APPENDIX D: COMPREHENSIVE WATERSHED BEST MANAGEMENT PRACTICES

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Categories of Measures

Management Measures outlined in the following sections include structural BMPs, measures for new development, retrofits for existing development, and demonstration projects to encourage adoption of water quality protection practices. Also included are non-structural management measures: land management strategies, preservation of undeveloped land, codes and regulations, and information gathering to address remaining water quality data gaps. Some are prioritized for immediate implementation (Section 2, Management Measures) and others are part of the Stakeholders' adaptive management "tool box." BMPs and management measures are organized and presented in the following categories:

1. Stakeholder Selected Regionally Appropriate Measures
2. Low Impact Development (LID) and Green Infrastructure (GI) Incentives and Fees
3. Habitat Conservation Plan Water Quality Protection Plan Measures
4. Additional Potential Water Quality Retrofits for the City of San Marcos and Texas State University Campus
5. Land Development Codes
6. Land Conservation and Management

1. Stakeholder Selected Regionally Appropriate Measures

Potential regional BMPs for implementation were selected for review based on BMP appropriateness and were also considered for each land use and land cover category contributing significant overland flow of pollutants. BMP data collected for this project focused on two major aspects: (1) Most recent studies and available data originating from trusted published sources and (2) Practices and measurements performed and collected in as similar eco-regions and urban settings as possible (Site Suitability). Potential BMPS were gathered from many sources around the nation, but the primary sources of information are listed in Table 1. Often, measures listed in Table 2 will also be found in later sections. These BMPs are expected to be implemented by many WPP partners, including the City of San Marcos (City), Hays County (County), Texas State University (University), and nongovernmental organizations (NGOs).

Table 1. Sources of BMPs compiled for WPP

Publishing Agency	Year	Title	Relevant Information Offered
City of Austin	2011	City of Austin, Texas Environmental Criteria Manual	Technical information on site and implementation design, BMPs by application type, feasibility, and some efficiency measurements
Center for Watershed Protection	2007	National Pollutant Removal Performance Database, Ver. 3	Performance analyses of currently available research through 2006, illustrates issues with types of reported values, provides tables of efficiency statistics on select popular BMP types
LCRA	2007	Highland Lakes Watershed Ordinance: Water Quality Management Technical Manual, 5th Ed.	Technical information on permit requirements/procedures, information on meeting water quality standards, erosion/sediment and permanent BMPs, and associated guidelines
NRCS	2011	Electronic Field Office Technical Guide for Hays County, Texas	Technical information on soils, water, air, plant, and animal resource conservation practices (sect. IV), preliminary cost data (sect. V), primarily oriented to rural needs
TCEQ	2005	Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices	Descriptors of structural BMPs, organized by temporary and permanent, includes TSS removal and sizing calculations, data and lab procedures
TSSWCB	2004	Water Quality Best Management Practices Manual	Descriptors of agricultural and rural BMPs, organized by practices (ex: AFO, Dry Land Cropland, etc.), loosely describes benefits and areas to be applied
TWDB	2004	Water Conservation Best Management Practices Guide (Water Conservation Implementation Task Force)	Descriptors of water conservation BMPs (municipal, industrial, agricultural), including programs and staffing recommendations, generally outlines applicability, implementation and cost considerations with some cost analysis
US EPA	1999	Urban Storm Water Best Management Practices Study	Excellent descriptors of BMPs (incl. variations on types), goals of BMPs, consideration factors in BMP selection, recommended BMP-type maintenance schedules, BMP efficiency ranges
US EPA	2005	National Management Measures to Control Nonpoint Source Pollution from Urban Areas	Lists urban BMPs by application and treatment with specific descriptors
Various	-	International Stormwater BMP Database	Collaboratively funded and managed public database of BMP studies

Bibliographies and references were utilized to further identify specific studies and documents illustrating details about and effects of BMPs. These studies helped identify whether a BMP was truly applicable to the Central Texas eco-region. Limiting parameters include soil and substrate type. Further data selection and compilation was directed toward specific parameters monitored for within the basin. Once appropriate BMPs were identified and categorized within appropriate Management Measure categories for the basin, an efficiency rating was developed and assigned to each BMP. Rating systems were created to “rank” or “rate” Value (effectiveness, compatibility, and watershed appropriateness), Implementation

(cost, barriers, available resources, and level of engineering) and Longevity (duration of best management practice and maintenance needs).

Stakeholder BMP Rankings

Each best management practice (BMP) was assigned an overall rating by stakeholders (1-9 and shown as %) which was calculated by averaging the scores of three equally weighted sub-ratings. The sub-ratings Value, Implementation, and Longevity are ranked 1-3 (and shown in percentages) according to descriptive characteristics. Information used in the rankings was gathered from various published technical sources. To the extent possible, units of measurement were standardized. For example, all agricultural BMP treatments are measured and priced in acres and have a life span of 15 years unless otherwise noted.

Sub-rating: 1. Value

- **Effectiveness** – Assessment of published efficiency or effectiveness rates for that practice including pollutant removal/reduction values and professional assumptions.
- **Compatibility** – Measurement of congruency a BMP has to other BMPs (or how well the BMP "works" with other BMPs to mitigate pollution, etc.) within the same category of Management Measures.
- **Watershed Appropriateness** - Measurement of appropriateness of a BMP for its Vulnerable Group (landscape, topography) and/or entire basin.

Sub-rating: 2. Implementation

- **Cost** – Ranking of overall cost of implementing the BMP (may or may not include maintenance costs), in standardized units to the extent possible. Lower rankings indicate a higher dollar amounts or cost, while higher rankings are attributed to less expensive BMPs. BMPs within a category (e.g. agricultural, stormwater) are ranked amongst each other by cost.
- **Barriers to Implementation** – Measurement of level of difficulty to implement and/or maintain a BMP based on level of physical, financial, legal, or social/political effort. For example, a sewage treatment plant may be a very effective BMP, but has high levels of necessary infrastructure, capital investment, and political support, thus receiving a low ranking. Higher rankings are assigned to BMPs with fewer barriers and lower rankings indicate more barriers or a greater difficulty to implement.
- **Available Resources** – Ranking based on ease of access to or availability of resources to implement a BMP. Again, a sewage treatment plant is a very effective BMP but would receive a low ranking due to the level of expense and materials required. High rankings are assigned to BMPs that have readily available resources; BMPs with resource restrictions receive low ratings.
- **Level of Engineering** – Estimation of the level of engineering a BMP may require to be implemented. For example, a rain barrel requires little engineering, while a pervious parking lot necessitates significant engineering. BMPs requiring significant engineering receive lower rankings and those with a low level (or no) engineering requirement receive higher scores.

Sub-rating: 3. Longevity

- **Longevity** - Based on prospective life-span of a BMP. More points for longer periods, fewer points for shorter periods.

- **Maintenance** - Based on the level of maintenance required over the lifespan of the BMP. Fewer points for more required maintenance, more points for less maintenance.

When reviewed, a BMP earned up to 3 points for each descriptive characteristic category within a sub-rating. Points from each of the sub-rating's descriptive characteristic were totaled and averaged into a **sub-rating** score ranging between 1 and 3. The sub-ratings were then totaled for each BMP to generate an **Overall Rating** (1-9). BMPs with overall ratings of 90% or better are presented in Table 2.

