive levels of indicator bacteria (*E. coli*). The Guadalupe River Above Canyon Lake is identified as Segment 1806 by the TCEQ. The upstream end of this segment is the confluence of the North and South Forks of the Guadalupe River in Kerr County. The downstream end of this segment is Canyon Reservoir, which begins 1.7 miles downstream of Rebecca Creek Road in Comal County. This project includes only a small reach of Segment 1806, located within the City of Kerrville, which is impaired for contact recreation. The impaired reach is defined as the Guadalupe River from its confluence with Town Creek downstream to Flat Rock Lake, as illustrated in Figure 1. This implementation plan addresses the impaired AUs and the watershed of the main tributaries of those AUs.

The Guadalupe River above Canyon Lake's watershed is principally a rocky, moderately dissected terrain fed by springs issuing from beds of limestone. The watershed averages 29 inches of rainfall annually and is a semi-arid, sub-humid climate. The land is used for recreation, raising livestock, and small-grain crops. During the drier months of summer, pumps are activated to divert water from the Guadalupe River for irrigation and domestic purposes. Base flow of the Upper Guadalupe River is sustained entirely by groundwater discharge. The main source of base flow is water discharged from the Edwards-Trinity formation and associated limestone.

Segment 1806 was first identified as not supporting the contact recreation use on the *2002 Texas Water Quality Inventory and List*. The 2002 Inventory and List

identified AU 1806_04 and AU 1806_06 as exceeding the contact recreation standard (126 colony forming units (cfu)/100mL) with values of 231 and 193 cfu/100mL respectively. Values reported in the *2006 Texas Water Quality Inventory and List* remained above the contact recreation standard. In the 2008 Inventory and List, both AU 1806_04 and AU 1806_06 reported *E. coli* geometric mean values just over 150 cfu/100mL.

In the draft *2010 Texas Water Quality Integrated Report* (formerly the Inventory and List), *E. Coli* concentrations in each AU continued to be above the contact recreation standard, with AU 1806_04 only slightly elevated at 128cfu/100mL and the upstream AU consistent with previous assessments at 151 cfu/100mL. The draft 2010 Integrated Report also identified two tributaries of the impaired reach as not supporting the contract recreation use: Quinlan Creek, AU 1806D_01, and Town Creek, AU 1806E_01. The draft 2010 Integrated Report also redefined the boundaries of all the AUs in 1806, but these will be revised and returned to their original descriptions in the 2012 Integrated Report.

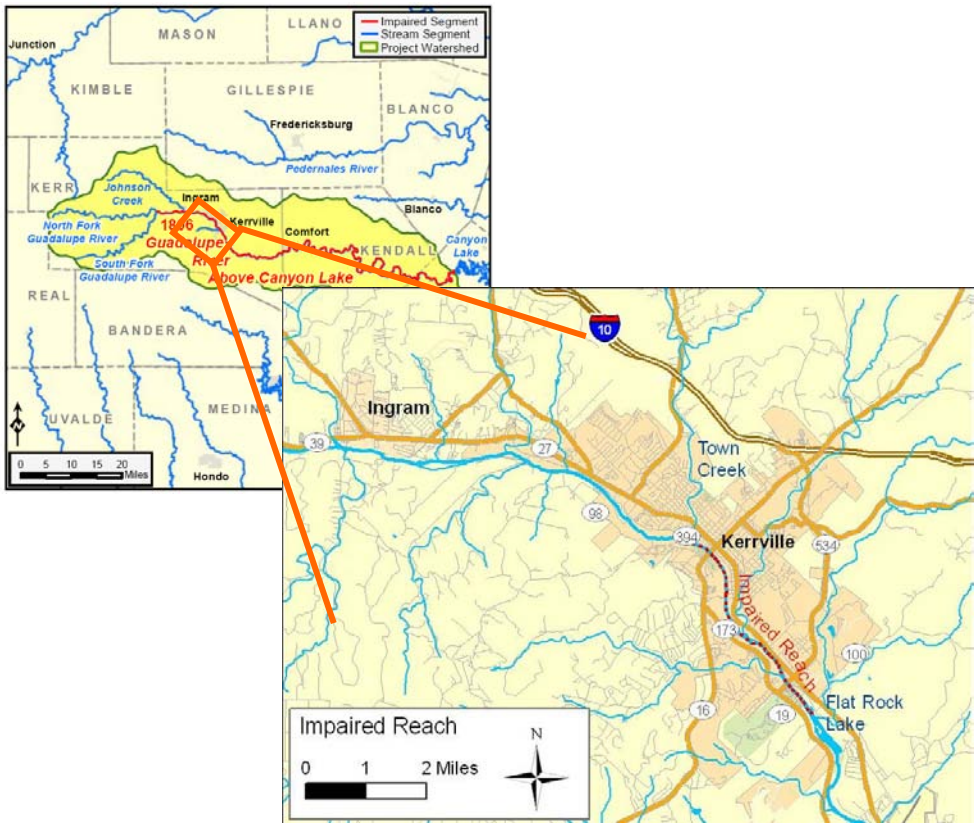

Figure 1: Map of the impaired reach of the Upper Guadalupe River Above Canyon Lake

Spatial and Seasonal Variation

The TMDL examined water quality data and identified spatial trends along the Guadalupe River Above Canyon Lake. A considerable increase in *E. coli* concentrations at water quality station 12617 (Guadalupe River at Louise Hays Park, Hwy 16) suggested that a significant source of bacteria loading exists within the vicinity of this station. *E. coli* concentrations remain relatively high throughout the impaired

reach, through at least Station 12615 (Guadalupe River at Kerrville-Schreiner Park), as shown in Figure 2.

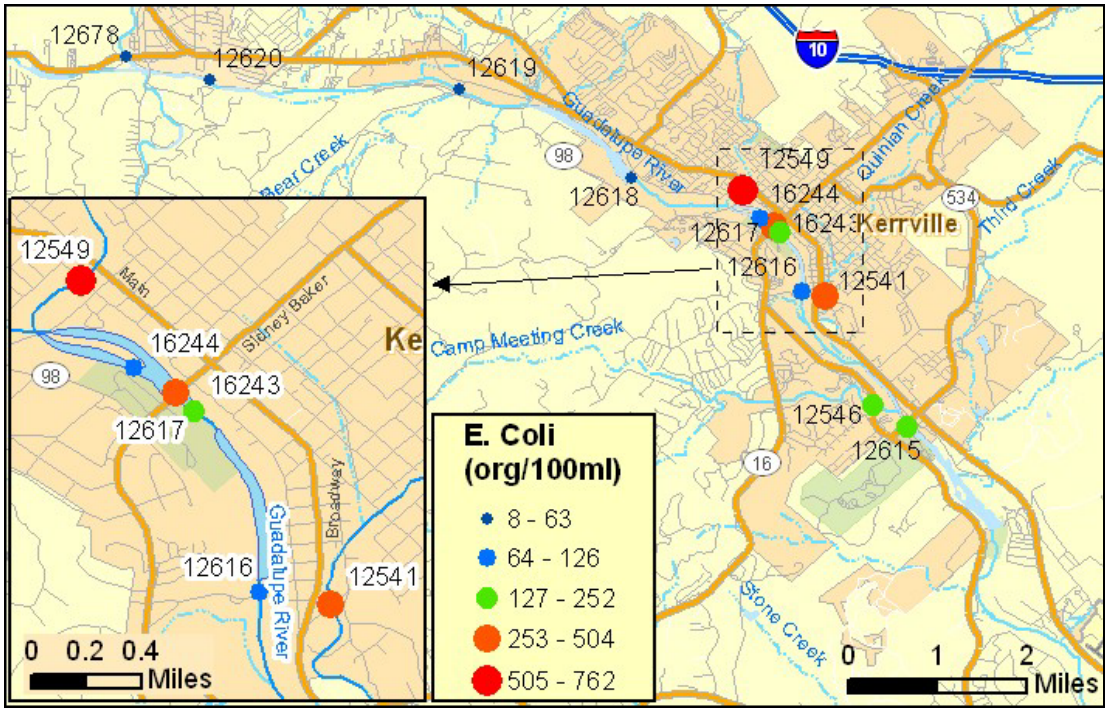

Figure 2: Spatial Variation in Summer Geometric Mean *E. coli* Concentrations 1993-2005

During the summer season, the river has relatively high bacteria levels; it is also when primary contact recreation activities occur frequently. The TMDL concluded the following about the seasonal variability of *E. coli* in the impaired reach:

- Stations that report the highest bacteria levels also have the greatest degree of seasonal variability.
- The highest *E. coli* concentrations are typically experienced in the late summer.
- Stations that report the lowest bacteria levels exhibit little or no seasonal variability in *E. coli* concentrations.

