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Chapter 6 Recommended Implementation Strategies

This WPP is designed to establish a clear link between the causes and sources of contamination, and the solutions identified and scaled to address them. Chapter 4 quantified the sources that contribute to water quality impairments and Chapter 5 identified the bacteria reductions needed to meet water quality standards. This Chapter details the voluntary solutions identified and prioritized by the stakeholders. Chapter 9 discusses the financial and technical resources needed to implement them. Chapter 7 links these activities to corresponding education and outreach elements and Chapter 8 details the timeline and milestones associated with implementation.

No single bacteria source is the primary cause of current waterbody impairments. According to pollutant loading estimates, OSSFs, dogs, livestock, and deer have the highest potential to contribute *E. coli* across the watersheds; however, all potential sources contribute to overall bacteria loading. Due to potential source diversity, various management strategies are recommended to address manageable *E. coli* sources in the watershed. Recommended management strategies were developed based on stakeholder feedback relative to pollutant removal efficiencies, likelihood of adoption and applicability to the watershed.

Estimated potential bacteria load reductions from each management measure are presented with each recommended action discussed in this chapter and further explained in Appendix X. Load reduction estimates are based on predicted worst-case scenario loading. As a result, these estimates do not accurately predict actual load reductions expected to occur instream. Actual reductions will depend on implementation volume and other changes across the watershed that may trigger the need for adaptive implementation. Comparison of target and potential annual load reductions from management measures discussed in this chapter (Figure 6-1) indicate that reducing bacteria loads to levels that support primary contact recreation use is feasible.

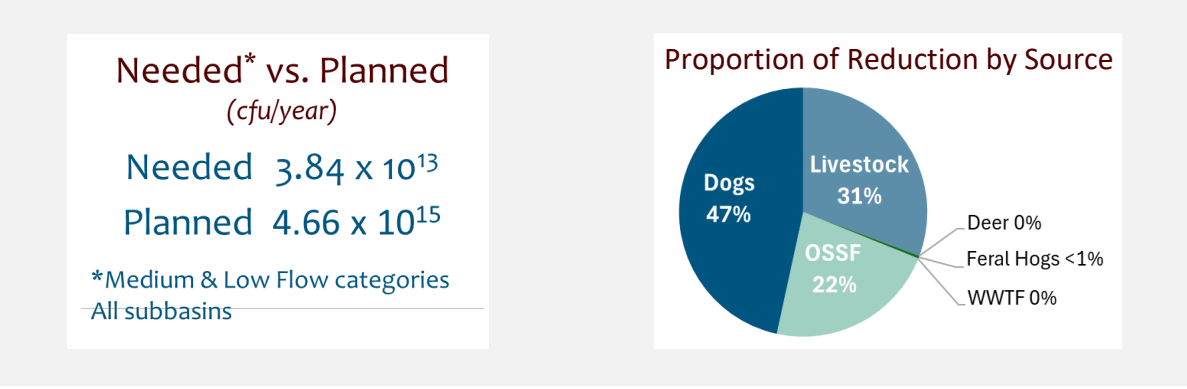

Figure 6-1. Estimated Annual E. coli reduction needed and planned from management measures.

Critical areas for each recommended management strategy were identified based on spatial analysis and stakeholder feedback. While management measures can be implemented throughout the watershed, priority locations were selected where management strategies may most effectively reduce potential loading. In all cases, management activity should be implemented as close to waterways as possible to increase potential instream water quality improvements. This targeted approach will help guide initial implementation in each watershed.

Stakeholder input was crucial throughout the decision-making process for identifying critical areas and management strategies. Stakeholders were engaged throughout the process through in-person workgroup and stakeholder meetings. Management measures suggested in this chapter are voluntary and rely on stakeholder adoption for successful implementation. Therefore, receiving stakeholder input on the feasibility and willingness to adopt these measures is the first step to ensuring successful implementation of the plan. All management measures were discussed with and approved by stakeholders to ensure support and successful implementation.

Reduce SSOs and Unauthorized Discharges

In the face of accelerated growth in the region, aging, new, and planned WWTF infrastructure are major concerns for stakeholders. While data discussed in Chapter 4 indicate that historical WWTF performance is generally good and SSOs are rare, the potential for upsets and overflows would be expected to increase as systems receive more wastewater from a growing population. Conversely, the uptick in purchases of treated effluent for non-potable uses such as irrigation and by commercial or industrial facilities has resulted in the diversion of effluent that would otherwise be discharged into Medio Creek or the Medina River.

The San Antonio Water System (SAWS) continues to make significant investments in upgrading its collection system and other assets for the Medio Creek Water Recycling Center to ensure continued capacity to meet growing demands for treatment and treated recycled water. Much of the treated effluent from the Medio Creek facility leaves the watershed through purchase agreements with a wide range of customers including industrial and commercial users, golf courses, municipal parks, universities, and others. The City of Castroville upgraded and increased treatment capacity of their WWTF in 2019 and utilizes some treated effluent for irrigation purposes. Newer and planned WWTFs are decentralized, serving individual subdivisions or developments in the watershed. While a decentralized approach can provide some flexibility in meeting the needs of rapidly growing areas, there is stakeholder concern that the existing decentralized facilities may not be sufficiently staffed or monitored to reliably comply with permit requirements. Operator training, good housekeeping, and planning for future growth were discussed by stakeholders as potential strategies to ensuring that facilities across the watershed prevent discharge of bacteria and other pollutants through SSOs or WWTF failures.

The TCEQ SSO Initiative is a voluntary program that initiates efforts to address SSOs. These events are often due to aging collection systems and may be the result of I&I issues during storm events caused by line breaks and blockages. Activities in SSO initiatives vary, but commonly include line inspections and testing, routine repairs and replacements, and education and outreach. Fats, oils,

grease, non-flushables, and many other substances should not be disposed of through household drains. These items can cause material build up and create blockages in collection systems which lead to system damage and repairs. Several educational programs on proper disposal of fats, oils and grease are available through AgriLife Extension. Education material distribution and other resources on the Medina River below Medina Diversion Lake WPP website will help encourage and inform homeowners of how to properly dispose of fats, oils, grease, and non-flushables.

Table 6-1. Summary of Management Measure: Reduce SSOs and unauthorized discharges.

<table>
<tr><td colspan="4">Source: Municipal Sanitary Sewer Overflow (SSO) or Unauthorized Discharges</td></tr>
<tr><td colspan="4">Problem: Fecal bacteria loading from SSO events and malfunctioning sewage infrastructure</td></tr>
<tr><td colspan="4">Objectives:
Reduce unauthorized discharges and SSOs.
Replace and repair sewage infrastructure as needed.
Educate residents and homeowners on the need for infrastructure maintenance and what types of waste can be put in the sewer system.</td></tr>
<tr><td colspan="4">Critical Areas: Areas serviced by WWTFs in subwatersheds 2, 4, 5, 6, 7, 9, and 10</td></tr>
<tr><td colspan="4">Goal: Work with entities operating WWTFs to continue and expand training and inspection efforts. Identify problematic areas and repair or replace problematic infrastructure to reduce I&I issues and minimize WWTF overload occurrences.</td></tr>
<tr><td colspan="4">Description: Identify potential locations within municipal sewer systems where I&I occurs using available strategies (e.g., smoke tests, camera inspections, etc.). Prioritize system repairs or replacements based on system impacts (largest impact areas addressed first). Complete repairs or replacements to reduce future I&I issues and WWTF overloading.</td></tr>
<tr><td colspan="4">Implementation Strategy</td></tr>
<tr><td>Participation</td><td>Recommendations</td><td>Period</td><td>Capital Costs</td></tr>
<tr><td>Cities, Permittees, Operators</td><td>Identify recurring or high-volume SSOs to target for repair or replacement through capital improvement programs.</td><td>2025-2035</td><td>TBD</td></tr>
<tr><td>Publicly owned WWTF Permittees</td><td>Participate in the TCEQ Sanitary Sewer Overflow Initiative (SSO Initiative).</td><td>2025-2035</td><td>N/A</td></tr>
<tr><td>Cities, Permittees, Watershed Coordinator</td><td>Identify potential resources and develop programs to aid repair or replacement of WWTF collection system infrastructure.</td><td>2025-2035</td><td>N/A</td></tr>
<tr><td>Cities, Permittees, AgriLife Extension, Watershed Coordinator</td><td>Develop and deliver education material to residents and property owners.</td><td>2025-2035</td><td>N/A</td></tr>
<tr><td>Permittees, Operators</td><td>Identify operations and maintenance training needs, develop and deliver resources to appropriate staff.</td><td>2025-2035</td><td>TBD</td></tr>
<tr><td colspan="4">Estimated Load Reduction</td></tr>
<tr><td colspan="4">Reduction of SSOs and discharges associated with I&I will result in direct reductions in bacteria loads. However, because the response to education efforts and resource acquisition to complete system repairs is uncertain, load reductions were not calculated.</td></tr>
<tr><td>Effectiveness</td><td colspan="3">Moderate to High: Although infrequent, reduction in SSOs and unauthorized discharges will result in direct reductions to bacteria loading during the highest flow events.</td></tr>
<tr><td>Certainty</td><td colspan="3">Moderate to Low: Costs associated with sewer pipe replacement and treatment plant upgrades are expensive to homeowners and municipalities.</td></tr>
<tr><td>Commitment</td><td colspan="3">Moderate: Municipal public works have incentive to resolve I&I issues to meet discharge requirements. However, limited funding hinders sewage line replacement.</td></tr>
<tr><td>Needs</td><td colspan="3">High: Financial needs are significant.</td></tr>
</table>

Address Failing On-Site Sewage Systems

OSSFs are used to treat wastewater where service by WWTFs is not available. Conventional systems use a septic tank and gravity-fed drain field that separates solids from wastewater prior to its distribution into soil where treatment occurs. In the Medina River watershed, approximately 99.5% of the watershed's soils are classified as "limited" or "somewhat limited" and considered unsuitable for proper treatment of household wastewater by conventional systems. In many areas, advanced treatment systems, most commonly aerobic treatment units, are used for wastewater treatment. While advanced treatment systems are highly effective, operation and maintenance needs for these systems are rigorous compared to conventional septic systems. Limited awareness and lack of maintenance can lead to system failures.

Failing or non-existent OSSFs can provide significant bacteria and nutrient loading into the watershed. The exact number of failing OSSFs is unknown; however, it is estimated that 10%, or 1,352, of the estimated number of systems may be malfunctioning across the watershed. Specific locations of failing OSSF are not known and can only be determined through physical inspections. Factors contributing to OSSF failure include improper system design or selection, improper operation and maintenance and lack of financial resources for proper maintenance. The lack of qualified service providers in the watershed was identified as a challenge in addressing failing systems.

Providing educational workshops to homeowners regarding OSSF operation and maintenance will help address these issues. Repairs and replacements are also needed. It's not possible to know the number that need true repair or replacement versus maintenance, but stakeholders believe that proper maintenance would correct most issues causing failure. Over the next 10 years, it is recommended that 60 failing septic systems in the watershed be addressed annually through repair, replacement, or improved maintenance (10 conventional and 20 aerobic in Medina County, 20 in Bexar County, and 10 in Atascosa and Bandera counties). While failing OSSFs should be addressed across the entire watershed, priority subwatersheds include 6, 9, 10, and 7 due to OSSF densities. Additional priority should be given to OSSFs within 100 yds of water bodies. Significant financial resources are needed to support OSSF repairs and replacements, while those addressed through education and proper maintenance would require less.

Table 6-2. Summary of Management Measure: Identify and address failing OSSFs.

