1.0 INTRODUCTION

The Lake Granbury WPP aims to improve and protect water quality within Lake Granbury and restore areas of the lake impacted by nonpoint source bacterial pollution. The plan will include an assessment of the sources of bacteria pollution, an implementation strategy to reduce and/or eliminate NPS inputs into the lake and an education strategy for the community.

1.1 WATER QUALITY GOALS

The natural beauty and proximity to major population areas result in Lake Granbury serving as a major recreational resource in the region. Recognizing that some areas of the lake have historically exhibited consistently higher bacteria concentrations than other areas (Table 1), and recognizing that concentrations are typically below the state recreational standards of 126 MPN/100mL, the stakeholders decided to establish a new bacteria concentration goal for Lake Granbury. The expectation is that the goal is more protective than the state standards, thereby providing increased water quality protection and recreational safety. The state recreational standard is determined at an acceptable gastroenteritis rate of 8 illnesses per 1000 swimmers (EPA, 1986). The stakeholder goal of 53 MPN/100mL would reduce the acceptable gastroenteritis rate between 4 and 5 illnesses per 1000 swimmers. The goal is anticipated to be protective for current conditions and is also intended as a preventative measure to ensure exceptionally protective conditions into the future.

The long-term goal for bacteria levels in Lake Granbury, as determined by the stakeholders, is to maintain the geometric mean of *E. coli* concentrations in all parts of the lake, including man-made canals, at or below 53 MPN/100mL (Stakeholder Goal). This benchmark was set based on the 75th percentile of all *E. coli* data collected on compliant Lake Granbury coves from 2002 through 2007. The goal is anticipated to be sufficiently flexible that all areas of the lake can be expected to become compliant; concentrations lower than the goal are exhibited in cove/canals areas that do not have the same pollutant sources (Table 1).

1.2 PURPOSE OF THE WATERSHED PROTECTION PLAN

A Watershed Protection Plan (WPP) is a plan developed by local stakeholders to restore and/or protect water quality and designated uses of a waterbody through voluntary, non-regulatory water resource management and through local regulations and ordinances. Public participation is critical throughout plan development and implementation, as ultimate success of any WPP depends on stewardship of the land and water resources by local landowners, business and residents of the watershed. The Lake Granbury WPP defines a strategy and identifies opportunities for widespread participation of stakeholders across the watershed to work together and as individuals to implement voluntary practices and programs that restore and protect the quality of water in Lake Granbury.

The purpose of the Lake Granbury WPP is to reduce bacterial impairments in all parts of Lake Granbury that do not meet State water quality standards or the stakeholder goal. The main strategy to achieve the goal is by developing programs to aid in watershed clean-up to reduce bacteria loadings. The WPP has identified areas of Lake Granbury that are not currently meeting State standards and the Stakeholder Goal and will target these areas with local programs. The

programs identified in the WPP will be administered on a local level by the Lake Granbury Watershed Protection Plan Stakeholders Committee (LGWPPSC) with continued citizen input and involvement facilitated by a Watershed Coordinator. The plan has goals and implementation strategies set up to bring all parts of Lake Granbury into compliance with State standards and the Stakeholder Goal.

The ultimate purpose of the WPP is to restore and maintain the environmental integrity of Lake Granbury. It is the Stakeholders Group's ambition to protect not only the water and land, but to provide protection for fish, wildlife and all living organisms in the Lake Granbury watershed.

Table 1. *E. coli* Bacteria concentration (MPN/100mL) by area, through May 2010

Area	E. coli Range (MPN/100mL)	Geometric Mean (MPN/100mL)	% Samples Above 53	% Samples Above 126	% Samples Above 394
Lake Granbury at Dam	1 - 326	2	2%	2%	0%
Lake Granbury at 51	1 - 2400	5	8%	7%	2%
Lake Granbury at Business 377	1 - 1400	6	7%	4%	1%
Port Ridglea East	1 - >2420	73	58%	31%	10%
Indian Harbor	1 - >2420	71	55%	29%	11%
Oak Trail Shores	1 - >2420	70	50%	34%	17%
Sky Harbor	1 - 24000	63	50%	29%	14%
Blue Water Shores	1 - >2420	37	36%	23%	9%
Rolling Hills Shores	1 - >2420	27	35%	24%	13%
Nassau Bay II	1 - 921	27	36%	16%	3%
Holiday Estates	1 - >2420	25	32%	17%	2%
Port Ridglea West	1 - 1120	26	28%	14%	5%
Lambert Branch	1 - 1600	22	29%	11%	4%
Mallard Pointe	1 - 410	9	16%	11%	2%
Waters Edge	1 - 1986	17	22%	10%	3%
Arrowhead Shores	1 - 1733	14	19%	8%	5%
Ports O' Call	1 - 170	9	10%	2%	0%
Canyon Creek Cove	1 - 2400	8	9%	5%	6%
Rough Creek Cove	1 - 249	8	9%	4%	0%
Long Creek	10 - 24000	156		43%	25%
Walnut Creek	7 - >2400	124		48%	20%
Strouds Creek	8 - >2400	105		34%	20%
Rucker Creek	5 - 6100	100		36%	23%
Robinson Creek	4 - >2400	76		30%	16%
Brazos River at Lake Country Acres	1 - 8665	28		25%	20%