Linkage Between Sources and Receiving Waters

The TMDL identified possible regulated and unregulated sources of bacteria, and quantified appropriate reductions necessary to comply with established water quality standards. Possible sources and/or causes of contamination identified in the TMDL include:

- Wildlife and feral animals (nesting birds, including domestic waterfowl, at bridge crossings in particular)
- leaking collection lines in sanitary sewer infrastructure
- failing septic systems
- direct human deposition
- livestock

- urban storm water runoff

TMDL Calculations

Updates to TMDLs are made through the TCEQ's WQMP. The WQMP identifies long-range planning and technical data for management activities as required under the Texas Water Code and the federal Clean Water Act. The following section summarizes the TMDL calculation for the waste load allocation (WLA) and load allocation (LA). A more detailed explanation can be found in the TMDL report.

The TMDL represents the maximum amount of pollutant that the stream can receive in a single day without exceeding the water quality standard. The final TMDL, including updates to the WQMP, for *E. coli* loadings to Guadalupe River Above Canyon Lake was determined using the following equation:

$$TMDL = \sum WLA + \sum LA + MOS$$

Where:

WLA = waste load allocation (regulated source contributions);
LA = load allocation (unregulated source allocation); and
MOS = margin of safety.

Waste Load Allocation (WLA)

A WLA represents the maximum allowable contribution of regulated sources. Kerrville WWTF was the only potential regulated source for bacteria in the study area during the development of the TMDL. The Kerrville WWTF is located on Third Creek, a tributary of the Guadalupe River. The WWTF source was not included in the 2007 TMDL allocation because of its downstream location. The TMDL identified no existing regulated sources and the WLA was identified as zero. In 2008 TMDL updates to the WQMP added a potential new discharge to the impaired segment: Hill Country Camp (Texas Pollutant Discharge Elimination System (TPDES) permit number 14832-001) with a discharge of 0.025 million gallons per day (MGD). The permit for Hill Country Camp was approved by TCEQ on February 3, 2010 and includes reporting requirements of daily monitoring for E. coli. A WQMP update adjusted the WLA to include the Hill Country Camp discharge identified in the permit.

Load Allocation (LA)

Load allocations represent the maximum allowable contribution of unregulated sources (nonpoint sources (NPS)). The TMDL allocated the City of Kerrville's urban runoff to the load allocation (LA). Currently the City of Kerrville does not have a Municipal Separate Storm Sewer System (MS4) permit because the US Census does not identify Kerrville as urbanized area. A city outside of an urbanized area is not regulated by a MS4 permit unless it is designated by TCEQ. Currently, the TCEQ has not designated the City of Kerrville. If the City of Kerrville were to be designated by the TCEQ, the urban runoff load would be included as part of the WLA instead of the LA.

TMDL Allocation

The total LAs, WLAs, and MOSs for *E. coli* are expressed as billion organisms per day for all flow categories. The TMDLs for each flow category are summarized in Appendix B for the monitoring stations identified as critical in the TMDL—Station

12617 (Guadalupe River at Highway 16 in L. Hays Park) and Station 12615 (Guadalupe River at Kerrville-Schreiner Park).

To achieve the water quality standards in effect at adoption of this TMDL, a 70.5% reduction in loads at Highway 16 (Station 12617) under mid-range flow conditions, and a 52.1% reduction in loads at Kerrville-Schreiner Park (Station 12615) under upper mid-range flow conditions is necessary. These loading reductions are to be achieved in the summer season when bacteria levels are typically highest.

Station 12617, Guadalupe River at Highway 16 in Louise Hays Park

Table 1: High Flow (0-10% Regime) TMDL at Station 12617

TMDL (10^9org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
1175	0.12	1115.88	59

Table 2: Upper Mid-range Flow (10-40% Regime) TMDL at Station 12617

TMDL (10^9org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
472	0.12	447.88	24

Table 3: Mid-range Flow (40-60% Regime) TMDL at Station 12617

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
274	0.12	260.88	13

Table 4: Lower Mid-range Flow (60-90% Regime) TMDL at Station 12617

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
172	0.12	163.88	8

Table 5: Low-range Flow (90-100% Regime) TMDL at Station 12617

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
108	0.12	102.88	5

Station 12615, Guadalupe River at Kerrville-Schreiner Park

Table 6: High Flow (0-10% Regime) TMDL at Station 12615

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
1233	0	1171	62

Table 7: Upper Mid-range Flow (10-40% Regime) TMDL at Station 12615

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
493	0	469	24

Table 8: Mid-range Flow (40-60% Regime) TMDL at Station 12615

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
290	0	275	15

Table 9: Lower Mid-range Flow (60-90% Regime) TMDL at Station 12615

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
179	0	170	9

Table 10: Low-range Flow (90-100% Regime) TMDL at Station 12615

TMDL (billion org/day)	WLA (billion org/day)	LA (billion org/day)	MOS (billion org/day)
111	0	105	6

Implementation Strategy

This I-Plan documents six management measures and one control action to reduce bacteria loads. Management measures are voluntary activities, such as restoring and improving riparian buffer zones. Control actions are regulatory activities, such as monitoring *E. coli* concentrations in WWTF effluent. The management measures were selected based on feasibility, costs, support, and timing. Implementation activities can be implemented in phases based on the needs of the stakeholders and the progress made in improving water quality.

Adaptive Implementation

All I-Plans are implemented using an adaptive management approach in which measures are periodically assessed for efficiency and effectiveness. This adaptive management approach is one of the most important elements of the I-Plan. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals, and expresses stakeholder commitment to the process.

The TCEQ will host annual meetings for up to five years. At the annual meetings, the stakeholders will assess progress using the schedule of implementation, interim measurable milestones, water quality data, and the communication plan included in this document. Based on the periodic assessments of progress the implementation strategy will be adjusted.

Activities and Milestones

As the lead water-resource planning agency in Kerr County, the Upper Guadalupe River Authority (UGRA) has worked with the TCEQ to develop the I-Plan. The plan includes surface water quality monitoring activities to define unregulated sources of bacteria, technical analysis of control measures to predict efficiency of possible best management practices (BMPs), and stakeholder guidance to review possible implementation measures and provide recommendations to the TCEQ for inclusion in the official I-Plan. In addition, the I-Plan outlines effective partnerships with local entities to implement the BMPs. The City of Kerrville, Kerr County, and the Texas Department of Transportation (TxDOT) have committed to collaborate with UGRA to implement the BMPs.

After drafting the TMDL document, the Guadalupe River Above Canyon Lake Stakeholder Advisory Group began developing the I-Plan during the spring 2007. The Guadalupe River Above Canyon Lake I-Plan describes the six stakeholder-developed management measures and one control action in the following sections.