Table 2. Stakeholder Highly Ranked BMPs

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
34, 35	Agriculture	Alternative Shade Structures	$75/head				EC-85%					Peterson et al., 2011
34, 35	Agriculture	Fencing Riparian Areas	$1-1.05/lin ft w/ EQIP + $1/lin ft for individuals (includes maintenance but not labor)		90%	54%	60%	81%				Sheffield et al., 1997, Landowner Resource Center, 2000
34, 35	Agriculture	Grazing Management Strategies	Prescribed grazing- $4.09/ac		8%	34%	EC-66%					Peterson et al., 2011
33, 35	Agriculture	Groundcover Establishment- Urban	Range Planting- $16-19/ac; Forage/Biomass planting- $58/ac	0	0.99		x			x		CWP, 1997
34, 35	Agriculture	Livestock Water Quality Management Plan	$10,000	x	x	x	x	x		x		
13, 23, 24	Stormwater	Bacteria and Oil Control for Stormwater Inlets	Proprietary Systems+A2				x		x			
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27,	Stormwater/ WQPP	Biofiltration /Rain Garden	$6/ft^3 or $50,000/1 af pond	89%		85% TKN	EC-85%	98%			97-99%	Read et al., 2008, Limouzin et al., 2011, Davis et al.,

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
28, 29, 30, 31, 32, 33, 35												2003, Davis et al., 1997
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35	Stormwater/ WQPP	Constructed Wetland	$1.90 per CF storage	55%	53%	46%	88%	48%			34%	Low Impact Development Center Inc., 2010
10, 11, 16, 22,	Stormwater/ WQPP	Dry Detention Pond	$41,600/af pond $239,000/10af pond $1,380,000/100af pond Routine maintenance= 3-5% construction cost		75%	24%	22%	26%			29% Cu, 29% Zn	TCEQ, 2005, Stanley, 1996
10, 11, 12, 13, 16, 20, 22, 23, 24, 26	Stormwater/ WQPP	Engineered Swales	$10/lin. ft. per 900 ft^2. vegetated installation, + $200/year for maintenance	0%	94%	23%	0%	97%	74%	0%	91%	Yousef et. Al 1985, Municipality of M.S. 1992, Barrett et al 1998, Yu et al, 2001
33, 35	Stormwater/ Ordinance	Nutrient & Fertilizer Management (city, county, university, businesses)	Cost and load reduction dependent on activity			x		x				
10, 11, 12, 13, 16, 20, 22 ,23, 24, 25, 26, 27, 29, 30, 31, 33, 35	Stormwater/ Water Quality/ Sourcewater	Karst Protection Measures	Gate feature - $10,000-12,000 + $100-300 monthly management fee (includes regular inspections &	x		x	FC- 8%	x	x	x	x	Boyer, 2008

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
			mitigation for problems)									
24, 26, 27, 31, 33, 35	Stormwater	Landscape Mulching	$10-19/yard bulk Price does not include labor		93%	52%		32%				Demars and Long, 1998, Faucette et al., 2005
13, 16, 20, 22, 23, 24, 25, 27, 29, 30 ,31	Stormwater	Riparian Buffer - Herbaceous	EQIP Average- $130,000/river mile ($64,000-$350,000 range), Or $70-$170/acre		79%	84%	FC 95%	83%				Young et al., 1980, Larsen et al., 1994
10, 11, 12, 24, 31 (Demo projects recommended in 9, 11, 13, 23)	Stormwater/ LID, GI	Parking Lot Pervious Design Strategies	Capital= $1.64/ft^2, Operation & Maintenance= $0.16/ft2	x	x	x	x	x	x	x	x	WQPP
All basins	Stormwater	Groundcover Establishment	Ag - $16.5-90/ac, Non-ag: • Sod= $0.08-0.60/ft^2 • Seed=$25/lb or $120/5lb, @ 1lb/1000ft2 for short mix • $1-2/ft^2 soil prep • Other groundcover plants= $5-7/ft^2	x	x					x		Cypress Creek WPP, 2014
10, 11	Stormwater/ Ordinance	Pet Waste Ordinance & Stations	Ordinance-formative, $620/Collection Station Installation, $85 Annual Maintenance/Station				510 BCFU/ yr Reduction					Cypress Creek WPP, 2014
13, 16, 20, 22, 23, 24, 25, 27, 29, 30 ,31	Stormwater	Riparian Buffer -	EQIP Average- $130,000/river mile ($64,000-$350,000		79%	84%	FC 95%	83%				Young et al., 1980, Larsen et al., 1994

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
		Herbaceous	range), Or $70-$170/acre									
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35	Stormwater/ WQPP	Vegetated Buffers	$4,500	85%		25%		50%				
10, 16, 20, 24, 25, 27, 31, 34	Stormwater/ WQPP	Vegetative Filter Strips	$7/lin ft seed, $22/lin ft sod, $13,000-30,000/acre- $0.30/$ft^2$ seed, $0.70/$ft^2$ sod ($3.20-7.41/$m^2$), Maintenance- $350/ac/year Native Filter Strip by EQIP- $255/ac		76%	41%					78%	Low Impact Development Center Inc., 2010
Basins with significant riparian zones	Stormwater/ WQPP	Continued removal of invasive plants from riparian zones (especially Ligustrum)	Hourly labor costs, limited pesticide expenses	x	x	x	x	x	x	x	x	
10, 11, 12, 13, 16, 20, 22, 23, 24, 25, 26, 27, 29, 30, 31	Stormwater/ WQPP	Wet Pond	$1.90 per ft^3 storage	83%	89%	39%	83%	50%			89%	Low Impact Development Center Inc., 2010
All basins	Stormwater/ WQPP/	Stormwater treatment train	Cost and load reduction dependent on activity	x	x	x	x	x	x	x	x	

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
	sourcewater protection											
All basins	Stormwater	Existing and new BMP maintenance										
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35	LID, GI/WQPP	Green Roof	$20.35 per Ft^2	72%			93%					
All basins	LID, GI/WQPP	Rainwater harvesting	• Generally, $1/gallon • Range of $2,500-30,000 + 2% of cost for annual maintenance • Roof RO Structure (inc. rain gutters & downspouts)- $3.25/lin. ft. • Rain Barrel= $50-75 + $5/year for maintenance	x	x	x		x	x	x		Cypress Creek WPP, 2014
Urban basins	LID, GI	Porous/Pervious Pedestrian Walkways	$2-7 ft2 + base material	x	x						x	
All basin, especially 26, 35	Ordinance	Tree Protection	$660-3,500 Average cost	x	x	x		x		x	x	(Seila and Anderson, 1982;

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
												adjusted for inflation)
Urban basins	Ordinance	Urban Wildlife Management – Deer	$660-$3,500 average cost of selective thinning with some protection measures such as barricades	x	x		x					(Seila and Anderson, 1982; adjusted for inflation)
All basins	Ordinance	Xeriscaping / Nativescaping and appropriate urban landscaping	Average yard - $125-270 plus $0-1/ft^2		x	x		x		x		
All basins, especially 31	Ordinance	Water-Intensive Turf Grass Regulation/ Ban	Ordinance development + Cost to replace grass per household/ft^2, Incentives = $20/100ft2 replaced with natives, Up to ½ staff person salary for project management/enforcement			x		x		x		
All basins	Ordinance/City of San Marcos Stormwater Technical Manual	Floodplain Management and Stormwater Detention,	varies	x	x	x	x	x	x	x	x	http://sanmarcostx.gov/documentcenter/view/801

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
		Erosion Control Measures and Water Quality BMPs, Easements and maintenance										
Urban basins	Ordinance/ Stormwater	Urban stormwater districts	Varies (exemption with fee)	x	x		x	x			x	WQPP
All basins	Incentives, Ordinance	Water Conservation Pricing Strategies	varies							x		
Urban basins	Incentives	Habitat Conservation Areas – Urban	• Average land value cost of purchase (~$8500/ac) or up to $750 annually to maintain. • For urban, 1/2 ac = between $100-400 to establish • Maintenance (urban) = <$50/year	x	x		x			x		
All basins	Incentives/ Water quantity	Rain/soil moisture sensors	$13-200, depending on level of technology		x					x		
All basins	Incentive/ Ordinance/ LID, GI	Fast track permitting	Varies (may include fee reduction)	x	x	x	x	x	x		x	