1.3 ELEMENTS OF THE WATERSHED PROTECTION PLAN

The Lake Granbury WPP is produced under the auspices of the U. S. Environmental Protection Agency (EPA). To promote watershed based planning, the EPA has outlined nine elements necessary to successful establishment of a WPP and the Lake Granbury WPP addresses each of

these elements. The following steps provide a template for creation, implementation and review of watershed protection efforts. While the composition and strategy of watershed plans vary, the basic elements of any plan should include:

1. Identification of Causes and Sources of Impairment
2. Expected Load Reductions from Management Measures
3. Proposed Management Measures
4. Technical and Financial Assistance Needs
5. Information, Education and Public Participation Component
6. Schedule for Implementing Management Measures
7. Interim Milestones for Progress in Implementation
8. Criteria for Determining Pollutant Load Reductions and Water Quality Improvement
9. Load Reduction and Water Quality Monitoring Component

1.4 UPDATES AND REVISIONS

The Lake Granbury WPP is a "living document," which can be updated and revised as new information emerges, implementation practices are put into place and as stakeholders reflect on accomplishments and forge ahead into the future. The water quality of Lake Granbury will improve with each individual's effort. This plan has been written to aid the development of water quality and community support. Short and long-term benefits will come from the implementation of the strategies laid out in this document.

1.5 SUMMARY OF EXISTING WATER QUALITY CONDITIONS

Since completion of the DeCordova Bend Dam in 1969 that resulted in the impoundment of Lake Granbury, numerous water quality parameters have been monitored for purposes of assessing water quality conditions within the lake. Conditions are assessed against protective criteria for designated uses that include public water supply, contact recreation and High aquatic life use. Lake Granbury is identified by TCEQ as water quality segment 1205. The lake is fully supporting of all uses currently assessed (TCEQ Draft 2010 Texas Integrated Report).

To assess current conditions and historical trends, a data evaluation report was developed as part of this WPP process (EC 2007). Elevated bacteria concentrations in the main body of the lake do not occur regularly nor are periods of high concentration persistent. Background levels of bacteria in the main body of Lake Granbury are less than 10 MPN per 100 mL (EC 2007). The main contributors of bacteria for the Lake Granbury Watershed (sub-watershed areas as analyzed in Figure 21) are livestock (primarily cattle), OSSFs (failing septic tanks), feral hogs, and pets (Table 2); however, low bacteria levels exhibited in monitoring data within the large, main body of the lake do not indicate significant watershed-wide bacteria problems.

Historically, local stakeholders expressed concerns about bacteria levels not within the main body of the lake but within canals. The BRA began a large-scale canals monitoring project in 2002 involving more than 50 sampling locations monitored monthly. The data developed through this effort are invaluable in identifying problem areas and problem conditions. Analysis indicates elevated levels of bacteria are found in many of the coves of Lake Granbury; levels are elevated compared to the bacteria in the lake and also elevated related to the state water quality standard of 126 MPN/100mL (Table 1). This WPP project was initiated to investigate and

develop appropriate goals to address these conditions. Significant additional detail on location-specific bacteria assessment and on improvement strategies are provided in this WPP document. Generally, the main contributor of bacteria within cove areas can be attributed to malfunctioning OSSFs (Table 3); however, each localized cove drainage area exhibits unique characteristics where cattle and pets are also significant potential sources.

Table 2. Total Lake Granbury watershed daily potential bacteria loading by source

Source	Total Potential Load for Entire Watershed (trillions cfu/day)
Cattle	1,936
OSSF	41
Feral hogs	31
Pets	9
Deer	0.190
WWTP	0.026

Table 3. Relative potential bacteria load contributions within selected priority areas (% by source per area)

Subdivision	SepticLd	PetLd	CattleLd	DeerLd	FeralHogsLd
Sky Harbor	12.5%	3.9%	81.8%	-	1.8%
Rolling Hills Shores	61.8%	0.2%	37.9%	0.2%	-
Waters Edge	-	99.9%	-	-	-
Blue Water Shores	62.9%	37.1%	-	-	-
Port Ridglea East	99.8%	0.2%	-	-	-
Indian Harbor	99.7%	0.3%	-	-	-
Nassau Bay II	98.2%	1.8%	-	-	-
Oak Trail Shores	54.1%	45.9%	-	-	-

Results of the data evaluation also indicate that there is an increasing trend in nutrients in the main body of Lake Granbury (EC 2007). Decreasing trends in overall DO concentrations, daytime DO increases from photosynthesis, decreasing trends in secchi depth and increasing trends in chlorophyll-*a* concentrations were also observed in the initial data review (EC 2007). The evaluation included data through 2006 (EC 2007); to consider recent high and low flow periods, more recent data should be incorporated into the trend analysis. These trends are not addressed within this WPP process which focuses only on bacteria. However, it is hoped that addressing bacteria nonpoint sources will also result in reduction of nonpoint source nutrient loading to the lake.