Management Measures

1) Reduce bird feeding at Louise Hays Park and Kerrville-Schreiner Park.
2) Install bird exclusion/deterrent devices on bridges directly over the waterway.
3) Manage the waterfowl population at Louise Hays Park and Kerrville-Schreiner Park.
4) Reduce human contributions through ongoing lateral sewage line replacement, sewer inspection and rehabilitation, ongoing septic system plan review and registration, mapping of the priority OSSF area, and an education program for OSSF owners.
5) Implement an education program for pet owners and install pet waste stations at public parks.
6) Reduce contributions from general urban runoff through street sweeping, river clean ups, and storm water education programs.

Management Measures 1 through 3

Reduce bird feeding at Louise Hays Park and Kerrville-Schreiner Park.

Install bird exclusion/deterrent devices on bridges directly over the waterway.

Manage the waterfowl population at Louise Hays Park and Kerrville-Schreiner Park.

Ducks and geese have long been suspected as a primary cause of the impairment in the Upper Guadalupe River Above Canyon Lake. Animal surveys conducted over the past several years provide data about the specific number of animals (including birds) in or near the waterway over the past several years. These surveys were conducted to gather additional information about the number of birds and animals in and near the waterway. These animal surveys are expected to continue. The recent monitoring and modeling work done for this project suggests that animals and birds found near the water's edge may be the largest source of bacteria loading to the Guadalupe River under dry weather conditions. For watershed management purposes, waterfowl can be broken into two primary categories:

- Wild (i.e. migratory) waterfowl are protected under the Federal Migratory Bird Treaty Act, and may not be harmed except during the legal hunting season or with special governmental permits. A small number of wild ducks were observed on the Guadalupe River during the main stem survey in September 2008. However, they were only found in remote portions of the river, far from points of regular human access. They generally appeared smaller than domestic ducks, and they flew away when approached. Due to their relatively small size and small numbers, wild ducks are not expected to be a major source of bacteria in the Guadalupe River.
- Domestic waterfowl are those that do not migrate, and include exotic and feral species. It is believed that most (or all) of the waterfowl at Louise Hays Park and Kerrville-Schreiner Park fall into this category. They are generally present in large groups.

Reduce bird feeding at Louise Hays Park and Kerrville-Schreiner Park

At the December 2008 meeting, stakeholders agreed that some action is required to reduce the number of waterfowl at the city parks. A public awareness campaign to reduce public bird feeding is planned including signs and pamphlets. Public feeding encourages waterfowl to congregate in unnaturally high concentrations. Reducing public feeding will help prevent additional waterfowl from gathering in public parks and may reduce the existing population.

Install bird exclusion/deterrent devices on bridges over the waterway

Stakeholders also agreed that actions should be taken to reduce the number of bridge roosting birds (pigeons, swallows, and grackles). Birds that roost on bridges are of particular concern because they can contribute fecal matter directly to a watercourse. Results from the TMDL study suggest that bridge-roosting birds are a significant source of bacteria loading to the impaired reach. Large colonies of cliff swallows nest under the Highway 16 Bridge in Louise Hays Park and under the Loop 534 bridge upstream of Kerrville-Schreiner Park. Over 400 swallow nests, lo-

cated directly over the water, have been counted at the Highway 16 Bridge. Pigeons (i.e. rock doves) are regularly seen roosting on the Highway 16 Bridge. Grackles are also seen along the Guadalupe River, but are not known to regularly roost on bridges.

Several methods of pigeon control are available. Unlike most Texas birds, pigeons are a non-native species, and are not protected by any federal or state laws. Since the primary goal of this project is to prevent pigeons from resting on bridges over a water body or in shallow pools on the water's edge, exclusion is an effective option. Exclusion of pigeons from bridges will be accomplished using screens, wires, netting, and/or spikes. Spikes have already been employed as a pigeon deterrent on portions of the Highway 16 bridge at Louise Hays Park as shown in Figure 3.

Figure 3: Pigeon Deterrents on Highway 16 Bridge

Bird deterrent/exclusion structures consisting of spikes and netting will be installed on the underside of the bridge sections over the water on which a bird could roost or build a nest at the State Highway 16 and Loop 534 crossings. The bird deterrent/exclusion structures will be applied on a total of 39,606 square feet. The bird deterrent structures are estimated to last at least five years with little to no maintenance. UGRA staff will inspect structural BMPs periodically and apply for additional funding for maintenance and replacement if necessary. A traffic control plan will also be prepared by TxDOT to address traffic concerns during the instillation of the deterrent/exclusion devices.

Swallows are protected by state and federal law, including the Migratory Bird Treaty Act of 1918. As such, it is illegal to harass swallows or destroy their active nests. Bird deterrent devices would be installed at times when swallows are not present. The most common way to control swallows is to remove old nests and deter the construction of new nests at undesirable locations.

Swallows do serve beneficial purposes and control of nesting locations should be carefully considered. Swallows help control insect populations, including mosquitoes. Local bird watchers may also appreciate swallows. Therefore, it will be important to fully inform the public as to the reasons why the control of the location where the swallows nest is necessary. Only the swallow nests located directly

over the water are a direct source of bacteria, and those nests will be the focus of the management measure.

Manage the waterfowl population at Louise Hays Park and Kerrville-Schreiner Park

Waterfowl management will include the continued removal of domestic waterfowl from City of Kerrville and Kerr County riverside parks. Limited waterfowl removal began in 2009. Public service announcements, press releases, brochures, and other publications are also proposed to inform the public of the impact that concentrated waterfowl populations have on *E. coli* levels in surface water and to encourage the public not to feed the waterfowl.

Stakeholders also viewed waterfowl capture and removal as an option if needed. Because the waterfowl populations at Louise Hays Park and Kerrville-Schreiner Park are well established, it may ultimately be necessary to capture and remove these animals. Park personnel have attempted waterfowl removal in the past with some success. Baited funnel trapping is one type of capture, which might be employed if needed. Kerr County Animal Control is willing to accept the captured waterfowl.

Responsible Parties

- UGRA
- City of Kerrville
- Kerr County
- Texas Department of Transportation

Measurable Milestones[2]

In Year One, all stakeholders will meet, review the I-Plan and agree on the schedule of actions for year one. UGRA will secure funding and design the public education campaign to focus on reducing bird feeding at Louise Hays Park and Kerrville Schreiner Park with input from the City of Kerrville. If time allows, the distribution of public education campaign materials will commence. UGRA will continue monitoring water quality and conducting animal surveys to measure improvements in water quality and to track animal populations. UGRA will secure funding and begin design of the bird exclusion/deterrent devices with input from the City of Kerrville and TxDOT.

In Year Two, all stakeholders will meet and review the results of year one, adjust the I-Plan as necessary and agree on actions for year two. UGRA and the City of Kerrville will implement the public education campaign including installing signs and distribution of pamphlets. If funding allows, UGRA will install bird exclusion/deterrent devices with assistance from the City of Kerrville and TxDOT. Water quality monitoring and animal surveys will continue. If the results of the animal surveys suggest additional actions are needed, the stakeholder group will discuss the removal of swallow nests from under bridge crossings and baiting and trapping to manage the waterfowl population at Louise Hays Park and Kerrville-Schreiner Park. Captured waterfowl would be relocated to Kerr County Animal Control.

[2] Year One begins once the TCEQ approves the I-Plan.

In Year Three, all stakeholders will meet and review the results of year one and year two, adjust the I-Plan as necessary and agree on actions for year three. Year three will include a focus on results of efforts to-date. UGRA and the City of Kerrville will continue to implement the public education campaign to reduce bird feeding and to share the results of efforts. The installation of bird exclusion and deterrent devices will be completed and the results of the devices will begin to be evaluated. Partners will continue to monitor water quality and conduct animal surveys. If stakeholders approve, and the bird surveys suggest the removal of swallow nests from bridge crossings is necessary, the nests will be removed in year three. Baiting and trapping of waterfowl populations at Louise Hays Park and Kerrville-Schreiner Park will occur if deemed necessary. Captured waterfowl would be relocated to Kerr County Animal Control.