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
		process for LID, GI										
All basins	Volunteer activities (in conjunction with E/O	Trash pick-ups, planting native plants/trees, water quality monitoring, tubing counts, trail restoration work	varies	x	x	x	x	x	x	x	x	
All basins	All	Watershed Coordinator or assignment of existing staff	$50-80,000 per year	x	x	x	x	x	x	x	x	
All basins/City jurisdiction	All	Urban forester and horticulturalist	$50-80,000 per year	x	x	x	x	x	x	x	x	
All	All	Watershed tour for residents and developers	>$10,0000									

BMP Implementation Information				Load Reduction Information								
Subbasin	**Management Measure Type**	**BMP**	**Cost**	**TSS**	**Sediment**	**N**	**Bacteria**	**P**	**Oil & Grease**	**Water Quantity**	**Metals**	**Source**
Add in anything missing from excel spreadsheet												

** The stakeholders recommended development of a tool box of agricultural management measures to be selected on the subbasin and individual parcel scales. The Agricultural BMPs represented in this table are examples of potential BMPs that could be selected from the tool box. The toolbox BMP is presented in "Land Conservation and Management" below*

Additional information on LID/GI BMPs (for stakeholder selected measures)

(LID) is a land-planning design approach that aims to preserve natural hydrologic regimes through innovative development while satisfying drainage and flood requirements. (GI), a similar approach to water management, protects and restores watersheds by mimicking the natural water cycle and landscape function. GI focuses on solutions that are effective, economical, and enhance community safety and quality of life. LID and GI encompass multiple design practices, focusing on new development and later shifts focus on existing developed areas to find opportunities for retrofitting (Pitzer, 2011). A LID/GI strategy is basically a suite of development BMPs such as rain gardens or dry ponds that help guide new development and retrofit existing development to reach the development goals of an area, without adding costly and significant traditional infrastructure.

Effects of LID/GI can include reduced flooding and erosion associated with urban runoff, reduced 'heat island' effect, enhanced property values, water conservation savings, increased access to community green space, and reduced costs of municipal stormwater infrastructure (Beckman, 2009).

More information about programs to encourage and incentivize LID, GI are in the following section. Additional LID/GI strategies are described in the Land Management section below.

Construction Quality Assurance Oversight for LID, GI

To ensure LID/GI practices perform as they were designed, construction oversight during LID construction is an important emerging practice. Bexar County and San Antonio, through the San Antonio River Authority, provides training for design and construction oversight and certify contractors and engineers to perform this critical function. Inspection of key elements such as dimensions, soil and gravel media, piping and overflow structures, and elevations for the drainage system, are key elements for the design engineer to verify. Field engineers and specialists can provide this data, photo documentation, and reporting to the design engineer. Verification and performance testing on the completed LID practice is another good method to document performance from the LID practice along with annual inspections and maintenance.

Selection and Sizing BMPs for Both Water Quality and Stream Protection

While BMPs are traditionally designed to provide water quality treatment, it is important that they also provide "stream protection", or control of "channel forming" flows that are the cause of most stream erosion. Urban development increases the frequency and magnitude of runoff, significantly increasing "channel forming" flow events, resulting in accelerated stream erosion. Stream erosion can account for 90% of the Total Suspended Solids (TSS) load in urban stream. The best control strategy is to provide extended detention (48 hours is optimal) of a specified volume (a function of impervious cover), and/or reduce runoff volume via infiltration or reuse. Detention of peak flows for flood control is not an effective strategy. From a detailed study by HDR and Kurkjian Engineering for the City of Austin ("Quantification of the Long-Term Benefits of On-Site Erosion Detention for Developing Austin Watersheds: Stream Protection Curve," 2011), the following Stream Protection Volume (SPV) relationship was derived:

$$SPV\ (in) = 1.4314 * IC - 0.0677$$

For example, a 50% impervious cover drainage area would require 1.4314*0.50 – 0.0677 = 0.65-inch SPV. To account for sediment accumulation, 20% is added to this value for construction purposes, consistent with the Texas Commission on Environmental Quality (TCEQ) Edwards Aquifer Rules technical manual.

The City of San Marcos is considering adopting an 85% TSS load reduction standard for new development, using TCEQ-based procedures. The TCEQ has two similar, but different procedures, one for selecting and sizing BMPs based on removal of the ***total*** TSS load ("Enhanced Procedures" manual RG-348A), the other for removing the ***increase*** in load from development (manual RG-348). While the TCEQ-based procedures are not generally recommended by the WQPP team, removal of the ***total*** load is more protective, and the RG-348A procedures have been modified to evaluate BMPs that provide both water quality treatment and stream protection.

The results of our analysis indicate that meeting the 85% standard simultaneously provides adequate stream protection, as long as a 48-hour drawdown time is provided. This simplifies the BMP selection and design procedure. Drawdown times substantially different than 48 hours can be problematic. Numerous "small footprint" proprietary BMPs have short drawdown times, and thus do not provide adequate stream protection. These would need to be combined with other "extended detention" BMPs in order for there to be an effective BMP.

2. LID and Green Infrastructure Incentives and Fees

Many of these measures were included after significant stakeholder review, but not all were ranked, as some of the elements or criteria used in rankings are specific to on-the-ground measures and are difficult to apply to incentives. Many LID and GI measures are included in Table 2. Incentives and fees as BMPs are described in this section.

Stakeholders recommend that BMPs and best practices in the TCEQ Optional Enhanced Measures for the Protection of Water Quality in the Edwards Aquifer be incentivized, to the extent practicably possible. The associated technical manual can be found at the SMWI project website under WPP Supporting Documents. A sample of BMPs listed in the technical manual (and their TSS removal efficiencies) that could be incentivized for builders and developers both inside and outside the recharge zone are shown in Table 3 (Table 4-3 in the Technical Manual).

Table 3. Optional Enhanced Aquifer Protection Measures and Associated TSS Removal Efficiency

BMP	TSS Reduction (%)
Retention/Irrigation	100
AquaLogic™ Cartridge Filter System	95
Wet Basins	93
Constructed Wetlands	93
Sand Filters	89
Bioretention	89
Vegetated Filter Strips	85
Ext. Detention Basin	75
Grassy Swales	70

Additional BMPs that could be incentivized include all non-regulatory LID, GI, stormwater, and nonpoint source (NPS) pollution mitigation measures listed in the WPP and WQPP. A 2016 EPA study noted that for one midwestern community, rain barrels, removal of hard surfaces (de-paving), rain gardens, native landscaping, tree planting, and downspout disconnection were the most preferred BMPs to be included

in a LID/GI incentive or rebate program (CDM Smith 2016). Additional information about the creation of incentive plans is provided below.

City Rainwater Harvesting Rebate/Incentive Expansion

The City currently has a water conservation initiative with a rainwater harvesting rebate program. The program could be expanded to include other LID and GI measures. To encourage rainwater harvesting, the City offers a rebate for purchasing rainwater system components including:

- Backflow devices installed at the City water meter
- First-flush diverters
- Leaf screens
- Primary filtration systems
- Pumps
- Rainwater barrels or tanks
- Screened gutters
- Tank pad/foundation

The rebate amounts are $0.50 per gallon of storage capacity for non-pressurized systems, and $1 per gallon of storage capacity for pressurized systems. Rebate cannot exceed 50% of total system cost. The maximum lifetime rebate amount is determined by water meter size:

- For 5/8 x3/4 inches meters (residential) the max rebate is $5,000
- For 1 inch water meters the max rebate is $10,000
- For 1.5 inches water meters the max rebate is $15,000
- For 2 inches meters and larger the max rebate is $20,000

Recommendations for the creation of home owner incentive and rebate plans are provided below and include the development of a technical support and assistance program. Programs for LID and GI measures can be implemented with the following steps:

- Create a rebate program (once funding has been identified) for an individual measure
- Develop and host a workshop for residents to provide technical information associated with installation and maintenance of the BMP as a pre-requisite for obtaining a rebate. This could be done in partnership with the Meadows Center for Water and the Environment and Texas Water Resources Institute
- Establish an online presence for obtaining information about the program and workshop (expand existing stormwater and rain barrel rebate sites
- Utilize City staff to provide technical assistance

County Rainwater Harvesting Rebate/Incentive Expansion

Hays County residents with rainwater harvesting systems can benefit financially in two ways:

• Those purchasing rainwater harvesting equipment and supplies are eligible for an exemption from state sales tax.