Source: Failing On-Site Sewage Facilities (OSSFs)			
Problem: Pollutant loading reaching streams from untreated or insufficiently treated household sewage			
Objectives: Inspect failing OSSFs in the watershed and secure funding to promote OSSF maintenance, repairs or replacement. Repair or replace OSSFs by working with counties and communities. Educate homeowners on system operations and maintenance.			
Critical Areas: Subwatersheds 6, 9, 10, and 7 and systems within 100 yds of perennial waterways.			
Goal: Identify, inspect, and repair or replace 60 failing OSSFs per year in the watershed (30 in Medina County, 20 in Bexar County, and 10 in Atascosa and Bandera Counties), especially within critical areas.			
Description: Deliver education programs and workshops on proper maintenance and operation of OSSFs to homeowners. Failing systems should be addressed as needed and appropriate as funding allows. Work with counties to leverage additional resources to address failing OSSFs in the watershed.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
Counties, contractors, homeowners	Identify, inspect and address through repair or replacement OSSFs as funding allows	2025–2035	Est. $8,000-$12,000 per system
Counties, municipalities, homeowners	Inspect and evaluate feasibility of connecting to existing/planned infrastructure	2025–2035	N/A
Counties, AgriLife Extension, TWRI, watershed coordinator	Develop and deliver materials (postcards, websites, handouts, etc.) to educate homeowners	2025–2035	N/A
Counties, AgriLife Extension, TWRI, watershed coordinator	Operate an OSSF education, outreach, and training program for installers, service providers and homeowners	2025–2035	N/A
Estimated Load Reduction			
As planned, 60 OSSFs will be addressed per year across the watershed. Estimated potential *E. coli* load reductions from these efforts are 1.04 x10^{15} per year.			
Effectiveness	High: Replacing, repairing, or properly maintaining failing OSSFs yields direct *E. coli* reductions.		
Certainty	Low: Funding available to identify, inspect and repair or replace OSSFs is uncertain; however, funding sources are available for assistance.		
Commitment	Moderate: Watershed stakeholders acknowledge failing OSSFs as a bacteria source. Addressing this source has the greatest human health benefit and is a high priority.		
Needs	High: Financial resources are needed to identify, repair and replace systems as many homeowners do not have the resources to fund replacement themselves. Education is also critical because many homeowners with failing systems may not realize their system is failing or understand the associated human health or environmental implications.		

Manage Pet Waste

Improper pet waste disposal can be a source of bacteria entering waterbodies from urban and rural residential areas, parks, and other public spaces. Because concentrations of dogs is generally greater in more populated areas, much of the *E. coli* loading from pet waste may be managed through proper stormwater management. However, additional activities and efforts to remove and properly dispose of pet waste from the landscape will aid in reducing *E. coli* loads from across the watershed.

Analysis of potential pollutant loading from pet waste was identified as a significant bacteria source in the watershed. Management strategies to address pet waste focus on reducing the transport to streams via stormwater runoff (Table X). Potential strategies include providing waste bag dispensers and collection stations in areas of high pet density (parks, neighborhoods, etc.) and handing out waste bag carriers for pet owners at events and programs around the watershed. These strategies encourage pet owners to pick up waste before it is transported to streams. Several parks in the watershed have pet waste stations, but there are opportunities to expand their numbers. Ongoing pet waste station maintenance should be addressed as new stations are installed.

As part of their MS4 Stormwater program, Bexar County collects stray animals, targeting areas with large numbers of stray dogs. One such area is in the far eastern portion of the Medina River watershed, where new homes and development is expanding. Approximately 17% of all stray animals collected in the county are caught in this area.

Providing education and outreach materials to pet owners about bacteria contributed by pet waste can increase the number of residents who pick up and dispose of pet waste. Recognizing that domestic pets in rural portions of the watershed likely have large areas to roam and that picking up pet waste is likely not feasible for all owners, management measures should target areas of the watershed with public parks and green spaces, and higher housing and pet densities. This management measure is applicable to all subwatersheds, with priority given to areas of higher population.

Table 6-3. Summary of Management Measure: Proper disposal of pet waste.

Source: Dog Waste			
Problem: Direct and indirect fecal bacteria loading from household pets			
Objectives: Furnish education and outreach messaging on disposal of pet waste. Install and maintain pet waste stations in public areas.			
Critical Areas: High pet concentration areas and urbanizing areas; subwatersheds 7, 6, 2, 8, 9, and 10.			
Goal: Reduce the amount of pet waste that may wash into waterbodies during rainfall runoff events by providing educational and physical resources to increase stakeholder awareness of water quality and health issues caused by excessive pet waste. Effectively changing behavior of 15% of households with dogs.			
Description: Expand education and outreach regarding the need to properly dispose of pet waste in the watershed. Install and maintain pet waste stations and signage in public areas to facilitate increased collection and proper pet waste disposal.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
Cities, counties, homeowners, homeowner associations	Install and provide needed maintenance supplies for pet waste stations:	2025–2035	Est. $3,500 per station
Cities, Counties, AgriLife Extension and Research, HOAs, MS4s	Develop and provide educational resources to residents	2025–2035	N/A
AgriLife Extension, watershed coordinator	Educational programming for residents	2025–2035	N/A
Estimated Load Reduction			
Estimated *E. coli* load reductions and potential nutrient reductions resulting from pet waste management measure are reliant on changes in people's behavior and are therefore uncertain. Assuming 15% of targeted households respond by properly disposing of pet waste, annual load reduction is: 2.17 x 10^{15} cfu/year.			
Effectiveness	High: Collecting and properly disposing dog waste is a direct method to immediately prevent *E. coli* from entering water bodies.		
Certainty	Low: Some pet owners in the watershed likely already collect and properly dispose of dog waste. Those that do not properly dispose of pet waste may be difficult to reach or convince. The number of additional people that will properly dispose of pet waste is difficult to anticipate.		
Commitment	Moderate: Some parks currently have pet waste stations installed; however, maintenance may be less frequent than it needs to be. Meanwhile, little encouragement for owners to pick up after their pets may occur.		
Needs	Low: Increasing maintenance on existing pet waste stations could occur. Landscapers may add this to their list of items when mowing parks if resources are provided.		

Manage Stormwater Runoff

The objectives of this management measure are to provide educational programs and work with local entities to identify opportunities to reduce and manage stormwater runoff, another potential source of *E. coli* influencing water quality.

As discussed in Chapter 2, the region is experiencing rapid growth and land use changes, particularly in the central portion of the watershed and along major roadways. Stakeholders voiced concerns about the effects of stormwater from rapidly expanding developments and whether stormwater regulations will be able to keep pace with growth. Discussions included the need for policies, strategies, funding, and decision-maker support for floodplain protection, stormwater detention, design and review criteria for new developments, and interlocal agreements between municipal and county governments to facilitate action. While regional flood planning is underway to manage stormwater and reduce flooding potential, water quality is not the focus of these efforts. Significant opportunity exists to combine flooding and water quality management through actions that address both flooding and water quality, including BMPs implemented at the demonstration, property, subdivision or regional scale. The watershed coordinator will work to encourage these activities as appropriate and as funding permits.

Urban stormwater BMPs reduce or delay runoff generated by impervious or highly compacted surfaces such as roofs, roads and parking lots. Potential BMPs include, but are not limited to, rain gardens, rain barrels/cisterns, green roofs, permeable pavement, bioretention, constructed wetlands, swales, and tree box filters. These BMPs vary in ability to reduce stormwater runoff quantity and improve runoff quality based on design and location. Furthermore, volume reductions from BMPs can reduce stormwater entering local sewage collection systems through inflow and infiltration . Well-placed and well-designed stormwater BMPs can substantially decrease and delay runoff and reduce bacteria and nutrient loading. Further implementation of these practices should be encouraged through ordinance development that encourage improved practice use requirements for new development where feasible. Addressing runoff concerns during development can reduce the burden of cost for corrective actions after development.

The Texas Water Development Board (TWDB) is currently developing guidance on the use of nature-based flood mitigation solutions for Texas communities (TWDB 2024). While the project arose from the state's flood planning effort, the guidance will also help address water quality, groundwater recharge, habitat improvement, and community enhancement goals. The manual will also provide guidance on integrating nature-based features with traditional flood mitigation infrastructure. The public draft release is expected in early 2025 and project completion by spring of 2025.

The San Antonio River Authority's (SARA's) program to promote nature-based solutions for managing stormwater through green infrastructure and low impact development have resulted in the implementation of stormwater BMPs throughout their jurisdiction. SARA's Green Infrastructure Master Plan guides decision-makers on where and how to apply resources to maximize water quality benefits while addressing local flooding concerns. The SARA Low Impact Development program includes a technical design manual, training program, and modeling tools to identify, plan, design, and construct on-site BMPs to mitigate stormwater pollutants.

There are four regulated Municipal Separate Storm Sewer Systems (MS4) in the watershed – Bexar County, City of San Antonio/San Antonio Water System, Joint Base San Antonio-Lackland, and the Texas Department of Transportation. Under these permits, each entity has developed a stormwater management plan (SWMP) that includes at least the following control actions:

- public education and outreach;
- public involvement or participation;
- detection and elimination of illicit discharges;
- control for stormwater runoff from construction sites;
- post-construction stormwater management in new development and redevelopment zones; and
- pollution prevention and "good housekeeping" measures for municipal operation.

Success of this management measure must be supported by educational programs that increase awareness of the impacts of stormwater on water quality. All MS4 permits in the watershed include outreach and education activities. These include activities such as educational workshops, outreach campaigns, recycling efforts, and more. Other recommended educational tools include installation of publicly accessible demonstration projects to promote low impact and green infrastructure practices, training for city and county staff, developers, maintenance providers, homeowners, and the public, as well as existing TAMU AgriLife trainings on lawn/landscape management and riparian areas, flyers, videos, or other outreach materials.

Table 6-4. Summary of Management Measure: Urban stormwater management.

Source: Stormwater Runoff			
Problem: Fecal bacteria loading from stormwater runoff in developed and urbanized areas			
Objectives: Educate residents and decision makers about stormwater BMPs. Identify and install stormwater BMPs at all scales feasible. Influence future stormwater manage decisions, requirements, and implementation			
Critical Areas: In and near urbanized and urbanizing areas in the watershed			
Goal: Reduce *E. coli* loading associated with urban stormwater runoff through implementation of stormwater BMPs as appropriate and to increase local officials and residents' awareness of stormwater pollution and management.			
Description: Promote stormwater management BMP projects through education, demonstration and leveraging of other resources. Coordinate with decision makers and property owners.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
Cities, Counties, SARA, EAA, MS4s, Watershed Coordinator	Identify candidate locations and partners for installing GI/LID BMPs and nature-based solutions for managing stormwater	2025–2035	N/A
Cities, Counties, SARA, EAA, MS4s	Develop plans and install GI/LID BMPs and nature-based solutions as funding becomes available	2025–2035	$40,000 to $100,000 per acre
AgriLife Extension, SARA, MS4s, Watershed Coordinator	Identify and implement opportunities for demonstration projects to encourage use of Green Stormwater/Low Impact Development BMPs	2025–2035	$40,000 to $100,000 per acre
AgriLife Extension and Research, SARA, MS4s, Watershed Coordinator	Deliver education and outreach to landowners and decision makers; encourage stormwater management requirements for future development	2025–2035	N/A
Estimated Load Reduction			
Installation of stormwater BMPs that reduce runoff or treat bacteria will result in direct reductions in bacteria loadings in the watershed. Potential load reductions were not calculated because the location, type, and sizes of projects installed will determine the potential load reductions. Nutrient reductions are also commonly realized with many stormwater BMPs; but are not estimated.			
Effectiveness	Moderate to High: BMP effectiveness for reducing bacteria loading is dependent on design, site selection and maintenance of the BMP.		
Certainty	Moderate: BMP installation requires sustained commitment from local governments. Recent grant funding acquired will help plan and implement specific projects to reduce local flooding which can also have a positive water quality impact if properly designed.		
Commitment	Moderate: Flood reduction is a high priority for local cities/counties/drainage districts; financial needs are significant though.		
Needs	High: Stormwater management is costly and financial assistance needs are significant yet largely unknown. Information regarding stormwater management alternatives is needed to increase awareness of potential water quality management benefits.		

Implement Water Quality Management Plans and Conservation Plans

The goal of this management measure is to increase the use of conservation planning and practices to reduce time spent in riparian areas by livestock and improve grazing resource management across the property.

Bacteria loadings from cattle and other livestock were estimated to be relatively high compared to other evaluated sources. These sources are also considered manageable since the behavior of cattle and the areas where they spend their time can be modified through changes to food, shelter, and water availability and access. Cattle grazing is highly dependent on these resources, especially water. Therefore, reducing the amount of time livestock spend in riparian pastures through practices such as rotational grazing, access to alternative watering facilities, or moving supplemental feeding locations can directly reduce loading to waterbodies from livestock. This can reduce bacteria volume entering nearby water bodies during runoff by increasing distance between deposition locations and water bodies.