In Years Four and Five, all stakeholders will evaluate efforts and determine future actions if needed.

Tables 11 and 12 provide additional details about Management Measures 1, 2 and 3. Appendix A provides a schedule of implementation. The loadings are estimated through analysis of local bacteria data and application of a numerical model developed for the impaired segment of the Upper Guadalupe River Above Canyon Lake. Additional information about the modeling can be found in the 2010 Upper Guadalupe River Best Management Practice Assessment Report.

Table 11: Summary Management Measures 1, 2, 3

*The loadings are estimates through analysis of local bacteria data and application of a numerical model developed for the impaired segments of the Upper Guadalupe River. LHP is Louise Hays Park and KSP is Kerrville-Schreiner Park.

(a) Causes and Sources of Bacterial Impairment	(b) Management Measures (MM) and Targeted Critical Areas	(c) Est. Potential Loading Reduction (109 cfu/day)*	(d) Technical and Est. Financial Assistance Needed	(e) Educational Component for Each Measure	(f) Schedule of Implementation	(g) Interim, Measurable Milestones	(h) Criteria to determine effectiveness	(i) Monitoring Component	(j) Responsible Party
Waterfowl at Louise Hays Park	(MM 1) reduce bird feeding at Louise Hays Park	@LHP*: 210	$1,000 for sign and pamphlet materials	signs/exhibits, public awareness programs	2011-2014	number of pamphlets distributed	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	UGRA & City of Kerrville
	(MM 3) manage waterfowl population at Louise Hays Park	@KSP*: 21	none requested	none	ongoing	reduce waterfowl at park to five or less	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	City of Kerrville
Waterfowl at Kerrville-Schreiner Park	(MM1) reduce bird feeding at Kerrville-Schreiner Park	@KSP: 36	$1,000 for sign and pamphlet materials	signs/ exhibits, public awareness programs	2011-2014	number of pamphlets distributed	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	UGRA & City of Kerrville
	(MM 3) manage waterfowl population at Kerrville-Schreiner Park		none requested	none	ongoing	reduce waterfowl at park to three or less	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	City of Kerrville
Pigeons, Swallows, & Grackles at Louise Hays Park	(MM1) reduce bird feeding at Louise Hays Park	@LHP: 246 @KSP: 25	$1,000 for sign and pamphlet materials	signs/ exhibits, public awareness programs	2011-2014	number of pamphlets distributed	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	UGRA & City of Kerrville
	(MM2) exclusion/ deterrent devices on Highway 16 bridge over water		$75,000 for design and contractor installation	none	2011-2014	reduce birds observed on bridge over water to near zero	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	UGRA with City & TXDOT support
Pigeons, Swallows, & Grackles at Kerrville-Schreiner Park	(MM1) reduce bird feeding at Kerrville-Schreiner Park	@KSP: 104	$1,000 for sign and pamphlet materials	signs and exhibits, public awareness programs	2011-2014	number of pamphlets distributed	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	UGRA & City of Kerrville
	(MM2) exclusion/ deterrent devices on Loop 534 bridge over water		$65,000 for design and contractor installation	none	2011-2014	reduce birds observed on bridge over water to near zero	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	UGRA w/City & TXDOT support

Table 12: Summary of Long-Term Management Measures 1, 2, 3
(To be considered in the future, if necessary.)

(a) Causes and Sources of Bacterial Impairment	(b) Management Measures (MM) and Targeted Critical Areas	(c) Est. Potential Loading Reduction (109 cfu/day)*	(d) Technical and Est. Financial Assistance Needed	(e) Educational Component for Each Measure	(f) Schedule of Implementation	(g) Interim, Measurable Milestones	(h) Criteria to determine effectiveness	(i) Monitoring Component	(j) Responsible Party
Waterfowl	(MM 3) procure professional waterfowl management services	to be determined	to be determined	none	to be determined	reduce waterfowl observed at public parks	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	to be determined
Pigeons and Grackles	(MM 3) trapping and removal of pigeons and grackles from L. Hays Park	to be determined	to be determined	none	to be determined	reduce pigeon and grackle population at L. Hays Park	reduction in *E. coli* levels	routine WQ monitoring, animal surveys	to be determined

*The loadings are estimates through analysis of local bacteria data and application of a numerical model developed for the impaired segments of the Upper Guadalupe River. LHP is Louise Hays Park and KSP is Kerrville-Schreiner Park.

Management Measure 4

Reduce human contributions through ongoing lateral sewage line replacement, sewer inspection and rehabilitation, ongoing septic system plan review and registration, mapping of the priority OSSF area, and an education program for OSSF owners.

Wastewater collection systems that are properly designed and installed are unlikely to contribute bacteria to the environment. However, as a system ages it may sometimes develop leaks, often as pipes are exposed to external loads and the penetration of tree roots. These leaks can result in the infiltration of rainwater and the release of sewage to the environment. If wastewater discharges occur near a watercourse, it is a potential direct source of bacteria.

Lateral Sewage Line Replacement

Service lines (also known as laterals) connect homes and other users to the collection system. Service lines are generally located on private land and require the cooperation of the homeowner to maintain. According to Kerrville City Code (Section 110-53), the property owner is responsible for maintaining their service line all the way to the City's collection main.

According to City of Kerrville staff, roughly 4-10 service lines are replaced each month. These are generally older lines that have suffered tree root intrusion, which blocks the flow of wastewater. The replacement of older service lines with newer service lines (utilizing improved materials and installation practices) should result in a decreased potential for leaks. Since the costs associated with lateral replacement and repair may discourage some homeowners from adequately maintaining their service lines, some cities have implemented programs to help low-income households cover these expenses. Such assistance, if desired, could be in the form of grants or interest-free loans.

Sewer Inspection and Rehabilitation

The City of Kerrville operates and maintains the area's sewage collection system. The City's collection system is predominantly vitrified clay pipe, though PVC is not uncommon, especially in the newer areas of the city that are further from downtown. Iron pipes are used at stream crossings. The City of Kerrville provided a GIS data set of its sanitary sewer system for use in developing the TMDL. The sewer lines were analyzed for their proximity to the Guadalupe River and its tributaries because lines located along these streams, or crossing them, have a relatively high potential to cause surface water contamination if a leak exists. Figure 4 shows the approximate extent of the City's wastewater service based on the locations of existing sewer mains.

Problems with sewage collection and infrastructure are mitigated through a process of inspection and rehabilitation. The City has used smoke testing and closed circuit televising (CCTV) of sewer mains to detect potential problems. Rehabilitation is typically performed through the replacement of aging and defective infrastructure. Table 13 presents work the City has done in recent years to improve the performance of their wastewater collection system.