• Those with existing systems can apply for a property tax exemption through Hays County by completing and submitting a series of forms including the Hays County Application for Rainwater Harvesting Incentive

Form, the Hays Central Appraisal District Application for Water Conservation Initiatives Property Tax Exemption form 50-2070, and the Hays Central Appraisal District Supplemental Rainwater Application. The property tax exemption application is due by May 1 annually.

This program could be expanded to include other LID and GI features, including rain gardens, riparian buffers, and detention ponds. County extension agents could also assist with design and planning for BMPs at no cost to the home or business owner.

City Incentives to Downtown Business Owners for LID

Downtown areas are notoriously highly impervious given the streets, sidewalks, and rooftops present. City officials are beginning to understand the connection between high areas of impervious cover and high bacteria, nutrient, and TSS loading from these areas from stormwater runoff. To address this issue, programs are being implemented to reduce impervious cover using permeable pavements in alleys, parking areas and sidewalks, downspout catchment from roofs to small planter box style rain gardens, and use of garden boxes on rooftops, for example. These features enhance the beauty and social attraction of these areas while disconnecting and reducing the impervious cover and runoff.

In San Marcos, the Business Improvement & Growth Grant Program, administered through the City's Developmental Services Department, provides 50% matching for up to $20,000 to downtown businesses for improving the property exterior storefront detail and an additional $5000 for improved signs. A similar program could be developed to match costs for downtown business owners to reduce their impervious cover. This could generate more interest in LID for business owners, and greatly boost the downtown's aesthetics, reduce heat, promote tree growth, and other water quality and runoff reduction benefits.

Please also see the WQPP, Section 8.1.5 BMP REQUIREMENTS WITH FEE-IN-LIEU AND COST RECOVERY OPTIONS for additional recommendations found on the SMWI project website under WPP Supporting Documents.

3. Habitat Conservation Plan Water Quality Protection Plan Measures

Also ranked by stakeholders, BMPs recommended by the City's Water Quality Protection Plan (WQPP) efforts were given priority and rated highest by stakeholders, as the measures have been carefully studied and are expected to be implemented within the City's WQPP effort boundaries. The full WQPP and its suite of BMPs, approved in full for inclusion in the WPP, can be found on the SMWI project website under Supporting Documents.

The WQPP was developed for the San Marcos area under the authority of the Edwards Aquifer Habitat Conservation Plan (EAHCP, 2012). The EAHCP requires that Texas State University and the City of San Marcos, take actions that increase the likelihood of survival and recovery of threatened and endangered species found in the Edwards Aquifer and Upper San Marcos River ecosystems. The area addressed by the WQPP includes the jurisdictional areas of each entity that drain to critical habitat from surface or ground water sources, as shown in Figure 1 and encompasses much of the WPP study area. The primary charge for the Plan, per the EAHCP, is to reduce the impacts of impervious cover and associated NPS pollution.

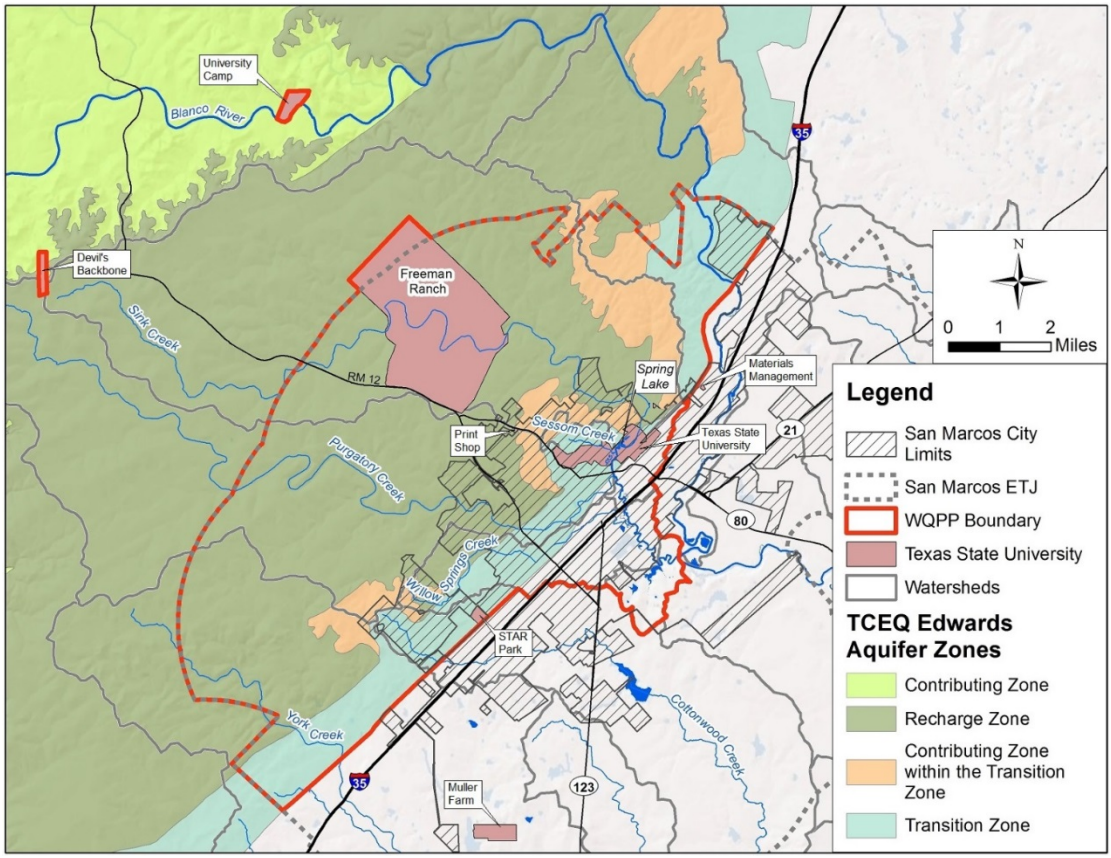


Figure 1. WQPP Boundaries

The WQPP recommends that both the City and Texas State University implement stormwater management measures that reduce pollutant loads, minimize downstream creek erosion, maintain or increase rates of infiltration for projects in the recharge zone, and reduce water use (potable, groundwater, river diversion) for landscape irrigation (by a percentage based on SITES guidelines).

Currently the geographic area where all development must include water quality protection is limited to the Edwards Aquifer Recharge Zone (per TCEQ requirements). The WQPP recommends expansion of the protected area to include all areas within the Plan boundary, as shown in Figure 2.