1.6 PREVIOUS WATER QUALITY EFFORTS

In 1993, a cooperative study between the Texas Water Commission, the Brazos River Authority (BRA) and the Hood County Health Unit first identified an increase in fecal coliform levels in the lake. The *On-site Wastewater Treatment Units at Lake Granbury and the Possible Impact Upon the Water Quality of the Lake Study* identified the most notable area of concern to be in the coves.

In 1995, a study titled *Survey of Conditions and Impact of Septic Tank Pollution on the Water Quality in Lake Granbury* indicated that the soils in which septic tanks are installed around Lake Granbury are generally not well-suited for septic tanks and absorption fields. Another finding was that almost all on-site systems around the lake include absorption fields that do not provide a capacity that would comply with current State criteria.

The combination of previous studies indicate a concern for water quality from on-site sewage systems in addition to forecasts for Hood County population to increase from its current level of about 42,000 persons to more than 78,000 persons by the year 2030. With this information in mind, the development of a feasibility study to bring a regional sewage system to Hood County and eliminate the on-site sewage facilities was completed in 2000. The *Hood County Regional Sewerage System Feasibility Study* was a cooperative effort between the BRA and the Hood County Intergovernmental Coalition. The capital costs for this regional wastewater facility were estimated to be approximately $149.9 million with annual operation and maintenance costs estimated to be approximately $16.23 million.

In 2001, the 77th Texas Legislature formed the Lake Granbury Water Improvement District. The new district encompassed all of Hood County and was granted powers to collect, transport, process, dispose of and control all domestic, industrial and communal wastes. The formation of the district, which would have taxing authority, was subject to a confirmation election. The confirmation election was held in May 2002, but the district failed to be confirmed by the voters of Hood County. Post-election polling revealed that voters felt that the taxes to fund the district and regional wastewater system would be too high; the scope of the district was too large, it covered the entire county, not just the lakeside communities; and that there was not sufficient data documenting water quality concerns in the canals to justify the expenditure.

In response to stakeholder concerns, the BRA began a large-scale monitoring initiative in the canals of Lake Granbury to assess the water quality of the coves. Beginning in May 2002, the Authority began collecting water quality samples on a monthly basis at more than 50 cove locations. Some of the locations showed no elevated concentrations of *E. coli* and were later discontinued. Some locations were added after a year of monitoring as new information was acquired on possible source locations. The data generated from this effort indicate that many of the canals on Lake Granbury are impacted by elevated *E. coli* concentrations and declining water quality in Lake Granbury has begun to negatively affect the use of the lake. Lake Granbury is the lifeblood of Hood County, with the majority of the county's communities rely on the lake for drinking water, irrigation, industry and recreation. The economy in Hood County is closely tied to Lake Granbury, and the environmental condition of the lake is crucial to the county's residents.

Recognizing the high potential for development around the lake and resulting potential for impact on water quality, two independent studies were sponsored in 2007-2008 by BRA and the City of Granbury to identify appropriate development guidelines for residential canal subdivisions. At the time the BRA began comprehensive water quality monitoring of many of the canal systems in 2002, the BRA's Board of Directors (BOD) placed a moratorium on new canal construction to assess the impact of canals on water quality and the Authority's water

resource. The City of Granbury expressed concern that placing a moratorium on canal development for the duration of the WPP would be detrimental to the economic development of the City and surrounding area. In March 2007, the BRA began a study to determine the feasibility of future canal systems on Lake Granbury and to develop engineering specification standards for future canal systems. The study commenced in April 2007 and concluded in July 2008 with the creation of minimum of canal development standards. A resolution to adopt the canal design standards was approved by the Board of Directors of the Brazos River Authority on July 28, 2008. Concurrently, a City of Granbury (City) study found conclusions similar to BRA's findings. The City amended their subdivision rules to regulate canal development that are in-line with the canal design standards approved by the BRA's BOD. Subsequently, the BOD lifted the moratorium on canal developments within the City's ETJ in January of 2009.

As a result of these studies and increased awareness and involvement in the WPP, Hood County enacted subdivision development ordinances that promote improved water quality in the lake. For development projects within 1 mile of the lake, the county now requires a minimum lot size of 3 acres if waste water treatment will be provided using on-site treatment facilities (septic systems). This county ordinance has led to annexation of some areas by the City of Granbury to allow for installation of waste water collection and treatment near the lake, which is consistent with one of the primary stakeholder goals.