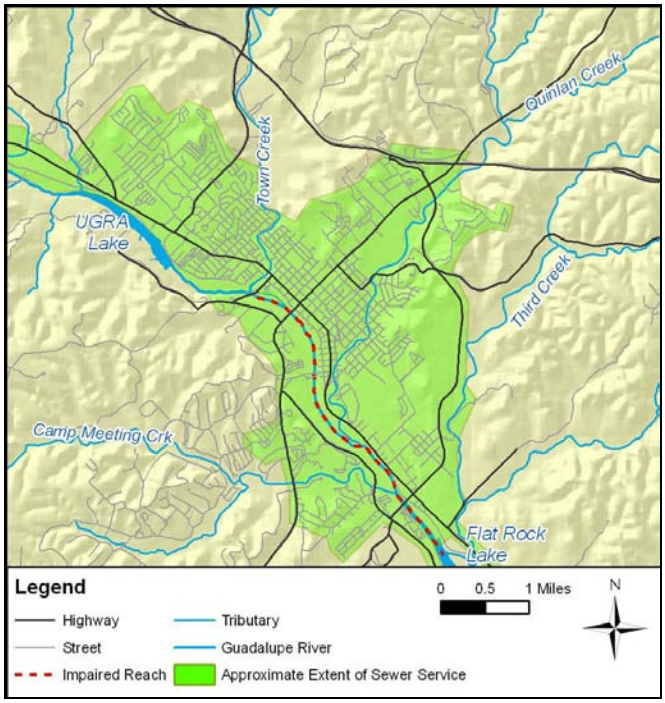

Figure 4: Approximate Extent of Wastewater Collection Service (2006)

Much of the City's efforts are aimed at reducing inflow and infiltration (I&I) to the sanitary sewer system. Inflow is storm water that enters directly into the sanitary sewer through unknown openings like missing manhole lids or through illicit storm water drainage connections. Infiltration is storm water that permeates into the soil and then slowly enters sewers and manholes through cracks and other openings. If not properly addressed, I&I can overload the collection system and result in overflows. I&I is primarily a wet weather phenomenon. However, the same cracks that allow infiltration under wet weather may also result in wastewater exfiltration (sewage leaking from pipes) under dry weather conditions. Therefore, resolving I&I problems can potentially reduce bacteria sources under both wet and dry conditions.

The City of Kerrville recognizes that some improvements to the wastewater collection system are possible, and is working to reduce the potential for leaks and overflows within the system. As part of additional sampling conducted by UGRA, staff identified a leaking sewer force main just below Highway 173. The City of Kerrville repaired the leak quickly. The City of Kerrville identified $700,000 in suggested sewer repairs and began funding these repairs in January 2010. System rehabilitation activities will be performed to the extent that funding is available. The potential impacts of wastewater infrastructure will continue to be evaluated throughout the course of this project.

Table 13: Kerrville Sewer Improvements, 2006-2008

Item	Quantity
Sewer Main Replaced	11,122 LF
Lift Stations rehabilitated/improved	7
Sanitary Sewer Manholes replaced	22
Broken customer cleanouts repaired	47
Footage of Gravity Main Smoke Tested	46,043 LF
Footage of Gravity Main Inspected (CCTV)	35,200 LF
Footage of Gravity Main Cleaned	505,842 LF

LF=Linear Feet

Ongoing septic system plan review and registration

Septic systems can act as sources of pathogens due to inadequate design, inappropriate installation, neglectful operation, or exhausted lifetime. However, many of these problems can be avoided through improved maintenance and inspection activities.

The number of septic systems in the watershed was estimated using information from the 1990 U.S. Census, which included a question regarding the means of household sewage disposal. Unfortunately, this question was not posed in the 2000 Census. Based on the 1990 data, the number of septic systems in the study area was estimated by intersecting the geographic census blocks with the study area watershed. Based on this analysis, there are an estimated 6,400 septic systems in the impaired reach area and an estimated 8,300 sewer connections.

Kerr County's On-Site Sewage Facilities (OSSF) regulations ensure that all OSSF complaints are investigated as mandated by state law and brought into compliance in accordance with the Title 30, Texas Administrative Code §285, the Texas Health & Safety Code §366, §341 and the Texas Water Code §7. Kerr County Environmental Health Department took over the registration and licensing of OSSFs in Kerr County in November of 2003. Previously, these activities were administered by UGRA. Kerry County reviews and registers all new OSSFs in the county. Kerr County OSSF regulations do not require that the sewage facilities be inspected at the time a property's ownership is sold. Continued investigation of complaints by Kerr County and review of new plans for septic systems will help to identify current failing septic systems and reduce the number of future systems from failing.

Mapping and education components

Human contributions will be addressed through the establishment of an OSSF priority area based on proximity to the impaired reach and contributing tributaries. Mapping of the priority area will be conducted as part of this effort. Residents in the priority area will be mailed a "Homeowner's Septic System Guide" including information on proper maintenance of conventional and aerobic systems and how

to identify a failing system. It is estimated that a 5% response rate from this mailing will result in an inspection by Kerr County Environmental Health Department staff. The guide will also be available to the public and possibly distributed through local realtors. Additional public information is also proposed such as public service announcements, brochures, and workshops.

Responsible Entities

- UGRA
- City of Kerrville
- Kerr County

Measurable Milestones

In Year One, all stakeholders will review the I-Plan, submit status reports on current projects and will agree on a plan of action for year one. The City of Kerrville recognized that some improvements to the wastewater collection system were needed and awarded a construction contract in January 2010 to continue sewer inspection and rehabilitation in Kerrville. The City of Kerrville will continue to replace laterals as needed. Kerr County will continue its OSSF plan review and registration. UGRA will mail residents in the priority area a Homeowner's Septic System Guide. Kerr County Environmental Health Department staff will respond to homeowners requesting an inspection. Additional public information plans will be established and begin in year two. UGRA will continue to collect water quality data.

In Years Two and Three, all stakeholders will review the progress of ongoing programs and agree on actions for years two and three. The City of Kerrville, Kerr County, and UGRA will continue projects outlined in years one and two as needed. Kerr County Environmental Health Department staff will respond to homeowners requesting an inspection.

In Years Four and Five, all stakeholders will review the progress of ongoing programs and agree on actions for years four and five.

Table 14 provides additional details about Management Measure 4. Appendix A provides the schedule of implementation.

Table 14. Summary of Short-Term Management Measures 4

(a) Causes and Sources of Bacterial Impairment	(b) Management Measures (MM) and Targeted Critical Areas	(c) Est. Potential Loading Reduction (109 cfu/day)*	(d) Technical and Est. Financial Assistance Needed	(e) Educational Component for Each Measure	(f) Schedule of Implemen-tation	(g) Interim, Measurable Milestones	(h) Criteria to determine effectiveness	(i) Monitoring Component	(j) Responsible Party
Humans	ongoing lateral replace-ment in Kerrville	@LHP: 139 @KSP: 106	no new fund-ing required	none	ongoing	number of laterals replaced	reduction in *E. coli* levels	routine WQ monitoring	City of Kerrville
	ongoing sewer inspection and rehabilitation in Kerrville		$700,000 in suggested sewer repairs have been identified by City	none	ongoing	feet of sewer main replaced, number of leaks repaired, etc.	reduction in *E. coli* levels	routine WQ monitoring	City of Kerrville
	map OSSF locations and determine priority areas, make site inspections		$8,000 for consulting/ mapping ser-vices	none	2010-2013	map of priority areas, number of systems visited	reduction in *E. coli* levels	routine WQ monitoring	UGRA, Kerr County
	education programs for OSSF owners		$2,000 for sign and pamphlet ma-terials	public education programs	2010-2013	number of pamph-lets distributed	reduction in *E. coli* levels	routine WQ monitoring	UGRA, Kerr County
	ongoing septic system plan review and registration		no new fund-ing required	none	ongoing	number of OSSF registrations issued, complaints resolved	reduction in *E. coli* levels	routine WQ monitoring	Kerr County

*The loadings are estimates through analysis of local bacteria data and application of a numerical model developed for the impaired segments of the Upper Guadalupe River. LHP is Louise Hays Park and KSP is Kerrville-Schreiner Park.

Management Measure 5

Implement an education program for pet owners and install pet waste stations at public parks.