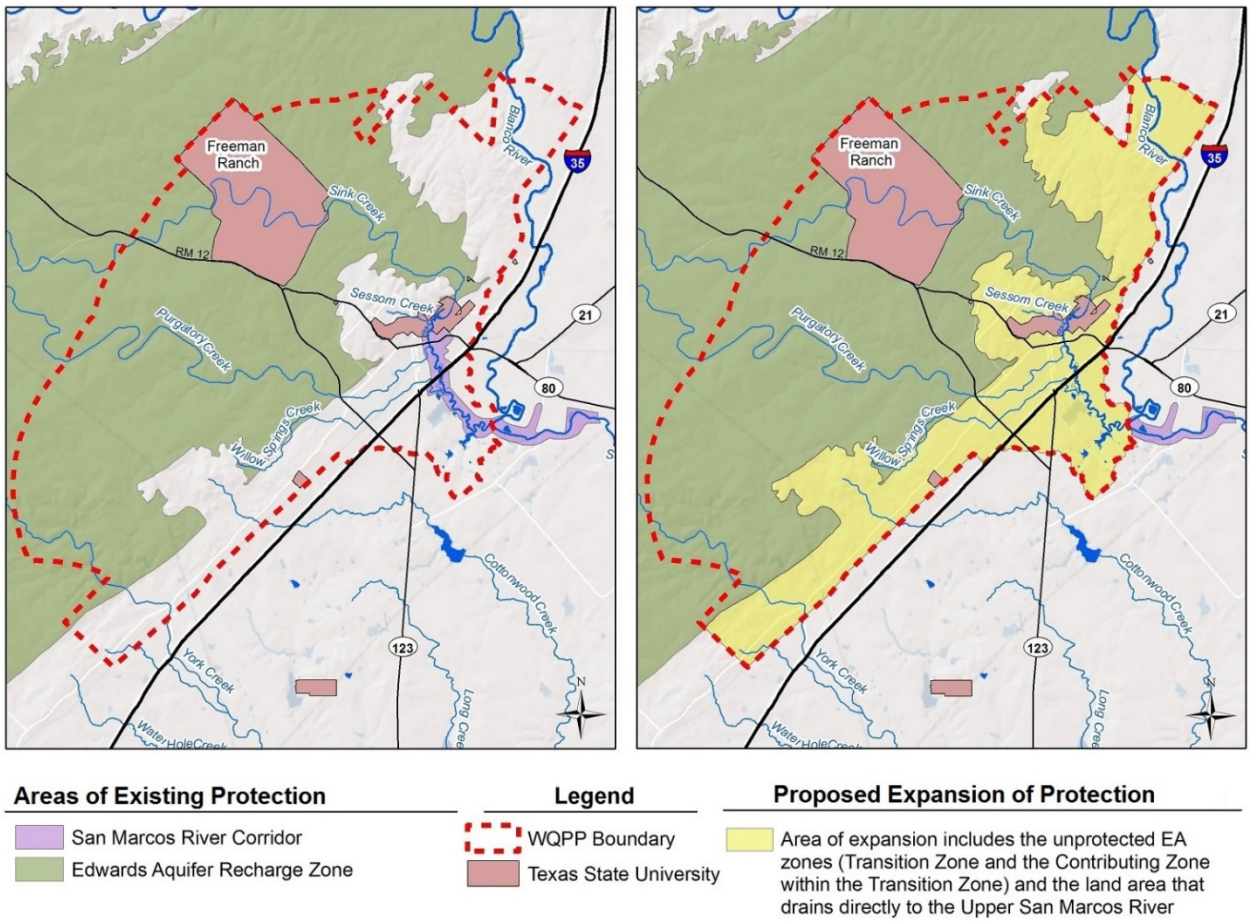


Figure 2. WQPP Proposed Expansion of Protection

The WQPP proposes that the campus implement stormwater management measures for new development and redevelopment in the main campus area, such that the post development runoff quality is equivalent to the water quality from a site with 10% impervious cover (though actual impervious cover % will be higher). This is important because 10% imperviousness is the level at which streams degrade due to the negative impacts of stormwater runoff (Schueler, 1994). The phrase 'stormwater management measures' includes structural stormwater facilities, such as ponds and rain gardens, as well as non-structural measures, such as design standards, design criteria, education, and programs.

The full list of WQPP BMPs can be found in the WQPP on the SMWI project website under WPP Supporting Documents. Table 4 lists the categories of WQPP measures and recommendations for Texas State University and associated WQPP page numbers. Please note that many of these BMPs and recommendations also appear in other sections of the WPP. Some of the BMPs are listed in the sections below.

Table 4. WQPP BMPs for Texas State University

WQPP Section	WQPP Measure	WQPP Page #
9.	Recommended Measures for Texas State University	159
9.1	Planning and Campus Construction Projects	159
9.2	Promote Campus Watershed Stewardship	162
9.3	Stormwater Green Infrastructure and Retrofit Projects	163
9.3.1	Green Infrastructure and Redevelopment	163
9.3.2	Water Quality Retrofit Identification and Prioritization	164
9.3.3	Texas State Stormwater Retrofits: High-Priority Retrofits	172

Campus Standards

The WQPP proposes that Texas State University adopt standards requiring enhanced construction sediment controls and permanent, structural BMPs that manage stormwater runoff quality and quantity for all future campus projects that exceed a threshold of 5000 square feet of soil disturbance (whether new construction or redevelopment). Projects that meet this standard will also allow Texas State University to take credit towards meeting the requirements of Minimum Control Measure 4 of the Campus Storm Water Management Program (SWMP). Surface facilities (e.g. biofiltration, rain gardens, and constructed wetlands) are recommended, and shall be designed based on their location within the proposed Water Quality Zones (Figure 3) and the performance standards described below.

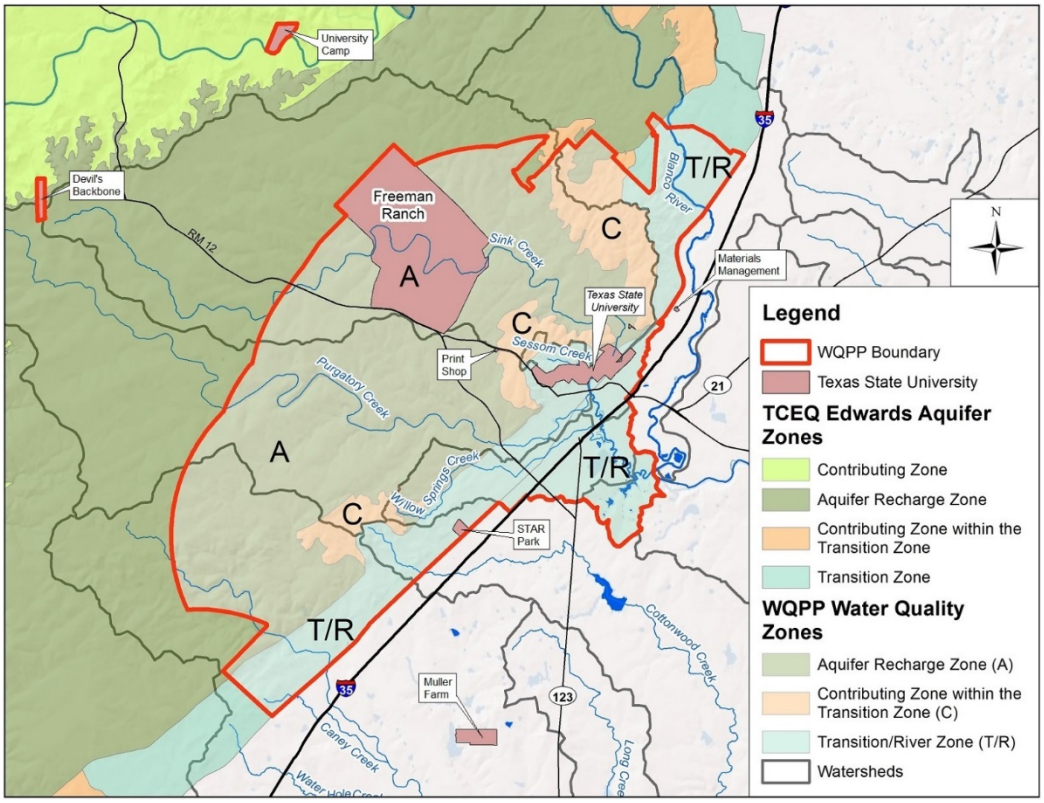


Figure 3. Design recommendations within proposed Water Quality Zones

Recommendations include:

1. Zone A – Aquifer Recharge Zone: Achieve a pollutant load target condition equivalent to a site with 0% impervious cover (non-degradation) and an actual impervious cover limit of 20%. University property that lies within this zone includes Freeman Ranch, Backbone property, University Camp, the Print Shop, and a very small area of campus near the Meadows Center parking lot. This is not intended to be retroactive for existing impervious cover.
2. Zone C – Contributing Zone (within the Transition Zone): Achieve a pollutant load target condition equivalent to a site with 0% impervious cover (non-degradation). University property that lies within this zone includes portions of the Devil's Backbone Property, University Camp, and a very small area of campus near the Meadows Center.
3. Zone T/R – Transition/River Zone: Achieve a pollutant load target condition equivalent to a site with ≤10% impervious cover. University property that lies within this zone includes 99% of the main campus and all of the STAR Park.
4. Capture and manage runoff to minimize downstream erosion and promote infiltration.
5. If the stormwater management target conditions (i.e. pollutant load, erosion and infiltration) cannot be met onsite, they shall be met in a downstream retrofit facility (further described below).
6. Reduce the use of potable water, river water diversion, and/or groundwater through coordination with the existing State regulations requiring rainwater harvesting, directing runoff from impervious cover onto landscape areas, the use of drought tolerant plants, and the use of efficient irrigation systems that, in some situations, are capable of reusing captured stormwater.