Various BMPs are available to improve forage quality, diversify water resource availability and appropriately distribute livestock across a property. The practices appropriate for implementation vary by operation due to landscape features and landowner goals. Technical assistance is available to landowners upon request to help identify appropriate practices to meet specific property goals. NRCS develops conservation plans (CPs) while the Texas State Soil and Water Conservation Board (TSSWCB) in partnership with local soil and water conservation districts (SWCDs) and NRCS develops water quality management plans (WQMPs). Stakeholders indicated that developing an additional 240 plans (CPs/WQMPs) over the next 10 years is feasible. Bacteria loading from cropland is predominantly from wildlife and is not considered manageable through land conservation practices. Bacteria load reductions on grazing lands achieved from these CPs/WQMPs will vary depending on specific conservation measures implemented.

Implementing CPs/WQMPs is beneficial, regardless of location in the watershed as these practices aim to keep water on the landscape by improving forage for livestock and wildlife and maintaining increased ground cover. Increasing vegetation amount and quality on a landscape aids the natural filtration process that can reduce pollutant loading to nearby waterbodies. Overall CP/WQMP effectiveness can be maximized on properties with riparian habitat. Therefore, all properties with riparian areas are considered a priority. Properties without riparian habitat are also encouraged to participate in implementation activities because the cooperative effect is still consequential. Priority subwatersheds for livestock related practice implementation are 11, 10, 9, 4, 5, 8, and 1.

This management measure is also supported by targeted educational programs that increase awareness of agricultural practices and measures that can be taken to protect water quality. These programs include educational workshops, demonstration projects, field days, tours, and more. In recent years, a trend toward new and small landowners has been observed, and stakeholders recommend that educational materials and activities also be developed and delivered to meet the needs of these groups. County appraisal districts (CAD) are often a first stop for new landowners in understanding how to optimize their investment. CADs in the Medina WPP watershed take existing WQMPs and CPs into consideration when appraising agricultural property and routinely refer new landowners to AgriLife Extension, SWCDs, and NRCS for technical assistance.

Table 6-5. Summary of Management Measure: Develop and implement WQMPs or CPs.

Source: Cattle and Other Livestock			
Problem: Direct and indirect fecal bacteria loading due to livestock in streams, riparian degradation, and overgrazing which can increase pollutant loading to water bodies			
Objectives: Work with landowners to develop property-specific CPs/WQMPs that improve grazing practices, enhance ground cover, increase pollutant retention, and improve water quality. Develop funding to hire WQMP technician. Deliver education and outreach information, programs and workshops to landowners. Reduce fecal loadings attributed to livestock.			
Critical Areas: All livestock operations with riparian habitat and subwatersheds 11, 10, 9, 4, 5, 8, and 1.			
Goal: Develop and implement CPs/WQMPs that reduce time spent in riparian areas by livestock and improve grazing resource management across the property.			
Description: CPs/WQMPs will be developed upon producer request to implement BMPs that reduce water quality impacts from grazing livestock. Practices will be identified and developed in consultation with NRCS, TSSWCB and local SWCDs as appropriate. Education information, programs and workshops will support and promote the adoption of these practices.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
TSSWCB, SWCDs	Develop funding to hire WQMP technician	2025 – 2035	Estimated $75,000 per year
Producers, NRCS, TSSWCB, SWCDs, landowner, lessees	Develop, implement, and provide financial assistance for livestock CPs and WQMPs	2025 – 2035	Est. up to $30,000 per plan) *
AgriLife Extension, TWRI, watershed coordinator	Deliver education and outreach information, programs and workshops to landowners, producers	2025 – 2035	N/A
Estimated Load Reduction			
Prescribed management under 24 WQMPs or CPs per year will reduce bacteria loadings associated with livestock by reducing runoff from pastures and rangeland and by reducing direct fecal deposition in water. Nutrient reductions are possible from some implemented practices. Implementation is estimated reduce E.coli loading by 1.43×10^{15} cfu/year.			
Effectiveness	High: Decreasing time livestock spend in riparian areas and reducing runoff by managing vegetative cover will reduce NPS contributions of bacteria and other pollutants to creeks.		
Certainty	Moderate: Landowners acknowledge the value of good land stewardship practices; however, financial incentives are often needed to encourage CP/WQMP implementation.		
Commitment	Moderate: Landowners are willing to implement stewardship practices shown to improve productivity; however, costs are often prohibitive and financial incentives are needed to increase implementation rates.		
Needs	High: Financial costs are a major barrier to implementation. Education and outreach are needed to demonstrate benefits of plan development and implementation to producers.		

*Unit costs for Water Quality Management Plans and NRCS Conservation Plans vary widely depending on plan specifics

Reduce Feral Hog Population

Potential bacteria loading from feral hogs represents a considerable influence on instream water quality. While other sources of bacteria are potentially larger in volume, feral hogs congregate in riparian areas due to the presence of dense habitat, food sources, and water. Common feral hog behavior, such as rooting and wallowing, affects water quality by degrading ground cover which increases erosion. Through a combination of agency technical assistance, education, and landowner implementation of feral hog management techniques, the goal of this management measure is to reduce feral hog populations 8% below current numbers.

Various control efforts are currently employed such as live trapping, shooting, hunting with dogs, exclusion, and habitat management. Aerial hunting is recommended as an additional strategy, but rapidly increasing population density may preclude this from being a feasible option. Trapping has proven to be a common and effective method currently available to landowners. With proper planning and diligence, larger scale trapping can successfully remove large numbers of hogs at once. Comparatively, shooting feral hogs removes fewer than trapping as the animals tend to quickly move away from hunting pressure.

Excluding feral hogs from supplemental feed is also an effective management tool. Given the opportunistic feeding nature of feral hogs, minimizing available food from deer feeders is important. Constructing exclusionary fences around feeders can reduce food ability (Rattan et al., 2010). Locating feeders away from riparian areas can also reduce their impacts on water quality.

The continuation and increased intensity of removal practices, especially in priority areas, along with technical and financial assistance, is needed to reach the overall goal of this plan. Activities will be targeted toward priority areas where landowners should be contacted to discuss the economic savings of removing feral hogs, specific methods to do so, and available programs that assist in feral hog removal.

Educational programs and workshops will be used to improve feral hog removal efficiency. AgriLife Extension provides various online and in-person educational programs and resources for landowners. Delivering up-to-date information and resources to landowners through these workshops can lead to more success removing feral hog populations in the watershed. Landowner-developed wildlife management plans outlining their goals and management practices can also benefit the watershed's wildlife, habitat, and water quality.

Removing 500 hogs annually would represent approximately 8% of the current feral hog population across the watershed. Based on spatial analysis, subwatersheds 1, 2, 3, 4, 5, 8, 9, 10, and 11 have the highest potential for feral hog loadings based on available habitat. However, given feral hogs' propensity to travel along riparian corridors in search of food and habitat, priority areas will include all subwatersheds, with high importance placed on properties containing or adjacent to riparian habitat.

Table 6-6. Management Measure: Promote technical and direct operational assistance to landowners for feral hog control.

Source: Feral Hogs			
Problem: Direct and indirect pollutant loading and riparian habitat destruction from feral hogs			
Objectives: Reduce fecal contamination and land disturbance from feral hogs. Work with landowners to reduce feral hog populations. Reduce food availability for feral hogs. Provide education and outreach to stakeholders.			
Critical Areas: All subwatersheds, with high importance placed on riparian properties.			
Goal: Manage feral hog population through all available means to reduce populations by 8% (500 hogs annually).			
Description: Voluntarily implement feral hog population management practices including trapping, reducing access to food supplies and educating landowners and others as they are available.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
Landowners, managers, lessees	Voluntarily construct fencing around deer feeders to prevent feral hog utilization	2025 – 2035	Est $300 per feeder
	Voluntarily trap/remove/shoot feral hogs to reduce numbers	2025 – 2035	TBD
Landowners, producers, TPWD	Develop and implement wildlife management plans and wildlife management practices	2025 – 2035	TBD
AgriLife Extension, Texas Wildlife Services, TPWD	Deliver Feral Hog Education Workshop	2025 – 2035	N/A
Estimated Load Reduction			
Removing and maintaining feral hog populations directly reduces fecal bacteria, nutrient, and sediment loading to water bodies. Reducing the population by 8% would reduce annual E. coli loads by 1.74 x 10^{13} cfu/year.			
Effectiveness	Moderate: Reducing feral hog populations will decrease bacteria and nutrient loading to the streams. However, substantial reduction of the population is difficult.		
Certainty	Low: Feral hogs are transient, instinctual, and adapt to changes in environmental conditions. Population reductions require landowner diligence. Combined, there is considerable uncertainty in the ability to remove 8% of the population annually.		
Commitment	Moderate: Many landowners are actively battling feral hog populations and will continue to do so if resources remain available. Many other landowners welcome feral hogs as an additional income stream through paid hunting.		
Needs	Moderate: Landowners benefit from technical and educational resources to inform them about feral hog management options. Funds are needed to deliver these workshops and to increase removal resources available to landowners.		

Reduce Illicit Dumping

Stakeholders indicate that illicit dumping is a problem throughout the watershed. Dumping activities typically occur at or near bridge crossings and access roads near riparian habitats. Items deposited often include animal carcasses, tires, home appliances, household trash, and rubbish. The scope of the problem has not been quantified but it is a potential contributor to the degradation of water and environmental quality. While much of the known trash dumped is not a direct bacteria contributor, it undoubtedly invites additional trash dumping and creates other pollution concerns for habitat, soil and water. Requirements under existing MS4 permits, continued enforcement of local and state regulations, and delivery of educational and outreach materials that focus on the proper disposal of carcasses and other trash should reduce the negative impacts resulting from illicit dumping.

The San Antonio River Authority, as well as all four counties and many cities in the watershed have programs to identify or monitor illegal dumping sites, enforce anti-dumping rules, and conduct public education on anti-littering and illegal dumping. Counties conduct nuisance abatements and routine inspection of known dumping areas, organize clean-up events, and distribute educational materials to engage communities and help prevent illicit dumping. Both SARA and Bexar County conduct annual helicopter surveys to inspect for dumping along stream banks.

While TxDOT relies on the TCEQ or local government for enforcement, the department investigates reports of dumping on its property and right-of-way, and reports problems to the appropriate enforcement agency, as required under its MS4 permit. TxDOT also maintains a hotline and stormwater web page for reporting spills and illegal dumping, and maintains the famous "Don't Mess With Texas Water" program consisting of billboards placed in sensitive watershed areas that will include a phone number for reporting illicit dumping activities.

Hosting hazardous waste collection events (including agricultural waste) annually in the watershed can reduce improper waste disposal. Stream clean-up events and outreach materials will be scheduled and distributed to help improve current dumping sites and raise public awareness regarding dumping.

Table 6-7. Management Measure: Reduce illicit dumping.

Source: Illicit and Illegal Dumping			
Problem: Illicit and illegal dumping of trash and animal carcasses in and along waterways			
Objectives: Promote and expand education and outreach efforts in the watershed.			
Critical Areas: Entire watershed with focus on bridge crossings and publicly accessible areas			
Goal: Increase awareness of and access to proper disposal techniques and reduce illicit dumping of waste and animal carcasses in or near water bodies throughout the watershed.			
Description: Education and outreach materials will be developed and delivered to residents throughout the watershed on the proper disposal of waste materials.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
Counties, cities, Watershed Coordinator	Organize hazardous waste collection events	2025 – 2035	Est $30,000 per event
Counties, cities, SARA MS4s, Watershed Coordinator	Develop and deliver educational and outreach materials to residents	2025 – 2035	N/A
Estimated Load Reduction			
Load reductions are likely minimal from this management measure and are not estimated.			
Effectiveness	Low: Preventing illicit dumping, especially animal carcasses, is likely to reduce bacteria loads by some amount, although this loading is likely limited to areas with public access.		
Certainty	Low: Anticipating changes in resident behavior due to education and outreach is difficult at best. Reaching residents that illegally dump is likely difficult.		
Commitment	Moderate: Many stakeholders indicate illicit dumping occurs; however, enforcement is difficult. Addressing the issue is not a high priority in all locations and resource availability is low.		
Needs	Moderate: Financial resources are required to develop and distribute educational materials and provide additional events.		