The key to reducing bacteria loads from domestic pets is to encourage pet owners to clean up after their pets. There are generally three methods available for accomplishing this:

- Implement and enforce local ordinances, which require owners to collect and dispose of animal waste properly.
- Educate the public about the deleterious effects of uncollected animal waste, including human health hazards and the sullying of public parks.
- Provide the public with improved means of animal waste collection, including bag dispensers and disposal containers at public parks.

UGRA will work with Kerry County and the City of Kerrville to develop the public education campaign. As of October 2010, 19 public parks in the City of Kerrville could benefit from the addition of pooper-scooper stations. The City of Kerrville is interested in providing information to the public about proper pet waste disposal through brochures. Kerr County has expressed interest in installing stations in Flat Rock Park where the risk of bacteria loading to the waterways is high due to its proximity to the river. Seven pet waste stations have been installed at Flat Rock Park. Additional stations will be added in the watershed. Each station would contain a poster with information about pet waste contributions to *E. coli* levels in the river.

UGRA has applied for funding to create public service announcements, press releases, and other publications. The new stations will have small signs or mounted posters explaining the virtues of pet waste collection. Currently, dogs and other pets are not suspected of being a major source of bacteria to the impaired reach of the Guadalupe River, but these proposed programs will further reduce waste contributions from this potential source. The potential impacts of pets will continue to be evaluated throughout the course of the I-Plan.

Responsible Parties

- Kerr County
- UGRA
- City of Kerrville

Measurable Milestones

In Year One, UGRA will secure funding and develop a pet waste education campaign including brochures and signage. The City of Kerrville has expressed interest in providing information about proper pet waste disposal in its outreach materials. Pet waste containers, signs, and collection bins will be installed in area parks. A program to evaluate the effectiveness of the pet waste stations will be implemented. UGRA will continue to monitor water quality.

In Years Two and Three, all stakeholders will review the progress of ongoing programs and agree on actions for years two and three. The pet waste education

campaign will continue and if funding is available, additional containers and signage will be distributed. Routine water quality monitoring will continue.

In Years Four and Five, all stakeholders will review the progress of ongoing programs and agree on how to move forward with actions for years four and five.

Table 15 provides additional details for Management Measure 5. Appendix A provides the schedule of implementation.

Management Measure 6

Reduce contributions from general urban runoff through street sweeping, river clean ups and storm water education programs.

The goal of this management measure is to decrease nonpoint source pollution from storm water runoff and raise awareness of how unregulated sources of pollution impact water quality. The City of Kerrville has agreed to conduct street sweeping in the watershed of the impaired reach on a routine basis. The street sweeping will remove potential pollutants, including material that may contribute to the bacterial impairment from impervious roadway surfaces. In addition, UGRA will continue the River Crossing Cleanup program to remove trash from three crossings within the impaired reach. UGRA will also conduct annual river clean ups to remove trash from the watershed and promote awareness of the litter program by involving the community.

UGRA also plans to purchase an interactive kiosk that will support an educational program that will rotate among local school libraries and other locations in the community. In addition to the interactive kiosk, public service announcements, press releases, and workshops are also proposed to increase public knowledge of storm water runoff.

Responsible Parties

- UGRA
- City of Kerrville

Measurable Milestones

In Year One, UGRA will secure funding and purchase the interactive kiosk and begin developing the educational program that could potentially include public service announcements, press releases, workshops, and school programs. The first year will focus on design and creation of the educational program. UGRA will continue the River Crossing CleanUp program at up to two river crossing in the impaired reach. The City of Kerrville will conduct street sweeping in the watershed on a routine basis.

In Years Two and Three, all stakeholders will review the progress of ongoing programs and agree on actions for years two and three. UGRA will begin implementing the storm water education program. UGRA will continue the River Crossing CleanUp program at up to two river crossing within the watershed. The City of Kerrville will conduct street sweeping in the watershed on a routine basis.

In Years Four and Five, all stakeholders will review the progress of ongoing programs and agree on how to move forward with actions for years four and five.

Table 16 provides additional details for Management Measure 6. Appendix A provides the schedule of implementation.

Control Action

Monitor and report E. coli concentrations from WWTFs.

Control Action 1

There is currently one WWTF (Hill Country Camp) that discharges in the Upper Guadalupe River Above Canyon Lake watershed. This WWTF will monitor and report *E. coli* concentrations in their final effluent. Monitoring will then continue as required by the permit.

The goal of the monitoring is to ensure that the facility's effluent has concentrations less than the water quality stream standard for contact recreation. If monitoring results indicate concentrations approaching or exceeding the standard, the facility will make necessary operational changes to reduce bacteria concentrations.

In November 2009, the TCEQ's Commissioners approved Rule Project No. 2009-005-309-PR. The rulemaking adds bacteria limits for either *E. coli* for fresh water discharges or *Enterococc*i for saltwater discharges to TPDES domestic permits in Chapter 309 and sets the frequency of testing for bacteria in Chapter 319.

The TCEQ is responsible for enforcement of compliance with permits. The goal of the monitoring is to ensure that the facilities' effluent has concentrations less than the limits stated in each facility's permit.

Responsible Parties

- TCEQ
- WWTFs in the watershed

Measurable Milestones

In 2009, the TCEQ included an *E. coli* monitoring requirement in the permits for the existing WWTFs.

In Years One, **Two, Three, Four and Five,** all WWTFs will continue to monitor and report *E. coli* bacteria data as required by individual wastewater permits and will make appropriate adjustments to operations, if *E. coli* concentrations warrant adjustments to decrease concentrations. The TCEQ TMDL team and responsible entities will review, summarize, and present monitoring data to the stakeholders at annual stakeholder meetings or as needed.

Table 15. Short-Term Management Measure 5

(a) Causes and Sources of Bacterial Impairment	(b) Management Measures (MM) and Targeted Critical Areas	(c) Est. Potential Loading Reduction (109 cfu/day)*	(d) Technical and Est. Financial Assistance Needed	(e) Educational Component for Each Measure	(f) Schedule of Implementation	(g) Interim, Measurable Milestones	(h) Criteria to determine effectiveness	(i) Monitoring Component	(j) Responsible Party
Pets (dogs)	pet waste stations at public parks	@LHP: 30 @KSP: 16	each station: $400 for equipment + $300/yr maintenance	signs and exhibits	2011-2014	number of stations installed/waste bags used	reduction in E. coli levels	routine WQ monitoring	County and possibly City
	education programs for pet owners		$2,000 for sign and pamphlet materials	public education programs	2011-2014	number of pamphlets distributed	reduction in E. coli levels	routine WQ monitoring	UGRA & City of Kerrville

*The loadings are estimates through analysis of local bacteria data and application of a numerical model developed for the impaired segments of the Upper Guadalupe River. LHP is Louise Hays Park and KSP is Kerrville-Schreiner Park.

Table 16. Short-Term Management Measure 6

(a) Causes and Sources of Bacterial Impairment	(b) Management Measures (MM) and Targeted Critical Areas	(c) Est. Potential Loading Reduction (109 cfu/day)*	(d) Technical and Est. Financial Assistance Needed	(e) Educational Component for Each Measure	(f) Schedule of Implementation	(g) Interim, Measurable Milestones	(h) Criteria to determine effectiveness	(i) Monitoring Component	(j) Responsible Party
General urban runoff	routine street sweeping in the City of Kerrville in the watershed of the impaired area	@LHP: 1-2 @KSP: 1-2	no new funding required	none	ongoing	# and frequency of streets swept	reduction in E. coli levels	routine WQ monitoring	City of Kerrville
	routine river clean ups in the watershed of the impaired area		no new funding required	none	ongoing	pounds of trash and debris removed	reduction in E. coli levels	routine WQ monitoring	UGRA
	storm water education program		$2,000 for sign and pamphlet materials	public education programs	2010-2013	# of pamphlets distributed	reduction in E. coli levels	routine WQ monitoring	UGRA

*The loadings are estimates through analysis of local bacteria data and application of a numerical model developed for the impaired segments of the Upper Guadalupe River. LHP is Louise Hays Park and KSP is Kerrville-Schreiner Park.