The basis for the proposed higher standards described above is provided in Table 5.

Table 5. Basis for proposed WQPP standards

Recommendation	Basis
Require practices (BMPs) that manage stormwater runoff quality and quantity for all future campus projects that exceed a threshold of 5000 square feet	The proposed threshold of 5000 sf has been selected as reasonable compared to reference ranges, which extend from all IC (TCEQ EA Rules, CoSM Recharge Zone, CoA BSZ, and Lake Tahoe), the State of Maryland (250 sf when near Chesapeake Bay), CoA non-Barton Springs Zone (8,000 sf), and the MS4 SWMP (1 acre)
Zone A: For new development and redevelopment, manage stormwater runoff pollution from developed sites to mimic undeveloped conditions (non-degradation) and limit IC to 20% of site.	The Edwards Aquifer is highly susceptible to pollutants and the listed species are vulnerable to, and threatened by, pollution due to land development. Current impacts exist and are attributed to land development activities thus a high level of protection is necessary. Non-degradation and 20% IC limits are used regionally where endangered aquatic species exist (in the CoA BSZ Rules).
Zone C: For new development and redevelopment, manage stormwater runoff pollution to mimic undeveloped conditions (non-degradation) and no IC limits	This area drains into Zone A thus the pollutant load goals are the same ('Non-degradation', see Zone A, above). WQPP chapters 5 and 6 provide more detailed information on pollutants, threats and impacts. No IC limits are recommended since no direct recharge occurs.
Zone T/R: For new development and redevelopment, achieve a pollutant load target condition of 10%	No IC limits are proposed. 10% IC is a threshold at which stream systems are likely to become impacted, thus the proposed requirement should be reasonably protective.
Retain and manage frequent stormwater events to minimize downstream erosion and promote infiltration	Not required in TCEQ Rules or the MS4 SWMP. Yet the cause for the majority of sediment load in streams and rivers is due to downstream bank erosion caused by excessive runoff volumes from upstream IC.
Reduce the use of potable water, river water diversion, and/or groundwater (use the baseline for irrigation reduction described in SITES v2)	Experts estimate that as much as 50% of water used for irrigation is wasted on average nationwide. Alternative water sources include harvested rainwater and redirected stormwater runoff. Reduce demand with drought tolerant plants and efficient irrigation systems.
Reduce the impacts of existing development by implementing regional stormwater retrofits	Current impacts to Critical Habitat are attributed to existing IC thus stormwater retrofits are recommended to be included in new and redevelopment projects as the Campus Master Plan is implemented

Campus Stormwater Retrofits

The WQPP recommends the implementation of stormwater retrofit projects to counteract impacts of existing development on critical habitat. Retrofit opportunities consist of new installations or upgrades to existing BMPs in developed areas lacking adequate stormwater treatment. These facilities shall be designed to serve as campus amenities and be integrated into projects resulting from the Ten Year Building Plan, the Ten Year Renovation Plan, and the Landscape System Plan. A prioritized ranking of selected potential projects is shown in Figure 4.

Prioritized University Retrofit Opportunities

1. Fish Ponds (Option 3): The existing fish ponds are to be retrofitted as constructed wetlands. They will treat 413 acres and remove 184 lbs. of phosphorus annually.
2. Jowers Center: Rainwater harvesting and rain gardens are proposed to treat 10 acres with 67% impervious cover yielding 15 lbs. of phosphorus annually.
3. The Glade: A series of rain gardens and biofiltration will treat 26 acres at 40% impervious cover. Improvements will also address problematic storm flows at the adjacent recycling center.
4. Sessom Creek Wet Pond (Option 3): The existing wet pond is under-sized and needs maintenance. Improvements allow it to treat 476 acres, removing 253 lbs. phosphorus annually.
5. Implementation of BMPs in the Sessom Creek Watershed Restoration Plan (outlined below under Sessom Creek Watershed Restoration Plan Section) [not shown in Figure 4], including The Gulch: Biofiltration is proposed at the existing facility, which drains 57 campus acres and 27 lbs. of phosphorus will be removed annually.

The potential water quality retrofit opportunities noted above, as well as additional opportunities, are shown in Figure 4. In addition to those shown, the WQPP team believes that there are many additional small-scale potential retrofit opportunities throughout the 486-acre site. In addition to treating urban runoff, these small-scale BMPs can serve as landscape amenities that, if properly designed, may reduce the required levels of irrigation and maintenance in comparison to the landscapes they replace.

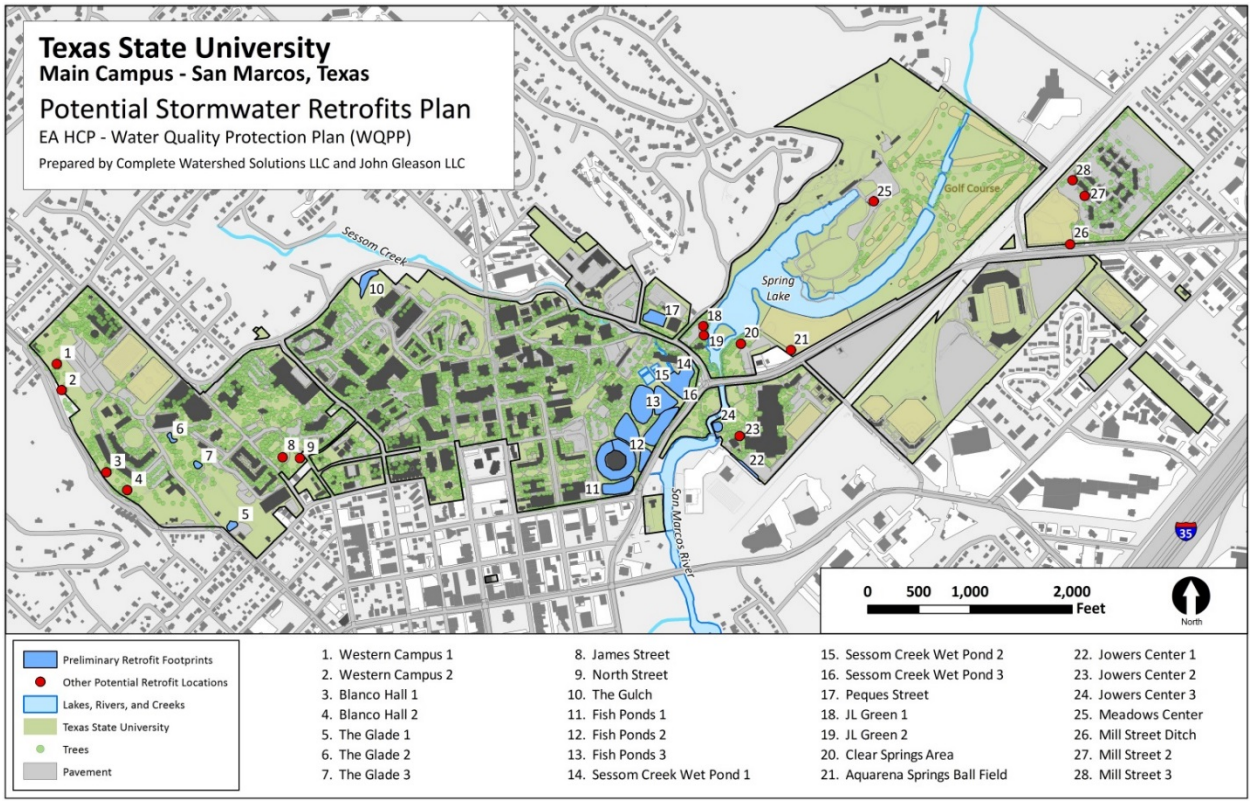


Figure 4. Potential Texas State University stormwater retrofits

Additional Campus Recommendations

Additional WQPP elements and recommendations for the campus include:

1) Design Criteria: Create and adopt design criteria that provide detailed design guidelines for stormwater BMPs intended to meet the Campus Standards noted above.
2) Turf Management: As required in section 5.4.9 of the HCP and addressed in section 6.2.3 of the Campus SWMP, update campus standards for turf management BMPs. This includes developing a Turfgrass Management System Plan for the campus golf course and athletic fields. This document should include proposals for and descriptions of improvements to current and future practices.
3) Adaptive Management Process (AMP): periodically review and revise the campus stormwater standards, criteria, and retrofit plans, as necessary, to be both protective and cost-effective. These periodic reviews could align with the Campus Master Plan updates, the Ten Year Building Plan, the Ten Year Renovation Plan, and the Landscape System Plan.

City Standards and Measures

The WQPP implements the concept of sustainability by integrating stormwater management measures with water conservation practices and water supply protection. Many recommendations are broadly addressed in the City's Comprehensive Plan: Vision San Marcos (City of San Marcos, 2013). The phrase 'stormwater management measures' includes structural stormwater facilities, such as ponds and rain gardens, as well as non-structural measures, such as design standards, design criteria, education and programs. These are also called BMPs and, when utilizing attractive landscaping rather than concrete, are often collectively referred to as green infrastructure.

The WQPP proposes that the City of San Marcos adopt standards requiring enhanced construction sediment controls and permanent, structural BMPs that manage stormwater runoff quality and quantity for all future land development projects that exceed a threshold of 5000 square feet (whether new construction or redevelopment). Projects that meet this standard will also allow the City of San Marcos to take credit towards meeting the requirements of Minimum Control Measure 4 of the City's Storm Water Management Program (SWMP). Surface facilities (e.g. biofiltration and rain gardens) are recommended, and shall be designed based on their location within Water Quality Zones (see Figure 3) and the performance standards described below.

Table 6 lists the recommended water quality zones and summarizes their requirements including pollutant load target conditions and impervious cover limits. Pollutant load targets refer to a target impervious cover percentage that a developed site will match in terms of pollution loading and hydrologic conditions. For example, a developed site has 50% impervious cover yet, using LID and BMP's, generates the pollution load of 10% impervious cover. To minimize the potential for impervious cover to cause stream erosion, developed sites are to provide extended detention that will meet stream protection volume requirements. Table 6 shows proposed land development requirements, which are based on their location within each water quality zone.

Table 6. WQPP City recommendations for water quality zones

Zone Symbol	Water Quality Zone	Pollutant Load Target	Impervious Cover Limit
A	Aquifer Recharge Zone	0% (Non-degradation)	20%
C	Contributing Zone	0% (Non-degradation)	None
T/R	Transition/River Zone	10%	None

Due to the sensitive nature of the Edwards Aquifer Recharge Zone, and because the Contributing Zone (within the Transition Zone) drains to the Recharge Zone, the WQPP proposes a non-degradation standard, such that the post development runoff quality is equivalent to the water quality from a site with 0% impervious cover (though actual impervious cover % will be higher). In the Transition/River Zone, the WQPP proposes a pollutant load target of 10%. Table 5 in the previous section provides the rationale for proposed standards.

See the WQPP for the full list of BMPs on the SMWI project website under WPP Supporting Documents. Table 7 lists the categories of WQPP measures and recommendations for the City of San Marcos and associated WQPP page numbers. Please note that many of these BMPs and recommendations also appear in other sections of the WPP. Some of the BMPs are listed in the sections below.

Table 7. WQPP BMPs for the City of San Marcos

WQPP Section	WQPP Measure	WQPP Page #
8.	Recommended Measures for the City of San Marcos	79
8.1	Planning and Development Regulations and Programs	79
8.1.1	Implement a Stormwater Retrofit Program	79
8.1.2	Establish Appropriate Impervious Cover Limits in the Recharge Zone	79
8.1.3	Adopt Improved BMP Performance Standards	80
8.1.4	Fee-in-Lieu and Cost Recovery	90
8.1.5	BMP Requirements with Fee-in-Lieu and Cost Recovery Options	91
8.1.6	Adopt Buffer Zone Requirements to Protect Critical Ecological Areas	93
8.2	Promote Compact Development and the Use of LID	98
8.2.1	Promote Compact Development that Manages Stormwater Onsite	98
8.2.2	Use Low Impact Development, Green Infrastructure and Better Site Design	105
8.3	Conserve Natural Areas & Open Space	109
8.3.1	Summary of WQPP Recommendations for Land Conservation	109

City Stormwater Retrofits

The WQPP identified a number of feasible, cost-effective stormwater retrofit opportunities that might serve as valuable community investments. The work products developed also provide a solid starting point for an ongoing Water Quality Retrofit Program. A prioritized ranking of selected potential projects is shown below.

Prioritized City Retrofit Opportunities Slated for Immediate Implementation

1. Wastewater Treatment Plant: The proposed infiltration and extended detention pond will treat 176 acres at 93% capture efficiency and remove 141 lbs. of phosphorus annually.
2. Downtown Biofiltration: Construction of this facility near C.M. Allen Parkway was recently completed. It treats runoff from 32 acres that are 60% impervious.
3. The Big Ditch: This existing channel drains 320 acres in the mid-town area that are 43% impervious. Proposed improvements will remove 147 lbs. of phosphorus annually.
4. Veterans Memorial Park: Proposed biofiltration will treat 86 acres that are 55% impervious and include most of Springtown Mall and many municipal facilities.

5. City Park: Biofiltration, rain gardens, and rainwater harvesting are proposed in association with a new parking facility. This will also serve as a demonstration site.
6. Downtown Stormwater Retrofits to sites that receives significant stormwater runoff in or near downtown San Marcos. Minimum criteria for demonstration projects include: significant pollution loadings from stormwater, excellent visibility and accessibility, and a drainage area of at least 3 acres. Potential pollution mitigation/management must be equivalent to or greater than 80% removal of TSS (approximately 2,000 lb. of TSS per year), 5 lb. of total phosphorus per year, and removal of levels of bacteria consistent with the TSS management requirements and WPP specified water quality targets.
7. Implementation of BMPs in the Sessom Creek Watershed Restoration Plan (outlined in the following section).

The potential water quality retrofit opportunities noted above, as well as additional opportunities, are shown in Figure 5. In addition to those shown, the WQPP team believes that there are many additional small-scale potential retrofit opportunities available throughout all City-owned property, including the public right of way. Additional implementation priorities for Sessom Creek are outlined in the following sections.