Restore Degraded Streams and Riparian Areas

Stakeholders expressed an interest in identifying areas for riparian restoration and buffers. Many streams in the watershed have been altered through the years by activities such as urban development, encroachment of cropland and pastures, and channelization. Easily identified results of these alterations include degraded riparian vegetation, compacted soils, degraded stream channels, and invasive vegetation. Such changes can alter the natural balance of stream corridors, resulting in flooding, increased erosion and sedimentation, reduced water quality, degraded habitat for aquatic and terrestrial wildlife, and threats to infrastructure such as roads and pipelines.

Maintaining a vegetated buffer (forest, native plantings, etc.) along waterways can slow storm flows, decrease erosion, filter pollutants, and provide other ecosystem services. When maintained in areas appropriate to drainage needs, riparian buffers are a natural, lower cost infrastructure solution. Implementation can take place on public or private land and use a mix of vegetative approaches. A preliminary screening effort was conducted by the Texas A&M Forest Service using the i-Tree Canopy tool to identify riparian areas in the watershed the Medina River with potentially moderate or poor riparian functions. Points representing approximately 6% were identified as moderately

functioning and approximately 2% were identified as poorly functioning. These areas are located in all three assessment units of Segment 1912 covered in this WPP. While over 90% of the Medina River riparian areas were identified as potentially properly functioning, the effort demonstrates there are multiple opportunities for establishment or rehabilitation of riparian areas with potential water quality benefits. It's recommended that a more robust assessment be conducted to identify and support targeted restoration of degraded riparian areas.

Stream channel erosion, often a result of unmanaged stormwater, can contribute to poor water quality through release of sediment, nutrients, and other pollutants from sediment and stream bank materials. Restoration of stream channels, especially when paired with riparian and floodplain restoration efforts, can be effective in reducing pollutants and improving water quality. Restoration methods referred to as Natural Channel Design (NCD) focus on the holistic improvement of physical, chemical, and biological functions of a stream system. Physical functions that might be improved are reduction in bank erosion and a self-sustaining water and sediment balance that does not require human intervention (such as dredging). Chemical function improvements can include higher water quality and greater removal of pollutants as water flows through the channel. Biological functions may be improved by expanding habitat for diverse species, such as fish, aquatic insects and other wildlife. The TWDB contracted a study evaluating the potential for use of NCD versus traditional stormwater infrastructure in Texas (TWDB 2013). The report indicated that NCD can be effective in reducing bacteria, nutrient, and sediment in streams.

SARA developed its Stream Restoration program in 2009 in response to recurring channel erosion and stream instability, and has incorporated NCD in both urban and rural locations across their area. Resources developed under this program include design protocols; training for design, construction, and maintenance professionals; research and technical reports; reference reach databases; as well as a stream restoration potential screening tool and database. As part of its watershed master planning efforts, the stream restoration potential screening tool was applied to streams across the San Antonio River basin, including the Medina River WPP watershed. Streams were classified according to the most appropriate method to restore or protect stream corridor functionality using restoration, rehabilitation, or preservation techniques. SARA also conducted feasibility studies for seventeen stream reaches and conceptual designs for three reaches in the watershed (SARA 2024).

The Medina River Beaver Dam Pilot Program is a recently initiated stream restoration effort to pilot test an alternative form of erosion control. SARA's Ecological Engineering Team, in collaboration with the City of San Antonio Parks and Recreation Department, proposed a pilot project involving the River Authority's team of "River Warrior" volunteers. The first project in the pilot program addresses erosion issues at the Medina River Natural Area, in the lower portion of the watershed. The project includes a series of post-assisted log structures in the erosion valley and miniature dams to reduce erosion, allowing nature to rebuild and stabilize the erosion valleys. The goal is to build 100 of these types of structures and assess the ecological and water quality outcomes.

While much effort has been and continues to be dedicated to identifying and prioritizing areas for potential restoration activities, design and construction costs are often a challenge to completing restoration projects, particularly on private property. Given the potential long-term benefits to communities and the environment, stakeholders recommend that both riparian and stream restoration opportunities be further investigated and implemented should funds become available.

Table 6-X. Summary of Management Measure: Riparian Restoration.

Source: Poorly Functioning Riparian Areas			
Problem: Degraded riparian areas fail to capture or mitigate pollutant runoff from adjacent areas. Resulting bank instability can promote channel/floodplain erosion and pollutant contributions to waterbodies.			
Objectives: Promote and expand education and outreach efforts in the watershed. Identify and implement opportunities for restoration of priority riparian areas.			
Critical Areas: Entire watershed with focus on poorly functioning riparian areas identified by screening tools.			
Goal: Increase awareness of properly functioning riparian areas and their benefits to water quality and ecosystem health. Identify and restore degraded systems in priority areas throughout the watershed.			
Description: Education and outreach programs will be developed and delivered. Screening tools will be used to assist in identifying candidate riparian areas. Restoration activities will be conducted at priority areas.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
TFS, Cities, Counties, SARA, EAA, SWCDs, NRCS, MS4s, Watershed Coordinator	Identify candidate locations and partners for restoration activities	2025 – 2035	N/A
TFS, Cities, Counties, SARA, EAA, SWCDs, NRCS, Watershed Coordinator	Develop plans and conduct riparian restoration activities at priority locations	2025 – 2035	TBD
TFS, Cities, Counties, SARA, SWCDs, NRCS, AgriLife Extension, Watershed Coordinator	Plan and deliver riparian education and outreach programs	2025 – 2035	N/A
Estimated Load Reduction			
Enhancement or installation of trees and other vegetation to promote riparian functions will result in direct reductions in bacteria loadings in the watershed by filtering and reducing runoff from adjacent areas. Potential bacteria and nutrient load reductions were not calculated because the location, type, and sizes of projects will determine the potential load reductions.			
Effectiveness	Moderate to High: Riparian effectiveness for reducing pollutant loading is known to be high, but will depend on site selection and maintenance of the area. Educational programs have proven effective in knowledge and technology transfer.		
Certainty	Moderate: Restoration activities and continued maintenance or protection of restored areas require sustained commitment from property owners. Technical and financial assistance is available to help plan and implement specific projects, especially those with additional flood mitigation benefits.		
Commitment	Moderate to Low: Riparian restoration may not be a high priority for local cities or counties. Financial needs may be significant depending on site characteristics.		
Needs	Moderate: Technical resources to identify priority sites are available and initial screening has been conducted. Long-term commitment from public property owners is needed. A common understanding by project partners of the expected use, maintenance, and ecosystem benefits of properly functioning riparian areas is needed.		

Table 6-X. Summary of Management Measure: Stream Restoration.

Source: Degraded Stream Channels			
Problem: Degraded and eroding stream channels impact riparian vegetation, resulting in bank instability, floodplain isolation, sedimentation, and poor water quality.			
Objectives: Promote and expand education and outreach efforts in the watershed. Identify and implement opportunities for restoration of priority areas.			
Critical Areas: Entire watershed with focus on poorly functioning riparian and publicly accessible areas identified by screening tools.			
Goal: Increase awareness of properly functioning riparian and stream systems and their benefits to water quality and ecosystem health. Identify and restore degraded stream channels in priority areas throughout the watershed.			
Description: Education and outreach programs will be developed and delivered. Screening tools will be used to assist in identifying priority areas where restoration activities will be conducted.			
Implementation Strategy			
Participation	Recommendations	Period	Capital Costs
Cities, Counties, SARA, EAA, SWCDs, NRCS, MS4s, Watershed Coordinator	Identify candidate locations and partners for stream restoration, rehabilitation, or preservation activities.	2025 – 2035	N/A
Cities, Counties, SARA, EAA, SWCDs, NRCS, Watershed Coordinator	Develop plans and conduct activities at priority locations	2025 – 2035	TBD
Cities, Counties, SARA, SWCDs, NRCS, AgriLife Extension, Watershed Coordinator	Plan and deliver riparian education and outreach programs	2025 – 2035	N/A
Estimated Load Reduction			
Rehabilitation or restoration of degraded stream systems, including channel, riparian, and floodplain components, will result in direct reductions in bacteria loadings by effectively filtering and reducing runoff from adjacent areas. Reduction in erosion will result in the reduction of bacteria and nutrient loads contained in channel bed and banks. Potential bacteria and nutrient load reductions were not calculated because the location, type, and sizes of projects will determine the potential load reductions.			
Effectiveness	Moderate to High: Riparian and floodplain effectiveness for reducing pollutant loading is known to be high, but will depend on site selection and maintenance of the area. Educational programs have proven effective in knowledge and technology transfer.		
Certainty	Moderate: Rehabilitation and restoration activities, as well as continued maintenance or protection of restored areas require education and sustained commitment from property owners. Technical and financial assistance is available to help plan and implement specific projects, especially those with additional flood mitigation benefits.		
Commitment	Moderate to Low: Rehabilitation or restoration may not be a high priority for local cities or counties. Financial needs are significant and will vary depending on site characteristics.		
Needs	Moderate: Technical resources to identify priority sites are available and initial screening has been conducted. Long-term commitment from public property owners is needed. A common understanding by project partners of the expected use, maintenance, and ecosystem benefits of properly functioning stream systems is needed.		

Conserve Land

According to the Texas Land Trust Council (TLTC 2024), over 90,000 acres are protected through conservation easements or fee simple agreements in the four counties partly located in the watershed. Land conservation occurs when landowners voluntary limit particular land use activities that pose a threat or would be detrimental to the natural resources they wish to protect. Depending on the type of easement or agreement, various natural resources may be protected, including water resources, riparian habitat, and native pastures. These voluntary agreements allow deed holders to retain ownership of the property and continue to live on and manage the land. Should the land ever be sold, these easements will typically still apply.

In the Medina River watershed, the Edwards Aquifer Authority joined an interlocal cooperation agreement with the City of San Antonio to support its program to protect land over the environmentally sensitive Recharge and Contributing Zones of the Edwards Aquifer via the Edwards Aquifer Protection Program (EAPP). Most of the properties are protected through conservation easements, legal agreements between the City of San Antonio and local ranch owners that limit development and other activities that may impact the water quality or quantity entering the aquifer. In return for placing a property in a conservation easement, landowners are compensated for a portion of the appraised value of the land. There are currently more than 150,000 acres of land across the aquifer protected under these conservation easements, with over 5,500 in the Medina River WPP watershed. The EAA continues to perform geologic evaluations on prospective properties and conducts the annual monitoring essential to the integrity of the program.

The Department of Defense's Readiness and Environmental Protection Integration (REPI) Program supports land conservation to prevent land use conflicts near military installations. Two REPI program areas are located in the watershed. The JBSA-Lackland REPI project works with local land trust organizations, the San Antonio River Authority, and others on a plan to protect buffer areas around the installation from development pressures. The Camp Bullis Sentinel Landscapes project boundary includes portions of the Contributing and Recharge zones in the upper watershed. Over 60 partner organizations collaborate on this effort to manage and conserve land and natural resources in an area covering portions of six counties. Land conserved under the REPI program could prevent future contributions of pollutants from key tracts along Medio Creek and the lower Medina River, as well as the upper reaches of the watershed.

Management Measure – Manage Abandoned Wells

Abandoned wells are capable of delivering contamination from the surface to groundwater, either by direct transport down the well casing or by providing a pathway between upper and lower groundwater layers. Because of the porous nature of rocks over the Edwards Aquifer, contaminated groundwater could potentially move back to the surface and into waterbodies through springs and seeps in the Contributing and Recharge zones, and via artesian wells or springs in the Artesian zone. Although not identified as a significant source of bacteria, identifying and plugging abandoned or deteriorated wells could prevent bacteria from being transported to waterbodies from more remote locations.

The EAA abandoned well closure program was initiated in 2007 and focuses on locating and assessing the condition of Edwards Aquifer water wells within the EAA jurisdiction. Of the over 300 confirmed abandoned wells identified, about 50 are located in the watershed. The EAA works with SAWS to identify and plug abandoned wells, and the EAA funds a needs-based abandoned well closure assistance program to assist well owners with proper plugging of wells.