Sustainability

The TCEQ and stakeholders in TMDL implementation projects periodically assess the results of the planned activities and other sources of information to evaluate the efficiency of the I-Plan. Stakeholders evaluate several factors, such as the pace of implementation, the effectiveness of BMPs, load reductions, and progress toward meeting water quality standards. The TCEQ will document the results of these evaluations and the rationale for maintaining or revising elements of the I-Plan, and will present them as summarized in the following section.

The TCEQ and stakeholders will track the progress of the I-Plan using both implementation milestones and water quality indicators. These terms are defined as:

- **Water Quality Indicator** – A measure of water quality conditions for comparison to pre-existing conditions, constituent loadings, and water quality standards.
- **Implementation Milestones** – A measure of administrative actions undertaken to effect an improvement in water quality.

Water Quality Indicators

Follow-up monitoring will be conducted within the watershed throughout the implementation schedule. The monitoring strategy will consider the spatial and temporal aspects necessary to characterize trends in water quality that result from implementing the activities in this plan. Follow-up monitoring will also provide water quality data for evaluation of standards attainment. The monitoring program is expected to consist of routine sampling exercises that emphasize historical monitoring locations, with some potential modifications as needed. Water quality monitoring and data collection will occur routinely throughout the year. As stated in the TMDL report, the summer season represents the critical condition, during which time the study area has the highest levels of bacteria and contact recreation. The TMDL and respective reductions are based on the critical condition.

UGRA, with support from the TCEQ, began a three-year monitoring regime in July 2008. The objective of this monitoring is to provide data for characterizing *E. coli* bacteria loads in the impaired reach. The scope of this monitoring includes three types of surveys: synoptic sampling surveys, spatially intensive surveys, and animal (including bird) surveys.

The synoptic sampling surveys are used to determine temporal variations in *E. coli* levels at key locations within the study area. The synoptic monitoring is performed irrespective of hydrologic conditions. The second type of monitoring is spatially intensive surveys that were performed under base flow conditions. For this monitoring the sampling density is much greater than that of synoptic sampling surveys. Sampling for spatial intensive surveys is performed at regular intervals along the length of the stream and at any flowing outfalls or tributaries rather than at prescribed stations. The last type of monitoring is the animal surveys. Animal surveys are used to determine the numbers and types of animals typically present along the impaired reach. For these surveys, animal counts are conducted at sever-

al stations on a semi-weekly basis during the summer (typically on a weekday) and semi-monthly during the rest of the year. Surveyed animals include humans, ducks, geese, bridge-roosting birds, and dogs. The data from these surveys combined with water quality sampling data can be used to measure the success of im-implementation measures.

The UGRA is responsible for coordinating the monitoring activities of the Clean Rivers Program in Kerr County. The data from these activities are included in the TCEQ's Surface Water Quality Monitoring database (SWQMIS), which houses the primary data used for the state's biennial assessment of water quality. The UGRA collects data quarterly from 10 fixed stations within the study area. During the summer months, UGRA also monitors bacteria levels at 21 swimming areas, but this data has not been included in SWQMIS since 2007. Progress related to these environmental indicators will be analyzed by UGRA and the TCEQ.

The TCEQ will assess Guadalupe River Above Canyon Lake every two years as part of updating the Integrated Report. If the Texas Surface Water Quality Standards criteria for contact recreation are revised or changes in the creek's water quality are observed, this plan will be modified. This management strategy allows stakeholders to learn and adapt the plan as progress is made. The ultimate goal is for the AUs of the Guadalupe River Above Canyon Lake to meet water quality standards for contact recreation. If sufficient reductions in *E. coli* are not observed, the stakeholders will reevaluate the potential sources identified in the TMDL and adapt the I-Plan as appropriate.

Implementation Milestones

Implementation tracking provides information that can be used to determine if progress is being made toward meeting the goals of the TMDL. Tracking also allows stakeholders to evaluate the actions taken, identify those which may not be working, and make any changes that may be necessary to get the plan back on target. Schedules of implementation activities and milestones for this I-Plan are included in Appendix A.

Communication Strategy

Communication is necessary to ensure stakeholders understand the I-Plan and its progress in restoring water quality conditions. The TCEQ will disseminate the information derived from tracking I-Plan activities to interested parties, including watershed stakeholders, state leadership, government agencies, non-governmental organizations, and individuals.

The TCEQ will report results and evaluations from implementation tracking to stakeholders for up to the next five years or as needed. The TMDL Program will summarize all actions taken to address the impairment and will report trends observed in the water quality data collected to track the progress of implementation as needed. Responsible parties are committed to providing appropriate information to the TCEQ to update these progress assessments and communicating information at annual meetings. Regionally, the progress and results of the I-Plan

will be reported in annual reports prepared by the Upper Guadalupe River Authority under provisions of the Texas Clean Rivers Program.

In accordance with CWA §319, the state must annually report to USEPA on success in achieving the goals and objectives of the *Texas Nonpoint Source Management Program*, including progress in implementing the NPS portion of TMDLs. The TCEQ and TSSWCB jointly publish *Managing Nonpoint Source Water Pollution in Texas: Annual Report*, which highlights the state's efforts during each fiscal year to collect data, assess water quality, implement projects that reduce or prevent NPS pollution, and educate and involve the public to improve the quality of water resources. Information derived from tracking and review activities of this I-Plan will be reported in each annual report. Previously published annual reports are available at <www.tceq.texas.gov/waterquality/nonpoint-source/>.

The TCEQ will be responsible for hosting annual meetings for up to five years so stakeholders may evaluate their progress. Stakeholders will continue to take part in annual meetings for up to the next five years to evaluate implementation efforts. At the completion of the scheduled I-Plan activities, stakeholders will assemble and evaluate the actions, overall impacts, and results of their implementation efforts.

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Appendix A.
I-Plan Matrix

Table A-1. Implementation Task Schedule for Management Measures 1, 2, and 3

1) Reduce Bird Feeding at Louise Hays Park and Kerrville-Schreiner Park.

2) Install bird exclusion/deterrent devices on the Highway 16 and Loop 534 bridges over the water.

3) Manage the waterfowl population at Louise Hays Park and Kerrville-Schreiner Park.

Plan Year	Responsible Parties	Implementation Task Schedule	Implementation Milestones
Year 1			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Number of stakeholders reporting efforts and participating Detailed year one schedule complete
	UGRA	Apply for and receive funding to reduce bird feeding	Amount of funding received
	UGRA, City of Kerrville	Distribute educational materials to reduce bird feeding	Number of materials distributed
	UGRA	Continue Water Quality Monitoring	Number of water quality samples taken Percentage of water quality samples below contact recreation standard
	UGRA	Conduct animal surveys at local parks and where implementation measures have been installed	Number of animal surveys completed Reduction in number of animals as a result of implementation measures
	Kerr County and City of Kerrville	Removal of waterfowl from Louise Hays Park and Kerrville-Schreiner Park	Number of waterfowl successful relocated to Kerr County Animal Control
	UGRA with assistance from TxDOT and the City of Kerrville	Secure funding and begin design of the bird exclusion/deterrent devices.	Amount of funding secured Complete design of bird exclusion/deterrent devices
Year 2			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Number of stakeholders reporting efforts and participating Detailed year two schedule complete
	UGRA, City of Kerrville	Implement the public education campaign	Number of signs installed Number of pamphlets distributed
	UGRA, and TxDOT	Install bird exclusion/deterrent devices	Number of bird deterrent devices installed Funding match provided to complete installation of bird deterrent devices Reduction in the number of birds roosting as a result of bird deterrent devices/ Reduction in bird bacteria loading values
	Kerr County and City of Kerrville	Removal of waterfowl from Louise Hays Park and Kerrville-Schreiner Park	Number of waterfowl successful relocated to Kerr County Animal Control

Table A-1, continued

Plan Year	Responsible Parties	Implementation Task Schedule	Implementation Milestones
Year 2 continued			
	TxDOT	Design traffic safety plan when installation of devices occurs	Complete safety plan Safely installation of devices
	UGRA	Continue Water Quality Monitoring	Number of water quality samples taken Percentage of water quality samples below contact recreation standard
	UGRA	Conduct animal surveys at local parks and where implementation measures have been installed	Number of animal surveys completed and the reduction in the number of birds Reduction in the bacteria contributions per bird
Year 3			
	All Stakeholders	Meeting to review year one and two results and draft schedule for year three	Number of stakeholders reporting efforts and participating Detailed year three schedule complete
	UGRA and City of Kerrville	Continue to implement public education campaign with a focus on evaluation of efforts to date	Number of signs installed and estimated results of signage Number of pamphlets distributed and estimated results of pamphlets
	UGRA	Evaluate effectiveness of bird exclusion/deterrent devices	Reduction in bird numbers on the bridges Reduction in the bacteria contributions from birds
	UGRA	Continue water quality monitoring	Number of water quality samples taken Improvements in water quality Percentage of water quality samples below contact recreation standard
	UGRA	Conduct animal surveys at local parks and where implementation measures have been installed	Reduction in bacteria contributions based on reduction in survey results
	All Stakeholders	Removal of swallow nests from bridge crossings directly over the water body (if necessary based on animal surveys and stakeholder discussions)	Reduction in bacteria contributions by removal of swallows nests from bridge crossings directly over the water body.
	Kerr County and City of Kerrville	Removal of waterfowl from Louise Hays Park and Kerrville-Schreiner Park	Number of waterfowl successful relocated to Kerr County Animal Control
Years 4 & 5			
	All Stakeholders	Review results of implementation plan efforts, water quality data and determine year 4 and year 5 efforts	Number of stakeholders reporting efforts and participating Detailed schedule for each year if needed

Table A-2. Implementation Task Schedule for Management Measure 4

4) Reduce human contributions through ongoing lateral sewage line replacement, sewer inspection and rehabilitation, and ongoing septic system plan review and registration.

Plan Year	Responsible Parties	Implementation Task Schedule	Implementation Milestones
Year 1			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Number of stakeholders reporting efforts and participating Detailed year one schedule complete
	City of Kerrville	Conduct improvements to wastewater collection system	Amount spent to improve collection system Lateral feet of collection line system repaired or replaced Number of lift stations rehabilitated/improved Number of sanitary manholes replaced Number of broken customer cleanouts repaired Footage of Gravity Main inspected, smoked tested and cleaned Information and updates submitted to stakeholders
	Kerr County	Continue OSSF plan review and registration	Number of septic systems inspected Number of septic systems repaired or replaced Number of septic systems review and registered
	UGRA and Kerr County	Map the OSSF priority area and mail residents in the priority area a Homeowner's Septic System Guide and respond to any homeowner requests for an inspection	Number of pamphlets distributed Number of home owners requesting an inspection from Kerr County Number of septic systems repaired or replaced
Years 2 & 3			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Number of stakeholders reporting efforts and participating Detailed year two schedule complete Detailed year three schedule complete
	UGRA and Kerr County	Additional public information distributed through public service announcements, brochures or workshops as needed and the possible distribution of the Homeowner's Septic System Guide by realtors	Number of materials distributed Public reached through public service announcements or workshops Number of realtors distributing information
	Kerr County	Continue OSSF plan review and registration	Number of septic systems plans reviewed and registered Number of septic systems inspected, and repaired or replaced

Table A-2, continued

Plan Year	Responsible Parties	Implementation Task Schedule	Implementation Milestones
Years 2 & 3, continued			
	City of Kerrville	Conduct improvements to wastewater collection system	Amount spent to improve collection system Lateral feet of collection line system repaired or replaced Number of lift stations rehabilitated/improved Number of sanitary manholes replaced Number of broken customer cleanouts repaired Footage of Gravity Main inspected, smoked tested and cleaned Information and updates submitted to stakeholders
Years 4 & 5			
	All Stakeholders	Review results of implementation plan efforts, water quality data and determine year four and year five efforts	Number of stakeholders reporting efforts and participating Detailed schedule for each year if needed

Table A-3. Implementation Task Schedule for Management Measure 5

5) Implement an education program for pet owners and install pet waste stations at public parks.

Plan Year	Responsible Parties	Implementation Task Schedule	Implementation Milestones
Year 1			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Number of stakeholders reporting efforts and participating Detailed year one schedule complete
	UGRA	Secure funding to develop pet waste education campaign and develop educational campaign	Amount of funding secured Materials created for educational campaign
	City of Kerrville	Potential distribution of education materials	Number of education materials distributed
	UGRA and possibly Kerr County and City of Kerrville	Install pet waste container, signs, and collection bins in area parks Implement program to measure effectiveness of pet waste stations	Number of pet waste containers installed Number of signs installed Number of collection bins installed Results of effectiveness monitoring program
Years 2 & 3			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Detailed year two schedule complete
	UGRA, City of Kerrville, Kerr County	Install additional pet waste containers, signs, and collection bins if funding is available	Number of pet waste containers installed Number of signs installed Number of collection bins installed
	UGRA	Evaluate results of areas with and without collection stations	Percent change in people's behavior before and after instillation of pet waste containers, signs and collection bins
Years 4 & 5			
	All Stakeholders	Review results of implementation plan efforts, water quality data and determine year four and year five efforts	Number of stakeholders participating Detailed schedule for each year if needed

Table A-4. Implementation Task Schedule for Management Measure 6

6) Reduce contributions from general urban runoff through street sweeping, river clean ups and storm water education programs.

Plan Year	Responsible Parties	Implementation Task Schedule	Implementation Milestones
Year 1			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Number of stakeholders reporting efforts and participating Detailed year one schedule complete
	UGRA	Secure funding to develop educational campaign and develop campaign	Amount of funding secured Materials created for educational campaign
	City of Kerrville	Conduct street sweeping	Miles of streets swept Frequency of street sweeping
	UGRA	Conduct up to two river clean ups	Pounds of trash and debris removed
Years 2 & 3			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Detailed year two schedule complete
	City of Kerrville	Conduct street sweeping	Miles of streets swept Frequency of street sweeping
	UGRA	Conduct up to two river clean ups	Pounds of trash and debris removed
	UGRA	Implement education program including educational kiosk, workshops, or educational materials	Number of people viewing educational materials Number of people attending workshops Number of educational materials distributed
Years 4 & 5			
	All Stakeholders	Review results of implementation plan efforts, water quality data and determine year four and year five efforts	Number of stakeholders participating Detailed schedule for each year if needed

Table A-5. Control Action 1

Monitor and report E. coli concentrations from WWTFs.

Plan Year	Responsible Parties	Implementation Task Schedule	Implementation Milestones
Years 1 through 5			
	All Stakeholders	Meeting to review and draft I-Plan schedule	Number of stakeholders reporting efforts and participating Detailed year one schedule complete
	WWTFs	Monitor and report bacteria data as required by individual wastewater permits to TCEQ	Number of monitoring events submitted Percentage of monitoring events below the water quality standard Repairs or items corrected reported to TCEQ
	TMDL Program	Review WWTF water quality data, summarize and present information to stakeholders at yearly meetings	Percentage of results reviewed and presented at yearly meetings