Chapter 7 Education and Outreach

Engaging both the general public and specific targeted audiences is a crucial component of ensuring the success of the WPP. This section outlines the various educational programs, outreach efforts, and related strategies that will be used to support implementation of this WPP. The purpose of these efforts is to ensure ongoing community involvement in the effort as well as to increase public awareness of water quality and other water resource issues in the watershed.

Long-term commitments from citizens and landowners will be needed to accomplish comprehensive improvements in the Medina WPP watershed. The education and outreach component of implementation must focus on keeping the public, landowners, and agency personnel informed of project activities; provide information about appropriate management practices; and assist in identifying and forming partnerships to lead the effort. Efforts must also be sensitive to stakeholder needs and cultural identities of this urbanizing but historically rural watershed.

To ensure the continuity of the effort and a consistent point of coordination, it's recommended that a Watershed Coordinator facilitate implementation of the WPP. Existing communication networks, outreach opportunities, and partners will be used to maximize resources and reach a wide array of stakeholders. Potential communication and outreach partners will be prioritized to ensure messages meet the needs and concerns of stakeholders from multiple groups. A key focus will be emphasizing the WPP's respect for private property and voluntary solutions.

Watershed Coordinator

The watershed coordinator's role is to lead efforts to establish and maintain working partnerships with stakeholders. In addition to serving as a single point of contact for WPP-related issues, the Watershed Coordinator facilitates stakeholder meetings and coordinates with state and federal agencies to ensure compliance with agreements. The watershed coordinator will be tasked with maintaining stakeholder support, identifying and securing funds to implement the WPP, tracking success of implementation, and working to implement adaptive strategies. A full-time watershed coordinator position in or near the watershed is recommended to effectively support WPP implementation. Texas Water Resources Institute (TWRI) has taken the lead on this role and continues to guide the effort.

General Outreach

The WPP is one of many ongoing efforts toward similar goals of restoring and protecting water and other natural resources for communities in the watershed. These common goals will be leveraged to join forces with, rather than replace, partner organizations. Actively promoting public awareness and

interest in the watershed and the WPP is critical to ensuring community support and meeting water quality goals.

Public Stakeholder Meetings

During WPP development, stakeholder engagement was critical. Public meetings to develop the WPP began in October 2023 with local stakeholders. In total, XX meetings were held to discuss plan development, including general stakeholder meetings and specialized workgroup meetings.

Using stakeholder feedback and data led to the application of planning tools with the WPP as an end goal. This WPP integrates science and stakeholder input to develop a comprehensive watershed-specific plan for restoring and protecting water quality in the Medina River WPP watershed. Public meetings engaging watershed stakeholders have been integral to this effort. Through these meetings, information on new and existing management strategies as well as educational and outreach tools that could be implemented to improve watershed health and water quality was also conveyed.

Maintaining periodic public stakeholder meetings will achieve several WPP implementation goals. Public meetings will provide a platform for the watershed coordinator and project personnel to provide WPP implementation information including implementation progress, near-term implementation goals and projects, information on how to sign-up or participate in active implementation programs, appropriate contact information for specific implementation programs and other information as appropriate. These meetings will keep stakeholders engaged in the WPP process and provide a platform to discuss adaptive management to keep the WPP relevant to watershed and water quality needs. This will be accomplished by reviewing implementation goals and milestones and actively discussing how watershed needs can be better served. Feedback will be incorporated into WPP addendums as appropriate. It's anticipated that public meetings will be held on a quarterly basis during the early years of implementation but may reduce in frequency as the effort advances.

Future Stakeholder Engagement

Watershed stakeholders will continue to be engaged throughout the WPP implementation process. The Watershed Coordinator will play a critical role in this transition by continuing to organize and host periodic public meetings and needed educational events, and by meeting with focused groups of stakeholders to seek out and secure implementation funds. The watershed coordinator will also provide content to maintain and update a project website, track WPP implementation progress, and participate in local events to promote watershed awareness and stewardship. News articles, newsletters, and the project website will be primary tools used to communicate with watershed stakeholders on a regular basis and will be developed to update readers periodically on implementation progress, provide information on new implementation opportunities, available technical or financial assistance, and other items of interest related to the WPP effort.

Texas Watershed Stewards

The Texas Watershed Stewards program is a free educational workshop presented by Texas A&M AgriLife Extension and the TSSWCB. It is designed to help watershed stakeholders improve and protect their water resources by getting involved in local watershed protection and management

activities. The program is tailored to address the specific water quality issues within the Medina River WPP watershed.

Events and Opportunities

Many entities working in and around the watershed routinely host educational events that are relevant to the watershed and its stakeholders. These entities include AgriLife Extension, Texas Parks and Wildlife Department, Edwards Aquifer Authority, San Antonio River Authority, City of San Antonio, and various nonprofit organizations such as the Greater Edwards Aquifer Alliance, River Aide San Antonio, Friends of San Antonio Natural Areas, Master Naturalists/Gardeners, Texas Audubon, 4-H, and more. Community and neighborhood events and festivals will provide potential venues for engaging adult and youth through displays, demonstrations, competitions, and print materials. The Watershed Coordinator will identify organizations and events and coordinate as appropriate to increase awareness of the Medina WPP and provide educational materials on various water resource and water quality management strategies.

Volunteer Programs

Active volunteer groups in the watershed that have a focus on water quality and environmental protection include Texas Master Naturalist (TMN) Chapters Brush y Canyons in Medina County, Hill Country in Bandera County, and Alamo Area in Bexar County; as well as the Bexar County Master Gardener Association (TMGA) in Bexar County. These organizations provide training to their members on water quality and environmental protection issues and management strategies, and organize a number of volunteer events each year.

Many TMN, TMGA, and other volunteers engage in various long-term community science efforts such as iNaturalist to map and share observations of plant and animal species, riparian restoration and natural area maintenance, creek cleanups, and water quality monitoring. The Texas Stream Team (TST) is a network of trained volunteers that gather water quality data in lakes, rivers, streams, wetlands, bays, bayous, and estuaries throughout the state. Data collected by TST volunteers is uploaded to a central database and is available for public viewing online. This program is administered through a partnership between Texas State University, the TCEQ, and the EPA, and provides valuable information for local stakeholders and natural resource professionals about water quality.

SARA trains and maintains a group of volunteers, "The River Warriors," to support the health of the San Antonio River Basin through efforts such as post-storm event litter cleanups, ecosystem restoration plantings and projects, sustainable best management practices, and other workdays. The River Warriors were instrumental in recent construction of the Medina River Beaver Dam Pilot project in the Medina River Natural Area. Efforts will be made to coordinate with these and other volunteer organizations to bolster their activities in the watershed.

Youth Education Programs

Programs delivering knowledge and hands-on experiences to younger stakeholders are an important part of any watershed planning effort. Because youth often share with their parents the information they learn inside and outside the classroom, they can affect adult behavior. Youth educated about water resources may also be better stewards and make lasting behavioral changes in their own lives.

Organizations such as the Edwards Aquifer Authority, SARA, and the Greater Edwards Aquifer Alliance, to name a few, conduct and support youth-based educational programs on water resources, healthy watersheds, and water quality. Organizations, such as the Boys and Girls Clubs, that do not provide targeted education on water resources or environmental topics still provide the organizational framework and resources to reach additional stakeholders, and may be engaged to partner in water-related events and activities in the watershed. The Watershed Coordinator will explore interest and promote opportunities for engaging youth programs in the watershed.

The Edwards Aquifer Authority Education Outreach Center (EOC) provides exhibits, self-guided tours, and group learning opportunities. The facility includes a demonstration garden and rainwater harvesting system featuring drought-tolerant landscaping and native vegetation. The program also includes virtual classroom resources and travel scholarships for school groups to visit the facility. The EOC makes significant contributions to improving the environment by educating the community that relies on water from the Edwards Aquifer. EOC presentations are targeted to specific audiences based on age and grade level and include practical steps and calls to action that encourage visitors to do their part in protecting the Edwards Aquifer. SARA conducts an educational program that targets both adults and youth, and includes online presentations, educators toolkits, classroom curriculum, and a K-12 virtual education series. The Greater Edwards Aquifer Alliance (GEAA) also provides online resources, classroom activities and curriculum, as well as resources for managing stormwater, low impact development, and improving water quality.

4-H is the largest youth development program in Texas and is available in every county in the watershed. Programs include art, science, dog training, outdoor education and more. The Texas 4-H Water Ambassadors Program was formed to educate youth about water resources in Texas. Every spring, up to 30 high school youth participate in a summer Leadership Academy. Students travel throughout Texas to learn how water is collected, conveyed, treated, conserved and managed to meet the need of our economy and citizenry. To reinforce knowledge gained during the academy, water ambassadors pass on that information to others as they engage in various education and service activities throughout the year. This program also provides a platform for youth to connect with water industry professionals and educators who represent a wide range of water disciplines.

Emerging research has shown that education programs which include a localized action component like community science can increase knowledge gains and promote behavior change through personal connections to place. To promote these connections, TWRI has developed the Active Community and Citizen Education for Science and Stewardship (ACCESS), a program that connects teachers and students across the state with water educational resources. The goal is to develop watershed specific toolkits with interactive data collection projects leading to increased learning and behavioral impacts. The program engages stakeholders through targeted workshops, introducing a youth education component. This component engages K-12 educators, local universities, and local volunteers to establish a community of practice for ongoing water education efforts in the watershed.

SARA Environmental Advisory Committee

Each year, SARA's 13-member Environmental Advisory Committee (EAC) meets quarterly to review and provide input on SARA's environmental studies and programs. In addition to developing

an educated constituent base, the committee advises SARA departments about environmental issues within the basin. The EAC also acts as SARA's Clean Rivers Program Steering Committee, providing guidance and feedback on the River Authority's annual monitoring schedule. These are good meetings for high level issues and concerns and an excellent location to bring up localized water resource concerns and updates on WPP implementation activities.

Newsletters and News Releases

Watershed newsletters will be developed and sent to actively engaged stakeholders at least annually, or more often if warranted. News releases will be developed and distributed through the mass media outlets in the area to highlight significant happenings related to WPP implementation and to continue raising public awareness and support for watershed protection. These means will be used to inform stakeholders of implementation programs, eligibility requirements, and when and where to sign up for specific programs. Public stakeholder meetings and other WPP-related activities will also be advertised through these outlets.

Targeted Educational and Outreach Programs

Delivering applicable and desired educational programming is a critical part of the WPP implementation process. Multiple programs providing information on potential pollutant sources and feasible management strategies will be delivered in and near the watershed and will be advertised to watershed stakeholders. These programs will be coordinated with the efforts of other entities operating in and near the watershed. An approximate program delivery schedule is provided in the management measures described in Chapter 6. As implementation and data collection continues, the adaptive management process will be used to modify this schedule and respective educational needs as appropriate. Potential programs that can meet educational needs are described in subsequent sections.

On-Site Sewage Facilities

OSSF Operation and Maintenance Workshop

A training program that focuses on OSSF rules, regulations, operation and maintenance needs will be delivered in one or more locations in the watershed. This training consists of education and outreach practices to promote proper OSSF management and garners support for efforts to further identify and address failing OSSFs through inspections and remedial actions. AgriLife Extension provides the needed expertise to deliver this training.

Training workshops will be advertised through community newsletters, news releases, the project website, and other appropriate venues. Additionally, an online training module that provides an overview of septic systems, how they operate and what maintenance is required to sustain proper functionality and extend system life will be made available to anyone interested through the project website.

Texas Well Owners Network

Private water wells provide a source of water to many Texas residents. The Texas Well Owners Network (TWON) program provides needed education and outreach regarding private drinking water wells and the impacts on human health and the environment that can be mitigated by using

proper management practices. Water quality screenings are conducted through this program and provide useful information to well owners that will benefit them in better managing their water supplies. The "Well Educated" training focuses on informing landowners about groundwater resources, septic system maintenance, well maintenance, water conservation, water quality, and water treatment. As well, TWON has online information and fact sheets about maintaining septic systems to protect well water. Information on this program can be found at: twon.tamu.edu.

Pet Waste

Pet waste is an area in which direct engagement with the public is a necessary component of an effective outreach strategy. Unlike centralized sources like WWTFs, pet waste reduction relies on the individual efforts of thousands of residents. Education may include messaging on pet waste stations or dispensers, general water quality education with a pet waste message included, and amplification of existing educational materials. In addition to website resources and social media, community events and youth engagement opportunities will also be used as outreach tools.

Stormwater Management

Healthy Lawns Healthy Waters Workshop

The Healthy Lawns and Healthy Waters Program aims to improve and protect surface water quality by enhancing awareness, knowledge, and implementation of residential landscape BMPs. This program is most beneficial in urbanized portions of the watershed and can teach homeowners how to care for their lawns appropriately to reduce the risk of NPS pollution entering waterbodies.

Urban Riparian and Stream Restoration Workshop

The Urban Riparian and Stream Restoration workshop is available for delivery in the watershed. Although the watershed is predominantly rural at this time, urban stormwater influence on stream health and water quality is growing. This program discusses natural restoration techniques and the unique stressors faced by urban streams.

Regional partners in the WPP, such as the Texas Forest Service, promote urban and riparian forestry or restoration projects for the ecosystem services they provide. The Watershed Coordinator will seek to coordinate with ongoing programs and highlight water quality benefits. As appropriate, funding and technical support for local partners who are doing restoration or new plantings that have a water quality link will be identified. Education and outreach materials will be hosted on the project website to promote riparian restoration projects along the Medina River, Medio Creeks, and tributaries in the watershed.

SARA administers a training program in partnership with Bexar County for the site planning, design, construction inspection and maintenance of LID permanent on-site stormwater Best Management Practices (BMPs). LID is a site assessment and design approach that manages stormwater runoff by mimicking natural hydrologic processes, providing benefits for water quality and mitigating negative impacts of stormwater runoff on downstream resources including streams and rivers. LID practices support stormwater quality improvements within the watershed and can often serve multiple functions in any landscape. The LID training program is comprised of four courses, each offering an

optional credentialing component and attendees are eligible for continuing education and professional development hours.

Agricultural Operations and Land Management

Lone Star Healthy Streams Workshop

The watershed coordinator will coordinate with AgriLife Extension personnel to deliver the Lone Star Healthy Streams curriculum. This program is geared to expand knowledge of how to improve grazing lands by beef cattle producers to reduce NPS pollution. This statewide program promotes BMP adoption that is proven to effectively reduce bacterial contamination of streams. This program provides educational support for developing CPs and WQMPs by illustrating the benefits of many practices included in those plans.

Small Acreage and New Landowners

Analysis of historical records shows that small landowners are becoming more prevalent in the Medina River WPP watershed. Small acreage landowners are generally those having between 2 and 100 acres, often using the land for both residential and agricultural purposes. While these acreages are most often located in rural portions of the watershed, they may also be present in or near urban areas. To address stakeholder concerns that these areas are often susceptible to overgrazing, educational opportunities will be provided to small acreage landowners that focus on management of pastures, livestock, and wildlife, as well as proper maintenance of septic systems and water wells.

Field Days and Tours

In addition to printed material and social media, education and outreach methods employed in agricultural and rural areas will include peer-to-peer outreach through workshops, demonstration projects, and field days. Field days are educational events hosted by a producer or an educator and held on a farm or ranch. Events may include demonstrations of specific management practices and highlight economic outcomes or research results. Audiences may include producers, ag professionals, and community members. The field day can include presentations, posters, materials and guided field tours. The Watershed Coordinator will coordinate with NRCS, SWCD, and Extension staff to identify interested landowners and opportunities for hosting field days or tours.

Riparian and Stream Ecosystem Education Training

Healthy watersheds and good water quality go hand in hand with properly managed riparian and stream ecosystems. Delivery of the Riparian and Stream Ecosystem Education program will increase stakeholder awareness, understanding and knowledge about the nature and function of riparian zones and BMPs that can be used to protect them while minimizing NPS pollution. Through this program, riparian landowners will be connected with local technical and financial resources to improve management and promote healthy watersheds and riparian areas on their land. The Watershed Coordinator will work to plan an associated field day to coincide with this event.

Feral Hogs and Wildlife

Feral Hog Workshops

The Watershed Coordinator will coordinate with AgriLife Extension personnel to deliver periodic workshops focusing on feral hog management. This workshop will educate landowners on the

negative impacts of feral hogs, effective control methods, and resources to help them control these pests. Workshops will also include significant changes in available means and methods to control feral hogs. Feral hog management is also incorporated into the Lone Star Healthy Streams education program

Wildlife Management Workshops

Periodic wildlife management workshops are warranted to provide information on management strategies and available resources to those interested. The Watershed Coordinator will work with AgriLife Extension wildlife specialists, TPWD and others as appropriate to plan and secure funding to deliver workshops in and near the watershed. Wildlife management workshops will be advertised through newsletters, news releases, the project website, and other avenues as appropriate.

Chapter 8: Plan Implementation

Implementing the WPP is a multi-year commitment that will require active participation from various stakeholders and local entities for a planned 10-year period. Implementing management measures described in Chapter 6 will require significant financial and technical assistance supported by continued education and outreach. The first step to successful implementation is to create a reasonable implementation schedule with interim goals and estimated costs. All management strategies in the WPP are voluntary but have received stakeholder support, which increases the likelihood that they will be implemented.

A complete list of management measures and goals, responsible parties, and estimated costs is included in Table 8-1. Implementation goals are included incrementally to reflect anticipated implementation time frames. In specific cases, funding acquisition, personnel hiring, or program initiation may delay implementation progress. This approach provides incremental implementation targets that can be used as gages to measure implementation progress. If sufficient progress is not made, adjustments will ensue to increase implementation and meet established goals. Adaptive management may also be used to adjust the planned approach if the original strategy is no longer feasible or other measures have proven more effective.

Table 8-1. Implementation Schedule

Management Measure	Participation	Estimated Unit Cost	Number Implemented			Estimated Total Cost
			Years 1-3	Years 4-6	Years 7-10	
SSOs AND UNAUTHORIZED DISCHARGES						
Identify and address recurring or high-volume SSOs for repair or replacement through capital improvement programs	Cities, Permittees, Operators	---	1			n/a[2]
Participate in the TCEQ Sanitary Sewer Overflow Initiative (SSO Initiative)	Publicly owned WWTF Permittees	---	1			n/a[1]
Identify resources to aid repair or replacement of WWTF collection system infrastructure.	Cities, Permittees, Watershed Coordinator	---	1			n/a[1]
Develop and deliver education material to residents and property owners	Cities, Permittees, AgriLife Extension, Watershed Coordinator	$3,000	1	1	1	$9,000
Identify operations and maintenance training needs, develop and deliver resources to appropriate staff as available.	Permittees, Operators	---	As identified, needed, funding available			n/a[1]
OSSF MANAGEMENT						
Identify, inspect, and address 600 failing OSSFs repair, rehabilitation, or replacement	Counties, service providers, homeowners	$8,000 - $12,000	180	180	240	$4,800,000-$72,000,000
Evaluate feasibility of connecting to existing or planned infrastructure	Counties, municipalities, homeowners	---	1			n/a[1]
Develop and deliver materials (postcards, websites, handouts, etc.) to educate homeowners	AgriLife Extension, TWRI, Watershed Coordinator	---	1			n/a[2]
Operate an OSSF education, outreach, and training program for installers, service providers and homeowners	AgriLife Extension, TWRI, Watershed Coordinator, Counties	$4,000	1	1	1	$12,000
PET WASTE MANAGEMENT						
Install and provide maintenance supplies for pet waste stations	Cities, counties, homeowners, HOAs	$3,500	5	10	10	$87,500
Develop and provide educational resources to residents	Cities, Counties, AgriLife Extension and Research, HOAs, Watershed Coordinator	$3,000	1	1	1	$9,000
Develop and deliver educational programs for residents	AgriLife Extension, Watershed Coordinator	$3,000	1	1	1	$9,000

Management Measure	Participation	Estimated Unit Cost	Number Implemented			Estimated Total Cost
			Years 1-3	Years 4-6	Years 7-10	
STORMWATER MANAGEMENT						
Identify candidate locations and partners for installing GI/LID practices and nature-based solutions for managing stormwater	Cities, Counties, SARA, EAA, MS4s, Watershed Coordinator	---	As many as possible			n/a[1]
Develop plans and install GI/LID BMPs and nature-based solutions	Cities, Counties, SARA, EAA, MS4s	$40,000 - $100,000 /acre	As identified, needed, funding available			n/a[2]
Identify and implement opportunities for demonstration projects to encourage use of GI/LID BMPs and nature-based solutions	SARA, MS4s, AgriLife Extension, Watershed Coordinator	$40,000 - $100,000 /acre	As identified, needed, funding available			n/a[2]
Plan and deliver education and outreach programs for landowners, residents, developers, and decision-makers	SARA, MS4s, AgriLife Extension, Watershed Coordinator	$4,000	1	1	1	$12,000
IMPLEMENT WQMPs OR CPs						
Develop funding to hire WQMP technician	TSSWCB, SWCDs	Est $75,000/yr	1			$750,000
Develop, implement, and provide financial assistance for 240 livestock CPs and WQMPs	NRCS, TSSWCB, SWCDs, producers, landowners, lessees	Est. up to $30,000 /plan	72	72	96	$7,200,000
Deliver education and outreach information, programs and workshops to landowners, producers	AgriLife Extension, TWRI, Watershed Coordinator	$4,000	1	1	1	$12,000
FERAL HOG MANAGEMENT						
Voluntarily construct fences around deer feeders to prevent feral hog utilization	Landowners, producers, lessees	Est $300 per feeder	As many as possible			n/a[1]
Voluntarily trap/remove/shoot feral hogs to reduce numbers	Landowners, producers, lessees	---	1,500	1,500	2,000	n/a[2]
Develop and implement wildlife management plans and wildlife management practices	Landowners, producers, TPWD	---	As many as possible			n/a[2]
Deliver Feral Hog Education Workshops	AgriLife Extension, Texas Wildlife Services, TPWD	$4,000	1	1	1	$12,000
REDUCE ILLICIT DUMPING						
Organize hazardous waste collection events	Counties, cities, watershed coordinator	Est $30,000	1	1	1	$90,000
Develop and deliver educational and outreach materials to residents	Counties, cities, SARA MS4 permittees, Watershed Coordinator	$3,000	1	1	1	$9,000

Management Measure	Participation	Estimated Unit Cost	Number Implemented			Estimated Total Cost
			Years 1-3	Years 4-6	Years 7-10	
RIPARIAN RESTORATION						
Identify candidate locations and partners for restoration activities	TFS, Cities, Counties, SARA, EAA, MS4s, TSSWCB, NRCS, Watershed Coordinator	---	As many as possible			n/a[1]
Develop plans and conduct riparian restoration activities at priority locations	TFS, Cities, Counties, SARA, EAA, TSSWCB, NRCS, Watershed Coordinator	---	As identified, needed, funding available			n/a[2]
Plan and deliver riparian education and outreach programs	TFS, Cities, Counties, SARA, TWRI, AgriLife Extension, Watershed Coordinator	$4,000	1	1	1	$12,000
STREAM RESTORATION						
Identify candidate locations and partners for stream restoration, rehabilitation, or preservation	Cities, Counties, SARA, EAA, MS4s, Watershed Coordinator	---	As many as possible			n/a[1]
Develop plans and install restoration or rehabilitation features	Cities, Counties, SARA, EAA	---	As identified, needed, funding available			n/a[2]
Plan and deliver education and outreach programs for landowners, residents, developers, and decision-makers	SARA, AgriLife Extension, Watershed Coordinator	$4,000	1	1	1	$12,000

[1] Funded wholly or partially through existing participant program

[2] Extent and cost will be determined during implementation based on engineering or other assessments

RIPARIAN RESTORATION						
Identify candidate locations and partners for restoration activities	TFS, Cities, Counties, SARA, EAA, MS4s, TSSWCB, NRCS, Watershed Coordinator	---	As many as possible			n/a[1]
Develop plans and conduct riparian restoration activities at priority locations	TFS, Cities, Counties, SARA, EAA, TSSWCB, NRCS, Watershed Coordinator	---	As identified, needed, funding available			n/a[2]
Plan and deliver riparian education and outreach programs	TFS, Cities, Counties, SARA, TWRI, AgriLife Extension, Watershed Coordinator	$4,000	1	1	1	$12,000
STREAM RESTORATION						
Identify candidate locations and partners for stream restoration, rehabilitation, or preservation	Cities, Counties, SARA, EAA, MS4s, Watershed Coordinator	---	As many as possible			n/a[1]
Develop plans and install restoration or rehabilitation features	Cities, Counties, SARA, EAA	---	As identified, needed, funding available			n/a[2]
Plan and deliver education and outreach programs for landowners, residents, developers, and decision-makers	SARA, AgriLife Extension, Watershed Coordinator	$4,000	1	1	1	$12,000

[1] Funded wholly or partially through existing participant program

[2] Extent and cost will be determined during implementation based on engineering or other assessments

Acronyms: conservation plan, CP; Edwards Aquifer Authority, EAA; green infrastructure/low impact development, GI/LID; homeowners association, HOA; municipal separate storm sewer system, MS4; Natural Resources Conservation Service, NRCS; on-site sewage facility, OSSF; San Antonio River Authority, SARA; sanitary sewer overflow, SSO; soil and water conservation district, SWCD; Texas Commission on Environmental Quality, TCEQ; Texas Forest Service, TFS; Texas Parks and Wildlife Department, TPWD; Texas State Soil and Water Conservation Board, TSSWCB; Texas Water Resources Institute, TWRI; wastewater treatment facility, WWTF; water quality management plan, WQMP

Chapter 9: Resources

This chapter identifies potential technical and financial assistance sources available to implement management measures described in Chapter 6. Grant funding will be a substantial source of implementation funding given the type and variety of needs identified. In addition to technical and financial assistance, the Watershed Coordinator position serves a critical role for ensuring WPP success. It is recommended that local funds be identified and used to hire a local Watershed Coordinator to guide WPP implementation and facilitate long-term success.

Technical Assistance

Designing, planning, and implementing many management recommendations in the plan will require technical expertise. In these cases, appropriate technical support will be sought. Funding required to secure needed expertise will be included as appropriate in requests for specific projects. Potential technical assistance sources for each management measure are listed below (Table 9-1).

Table 9-1. Summary of potential sources of technical assistance.

Management Measure	Potential sources
SSOs and Unauthorized Discharges	TCEQ, SAWS, WWTFs, private firms
OSSF Management	Design technicians from counties, AgriLife Extension
Pet Waste Management	Cities, Counties, AgriLife Extension, SARA, MS4s
Stormwater Management	MS4s, SARA, EAA, AgriLife Extension
Implement WQMPs or CPs	TSSWCB, local SWCDs, NRCS
Feral hog management	AgriLife Extension, TPWD, NRCS, TSSWCB, TWS
Reduce illicit dumping	Cities, counties, MS4s, SARA, AgriLife Extension
Riparian and Stream Restoration	SARA, NRCS, TFS, private firms

Acronyms: conservation plan, CP; Edwards Aquifer Authority, EAA; municipal separate storm sewer system, MS4; Natural Resources Conservation Service, NRCS; on-site sewage facility, OSSF; San Antonio River Authority, SARA; San Antonio Water System, SAWS; sanitary sewer overflow, SSO; soil and water conservation district, SWCD; Texas Commission on Environmental Quality, TCEQ; Texas Forest Service, TFS; Texas Parks and Wildlife Department, TPWD; Texas State Soil and Water Conservation Board, TSSWCB; wastewater treatment facility, WWTF; water quality management plan, WQMP

County or City Designated Representatives

OSSF construction or replacement in Atascosa, Bandera, Bexar, or Medina counties requires a permit on file with local authorized agents. Permits must be applied for through a TCEQ-licensed professional installer. The county or city's designated representative is responsible for approving or denying permits. Site evaluations must be done by a TCEQ-licensed site and soil evaluator, licensed maintenance provider, or licensed professional installer.

Edwards Aquifer Authority

The EAA is a regional water management agency that regulates the use of the Edwards Aquifer, which provides water to over 2.5 million people. The EAA was created in 1993 to protect the aquifer from federal takeover and to preserve threatened and endangered species. The EAA has regulatory jurisdiction in all of Bexar, Medina and Uvalde counties and portions of Atascosa, Caldwell, Comal, Guadalupe, and Hays counties. The organization operates its Field Research Park for the purpose of conducting various field experiments and conduct long-term research on the aquifer system.

Natural Resources Conservation Service

NRCS provides conservation planning and technical assistance to private landowners. For decades, private landowners have voluntarily worked with NRCS personnel to prevent erosion, improve water quality, and promote sustainable agriculture. Assistance is available to help landowners maintain and improve private lands, implement improved land management technologies, protect water quality and quantity, improve wildlife and fish habitat, and enhance recreational opportunities. Local NRCS centers are located in Hondo, Bandera, Pleasanton, and San Antonio.

Private Firms

The technical expertise provided by firms may be required for wastewater infrastructure projects or stormwater BMP and GI/LID design. Private firms provide consulting, engineering, and design services. Private firms specializing in water and wastewater services offer onsite training to their clients as part of their water and wastewater treatment services. This is accomplished through hands-on instruction and seminars on basic water treatment practices and procedures control testing, and the safe handling of chemicals. Extensive work has been conducted by the Texas General Land to develop manuals and recommended strategies that can be incorporated into engineering designs. Existing resources can be leveraged by engineering firms to ensure future plans are aligned with the goals and regulatory guidelines of partnering organizations. Funding for services will be identified and written into project budgets as required.

San Antonio River Authority

SARA has a jurisdictional area that includes all of Bexar, Wilson, Karnes, and Goliad Counties, but provides valuable assistance throughout the San Antonio River Basin. SARA conducts water quality monitoring activities and special studies, education and outreach, as well as ecosystem restoration. SARA's programs encourage public use of water and natural areas, enhance water quality, and preserve aquatic and riparian habitat. SARA will be a source of environmental technical assistance across the watershed.

San Antonio Water System

Formally established in 1992 from various smaller utilities, SAWS works closely with the City of San Antonio and other customers to provide drinking water, wastewater, and stormwater services in the region. An important component of SAWS' planning role is the responsibility to protect the purity of the city's water supply coming from the Edwards Aquifer, including enforcing certain city ordinances related to subdivision development.

Soil and Water Conservation Districts

A SWCD, like a county or school district, is a subdivision of the state government. SWCDs are administered by a board of five directors who are elected by their fellow landowners. There are 216 individual SWCDs organized in Texas. It is through this conservation partnership that local SWCDs can furnish technical assistance to farmers and ranchers for the preparation of a complete soil and water CP to meet each land unit's specific capabilities and needs. The local SWCDs include Atascosa County SWCD, Bandera SWCD, Medina Valley SWCD, and Alamo SWCD.

Texas A&M AgriLife Extension

AgriLife Extension is a statewide outreach education agency with offices in every county of the state. AgriLife Extension provides a network of professional educators, volunteers, and local county extension agents. AgriLife Extension will be consulted to develop and deliver education programs, workshops, and materials as needed.

Texas Wildlife Services (TWS) is a division of the Texas A&M AgriLife Extension Service. This agency protects the resources, property, and well-being of Texans from damage related to wildlife. TWS serves rural and urban areas with technical assistance, education, and direct control for wildlife damage management of both native wildlife and non-domestic animals.

Texas Commission on Environmental Quality

TCEQ offers a variety of programming and personnel resources that can provide technical support for WPP Implementation. TCEQ's SSO Initiative is a voluntary program for permitted WWTFs and municipalities. Through the initiative, an SSO plan is developed outlining the causes of SSOs, mitigative and corrective actions, and a timeline for implementation. Assistance for SSO planning and participation in the SSO Initiative is available through the TCEQ regional office (Region 13, San Antonio) and the TCEQ Small Business and Environmental Assistance Division.

TCEQ regional offices also provide resources and expertise for environmental monitoring activities, investigating compliance at permitted facilities and responding to complaints, developing enforcement actions for violations, and performing environmental education and technical assistance for communities as needed. Regional offices also respond to environmental emergencies (disasters, spills, etc.) and evaluate public exposure to hazardous materials.

Texas Parks and Wildlife Department

TPWD's Private Land Services is a program to provide landowners with practical information on ways to manage wildlife resources that are consistent with other land use goals, to ensure plant and animal diversity, to provide aesthetic and economic benefits and to conserve soil, water, and related natural resources. TPWD offers assistance in developing property-specific wildlife habitat

management plans and can aid in tracking the expected water quality improvements. Additionally, TPWD offers a habitat management workshop through their regional biologists. To participate, landowners may request assistance by contacting the TPWD district serving their county. District 4 (Kerrville) serves Bandera County, while District 8 (Pleasanton) serves Atascosa, Bexar, and Medina Counties.

Texas State Soil and Water Conservation Board

TSSWCB supports the operation of local SWCDs and leads the WQMP program by providing technical assistance for developing management and conservation plans at no charge to agricultural producers. A visit with the local SWCD offices is the first step for operators to begin the plan development process.

Financial Resources

Successful WPP implementation will require substantial fiscal resources. Diverse funding sources will be sought to meet these needs. Resources will be leveraged where possible to extend the impacts of acquired and contributed implementation funds.

Grant funds will be relied upon to initiate implementation efforts. Existing state and federal programs will also be expanded or leveraged with acquired funding to further implementation impacts. Grant funds are not a sustainable source of financial assistance but are necessary to assist in WPP implementation. Other sources of funding will be used, and creative funding approaches will be sought where appropriate. Sources of funding that are applicable to this WPP will be sought as appropriate and are described in this chapter.

Federal Sources

Clean Water Act §319(h) Nonpoint Source Grant Program

EPA provides grant funding to Texas to implement projects that reduce NPS pollution through the §319(h) Nonpoint Source Grant Program. These grants are administered by TCEQ and TSSWCB. WPPs that satisfy the nine key elements of successful watershed-based plans are eligible for funding through this program. To be eligible for funding, implementation measures must be included in the accepted WPP and meet other program rules. Some commonly funded items include but are not limited to:

- development and delivery of education programs;
- water quality monitoring;
- OSSF repairs and replacements;
- BMP installation and demonstrations; and
- water body cleanup events.

Further information can be found at: https://www.tceq.texas.gov/waterquality/nonpoint-source/grants/grant-pgm.html and https://www.tsswcb.texas.gov/programs/texas-nonpoint-source-management-program

Conservation Stewardship Program

The Conservation Stewardship Program (CSP) is a voluntary conservation program administered by NRCS that encourages producers to address resource concerns in a comprehensive manner by undertaking additional conservation activities and improving, maintaining, and managing existing conservation activities. The program is available for private agricultural lands including cropland, grassland, prairie land, improved pasture, and rangeland. CSP encourages landowners and stewards to improve conservation activities on their land by installing and adopting additional conservation practices including but not limited to prescribed grazing, nutrient management planning, precision nutrient application, manure application, and integrated pest management. Program information can be found at: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/

Conservation Reserve Program

The Conservation Reserve Program is a voluntary program for agricultural landowners administered by the USDA Farm Service Agency. Individuals may receive annual rental payments to establish long-term, resource-conserving covers on environmentally sensitive land. The goal of the program is to reduce runoff and sedimentation to protect and improve lakes, rivers, ponds, and streams. Financial assistance is available to establish approved conservation practices, enrollment payments, and performance payments are available through the program. Information on the program is available at: https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index

Environmental Quality Incentives Program (EQIP)

NRCS operates EQIP, which is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of 10 years. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and provides opportunities to improve soil, water, plant, animal, air, and related resources on agricultural land and nonindustrial private forestland. Individuals engaged in livestock or agricultural production on eligible land are permitted to participate in EQIP. Practices selected address natural resource concerns and are subject to NRCS technical standards adapted for local conditions. They also must be approved by the local SWCD. Local work groups are formed to provide recommendations to NRCS that advise the agency on allocations of EQIP county-based funds and identify local resource concerns. Watershed stakeholders are strongly encouraged to participate in their local work group to promote the objectives of this WPP with the resource concerns and conservation priorities of EQIP. Information regarding EQIP can be found at: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/

National Water Quality Initiative

The National Water Quality Initiative is administered by NRCS and is a partnership between NRCS, state water quality agencies, and EPA to identify and address priority impaired water bodies through voluntary conservation. Conservation systems include practices to promote soil health and reduce

erosion and nutrient runoff. Further information is available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/?cid=stelprdb1047761

Regional Conservation Partnership Program

The Regional Conservation Partnership Program (RCPP) is a comprehensive and flexible program that uses partnerships to stretch and multiply conservation investments and reach conservation goals on a regional or watershed scale. Through RCPP and NRCS, state, local, and regional partners coordinate resources to help producers install and maintain conservation activities in selected project areas. Partners leverage RCPP funding in project areas and report on the benefits achieved. The Camp Bullis Sentinel Landscape RCPP was initiated in 2022 and includes upper portions of the watershed.

Information regarding RCPP and the Camp Bullis project can be found at: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/ and at https://rise.articulate.com/share/b41rEliehemd_HIChxGJ0K-lf_zR1k_x#/

Rural Development Water and Environmental Programs

USDA Rural Development provides grants and low interest loans to rural communities for potable water and wastewater system construction, repair, or rehabilitation. Funding options include:

- Rural repair and rehabilitation loans and grants: provide assistance to make repairs to low-income homeowners' housing to improve or remove health and safety hazards
- Technical assistance and training grants for rural waste systems: provide grants to nonprofit organizations that offer technical assistance and training for water delivery and waste disposal
- Water and waste disposal direct loans and grants: assist in developing water and waste disposal systems in rural communities with populations less than 10,000 individuals.

More information about the USDA Rural Development program can be found at: https://www.rd.usda.gov/programs-services/water-environmental-programs

Urban Water Small Grants Program

The objective of the Urban Waters Small Grants Program, administered by EPA, is to fund projects that will foster a comprehensive understanding of local urban water issues, identify and address these issues at the local level, and educate and empower the community. In particular, the Urban Waters Small Grants Program seeks to help restore and protect urban water quality and revitalize adjacent neighborhoods by engaging communities in activities that increase their connection to, understanding of, and stewardship of local urban waterways.

More information about the Urban Waters Small Grants Program can be found at: https://www.epa.gov/urbanwaters/urban-waters-small-grants

Community Development Block Grants

Grants are available through the U.S. Housing and Urban Development program. The Community Development Block Grant (CDBG) Program provides annual grants on a formula basis to states, cities, and counties to develop viable urban communities by providing decent housing and a suitable

living environment, and by expanding economic opportunities, principally for low- and moderate-income persons.

More information about the Community Development Block Grants Program can be found at: https://www.hud.gov/program_offices/comm_planning/cdbg

State Sources

Clean Rivers Program

TCEQ administers Texas CRP, a state fee-funded program that provides surface water quality monitoring, assessment, and public outreach. Allocations are made to 15 partner agencies (primarily river authorities) throughout the state to assist in routine monitoring efforts, special studies, and outreach efforts. SARA is the partner for the San Antonio River basin and Medina River watershed. The program supports water quality monitoring and annual water quality assessments and engages stakeholders in addressing water quality concerns. More information about the NRA CRP is available at: https://nracleanriversprogram.org/

Clean Water State Revolving Fund

The Clean Water State Revolving Fund, authorized through the CWA and administered by the Texas Water Development Board (TWDB), provides low-interest loans to local governments and service providers for infrastructure projects that include stormwater BMPs, WWTFs, and collection systems. The loans can spread project costs over a repayment period of up to 20 years. Repayments are cycled back into the fund and used to pay for additional projects. Through 2020, the program has committed approximately $10 billion for projects across Texas. More information on Clean Water State Revolving Fund is available at: http://www.twdb.texas.gov/financial/programs/CWSRF/

Landowner Incentive Program

TPWD administers the Landowner Incentive Program (LIP) for private landowners to implement conservation practices that benefit healthy aquatic and terrestrial ecosystems and create, restore, protect, or enhance habitat for rare or at-risk species. The program provides financial assistance but does require the landowner to contribute through labor, materials, or other means. Further information about this program is available at: https://tpwd.texas.gov/landwater/land/private/lip/

Supplemental Environmental Projects

The Supplemental Environmental Program (SEP) program, administered by TCEQ, directs fines, fees, and penalties for environmental violations toward environmentally beneficial uses. Through this program, a respondent in an enforcement matter can choose to invest penalty dollars to improve the environment, rather than paying into the Texas General Revenue Fund. Program dollars may be directed to OSSF repair, trash clean up, and wildlife habitat restoration or improvement, among other things. Program dollars may be directed to entities for single, one-time projects that require special approval from TCEQ or directed entities (such as Resource Conservation and Development Councils) with pre-approved "umbrella" projects. Further

information about SEP is available at: https://www.tceq.texas.gov/compliance/enforcement/sep/sep-main

Texas Farm and Ranch Lands Conservation Program

The Texas Farm and Ranch Lands Conservation Program was established and is administered by TPWD to conserve high value working lands to protect water, fish, wildlife, and agricultural production that are at risk of future development. The program's goal is to educate citizens on land resource stewardship and establish conservation easements to reduce land fragmentation and loss of agricultural production. Program information is available from TPWD at: https://tpwd.texas.gov/landwater/land/private/farm-and-ranch/

Other Sources

Private foundations, nonprofit organizations, land trusts, and individuals can potentially assist with implementing some aspects of the WPP. Funding eligibility requirements for each program should be reviewed before applying to ensure applicability. Some groups that may be able to provide funding include but are not limited to:

- Cynthia and George Mitchell Foundation: provides grants for water and land conservation programs to support sustainable protection and conservation of Texas' land and water resources
- Dixon Water Foundation: provides grants to nonprofit organizations to assist in improving/maintaining watershed health through sustainable land management
- Meadows Foundation: provides grants to nonprofit organizations, agencies and universities engaged in protecting water quality and promoting land conservation practices to maintain water quality and water availability on private lands
- Partnerships with local industry in the watersheds could also provide in-kind donations or additional funding for implementation projects
- Texas Agricultural Land Trust: funding provided by the trust assists in establishing conservation easements for enrolled lands

Chapter 10: Measuring Success

Implementing this WPP requires coordination with many stakeholders over the next 10 years. Implementation will focus on addressing readily manageable bacteria sources in the watersheds to achieve water quality targets. This plan identified substantial financial resources, technical assistance, and education required to achieve these targets. Management measures identified in this WPP are voluntary but supported at the recommended levels by watershed stakeholders.

Measuring WPP implementation impacts on water quality is a critical process. Planned water quality monitoring at critical locations will provide data needed to document progress toward water quality goals. While improvements in water quality are the preferred measure of success, documenting implementation accomplishments can also be used. Combining water quality data and implementation accomplishments helps facilitate adaptive management by illustrating which recommended measures are working and which measures need modification.

Water Quality Targets

An established water quality goal defines the target for future water quality and allows the needed bacteria load reductions to be defined. The water quality goal in the Medina River WPP watershed is the existing primary contact recreation standard for E. coli of 126 cfu/100 mL (Table 10-1). If there are revisions or adoption of new water quality standards, such as for nutrients, these targets may be revised or amended as appropriate.

Table 10-1. Water quality targets for the Medina River and Medio Creek.

Year	Medina River (Station 12814)	Medio Creek (Station 12916)
	E. coli† (cfu/100mL)	E. coli† (cfu/100mL)
Year 0	223	175
Year 5	175	151
Year10	126	126

† Geometric mean in units of most probable numbers of E. coli per 100 milliliters of water

Additional Data Collection Needs

Continued water quality monitoring in the Medina River and Medio Creek watersheds is necessary to track water quality changes resulting from WPP implementation. Routine water quality monitoring at stations used in state water quality assessment is critical for future evaluations and should be continued. Additionally, stations 12814 and 12916 were used in LDC analysis to determine needed load reductions to meet the water quality targets listed above. Continued data collection over time is imperative for changes in bacteria loading to be evaluated.

The current monitoring site distribution and data collection frequency across the watersheds may limit potential to observe changes water quality that result from targeted WPP implementation. Defining localized water quality impacts from specific WPP implementation activities will require focused water quality monitoring efforts, which can only be planned once specific WPP implementation activities and locations are known. Focused monitoring plans would require funding support and may be used to assess implementation effectiveness.

Through the adaptive management process and WPP updates, future water quality monitoring needs will be evaluated and adjusted as necessary. This could include adding new sites to address new concerns or areas of interest in the watersheds.

Data Review

The Watershed Coordinator will assist stakeholders in evaluating WPP implementation impacts on instream water quality. TCEQ's statewide biennial water quality assessment approach, which uses a moving 7-year geometric mean of bacteria data collected, will be the primary means of gauging water quality improvement and ultimate success of the WPP. This assessment is published in the *Texas Integrated Report and 303(d) List* and is available online at https://www.tceq.texas.gov/waterquality/assessment/305_303.html. It is noted that a 2-year lag occurs in data reporting and assessment; therefore the 2028 or 2030 *Texas Integrated Report* will likely be the first to include water quality data collected during WPP implementation.

Identifying water quality improvements from WPP implementation is challenging if only relying on the 7-year data window used for the *Texas Integrated Report*. Therefore, another method to evaluate water quality improvements is using the geometric mean of the most recent 3 years of water quality data identified within TCEQ's Surface Water Quality Monitoring Information System. To support data assessment as needed, trend analysis and other appropriate statistical analyses will be used. Regardless of method used, water quality changes resulting from WPP implementation will be difficult to determine and may be overshadowed by activity in the watersheds that negatively influences water quality. As such, data review will not be relied on exclusively to evaluate WPP effectiveness. Data will be summarized and reported to watershed stakeholders at least annually through stakeholder meetings and SARA's annual CRP meeting.

The Watershed Coordinator will be responsible for tracking implementation targets and water quality in the watersheds. Implementation progress and water quality will be evaluated to describe the success of WPP implementation to that point. Should implementation targets or water quality

lag significantly, adaptive management efforts will be initiated to reevaluate management recommendations and targets included in the WPP.

Interim Measurable Milestones

WPP implementation will occur over a 10-year timeframe. Milestones can be useful in evaluating incremental implementation progress of management measures described in the WPP. Milestones outline a clear process for progression throughout implementation. Interim measurable milestones for management measures and education and outreach are addressed in Table 8-1. Responsible parties and estimated costs (where available) are included in the schedule. In some cases, funding acquisition, personnel hiring, or program initiation may delay the start of some items. This approach provides incremental targets to measure progress throughout WPP implementation. Adaptive management may be used where necessary to reorganize or prioritize varying implementation aspects to achieve overarching water quality goals.

Adaptive Management

Watersheds are dynamic by nature, with countless variables governing landscape processes; therefore, uncertainty is expected and the WPP was developed with this in mind. As WPP implementation progresses, it is necessary to track water quality over time and make needed adjustments to the implementation strategy. Including an adaptive management approach in the WPP provides flexibility that enables such adjustments.

Adaptive management is the ongoing process of accumulating knowledge regarding impairment causes and water quality response as implementation efforts progress and adjusting management efforts as needed. As implementation activities are instituted, water quality is tracked to assess impacts. This information can be used to guide adjustments to future implementation activities. This ongoing, cyclical implementation and evaluation process can focus project efforts and optimize its impacts. Watersheds where impairments are dominated by NPS pollutants are good candidates for adaptive management. Progress toward achieving established water quality targets will also be used to evaluate the need for adaptive management. An annual implementation progress and water quality trends review will be presented to stakeholders during meetings. Due to numerous factors that can influence water quality and the time lag that often appears between implementation efforts and resulting water quality improvements, sufficient time should be allowed for implementation to occur before triggering adaptive management. In addition to water quality targets, if satisfactory progress toward achieving milestones is determined to be infeasible due to funding, implementation scope, or other reasons that would prevent implementation, adaptive management provides an opportunity to revisit and revise the implementation strategy. If stakeholders determine inadequate progress toward water quality improvement or milestones is being made, efforts will be made to increase BMP adoption and adjust strategies or focus areas as appropriate.

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