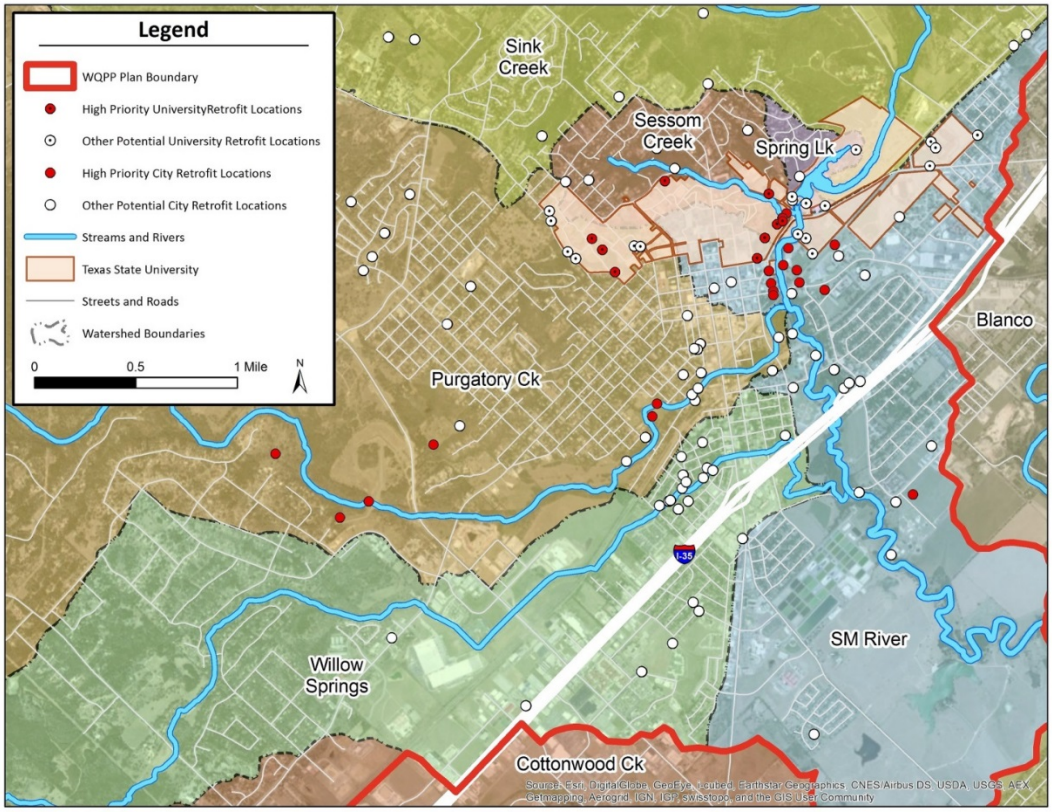


Figure 5. Potential City stormwater retrofit sites

Additional City Recommendations

Additional WQPP elements and recommendations for the City include:

1) Design Criteria: Create and adopt design criteria that provide detailed design guidelines for stormwater BMPs intended to meet the proposed Land Development Code standards noted above.
2) Comprehensive Site Planning and Pre-Development Review: Site plans of proposed new development and redevelopment should include a technical demonstration that it meets the City's water quality standards.
3) Reuse Stormwater for Landscape Irrigation: Reduce landscape irrigation with potable water by ≥ 50% by implementing water conservation practices and stormwater capture and reuse.
4) Natural Area Conservation: Acquiring land and establishing conservation easements will provide benefits in perpetuity by preventing future development and associated pollutants.
5) Transferable Development Rights: Direct higher intensity development either outside the Planning Region or into preferred growth areas by allowing development rights to be transferred from one property to another (defined below in Land Conservation and Management Section)
6) Public Education and Outreach: As noted in section 3.1 of the City's SWMP, expand efforts to increase the public's understanding of their overall water quality impacts and what they can do to reduce them.
7) Turf Management: As required in section 5.4.9 of the HCP and in consideration of BMPs 5.01 and 5.06 of the City's SWMP, develop a Turfgrass Management System Plan to minimize the potential water quality impact of municipal athletic fields.

Sessom Creek Watershed Restoration Plan

Sessom Creek is generating excessive sediment loads that impact critical habitat and water quality in the Upper San Marcos River. The middle reach of Sessom Creek (above concrete channel to Canyon Fork Street) is unstable and eroding. There are also several unstable, eroding tributaries within the subwatershed. Wastewater, drainage, and other infrastructure is damaged and/or threatened by this erosion.

Sessom Creek and Tributary Prioritization (for BMP Implementation)

WQPP efforts prioritized reaches of Sessom Creek and its tributaries based on problem severity, using erosion, sedimentation load, and threatened infrastructure as factors, shown in Figure 6, to determine BMP locations and implementation urgency. Reach 2 and the Windmill Tributary were determined to be in greatest need of BMPs both by the WQPP and the HCP Science Advisory Committee and can be coupled with scheduled City of San Marcos wastewater line relocation efforts to reduce costs and duplicative efforts.

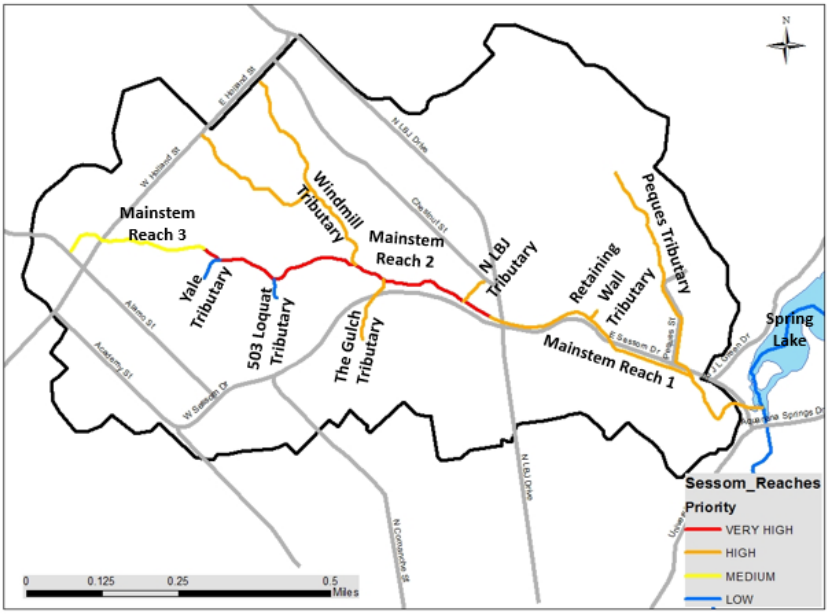


Figure 6. Prioritized reaches for Sessom Creek Watershed

Table 8. Sessom Creek Watershed reaches and tributary characteristics

Location	Description	Priority for Implementation
3 Sessom Creek Mainstem Reaches		
Reach 1	Mostly concrete but natural sections are eroding	HIGH
Reach 2	Unstable channel in middle Sessom Creek	VERY HIGH PRIORITY
Reach 3	Moderately impacted upper Sessom Creek	MEDIUM PRIORITY
7 Sessom Creek Tributaries		
Peques Tributary	Unstable, eroding above Peques Street	HIGH PRIORITY
Retaining Wall Tributary	Unstable, eroding	HIGH PRIORITY
N LBJ Tributary	Unstable, eroding	HIGH PRIORITY
The Gulch Tributary	Erosion at outfall to Sessom Creek	HIGH PRIORITY
Windmill Tributary	Unstable, eroding sections	HIGH PRIORITY
503 Loquat Tributary	Stable headcut but should be monitored	LOW PRIORITY
Yale Tributary	Appears relatively stable but should be monitored	LOW PRIORITY

Figure 7 denotes the locations of the highest priority restoration and retrofit BMPs to reduce NPS pollution in Sessom Creek, especially from stormwater runoff and includes:

- 12 identified Stream and Riparian Restoration Efforts
  - 1 rated Very High priority,
  - 6 High priority, and
  - 5 Medium priority
- 8 identified Stormwater Retrofit Projects
  - 4 regional retrofits (2 on Texas State University property), and
  - 4 small scale retrofits (1 on Texas State University property).

Figure 8 shows the location of BMPs that are planned for implementation in coordination with the removal and relocation of City wastewater lines. The section provides summaries of those measures recommended for earliest implementation in Sessom Creek, based on problem severity and NPS contribution in the Sessom Creek Watershed (Figure 7 and Table 8).

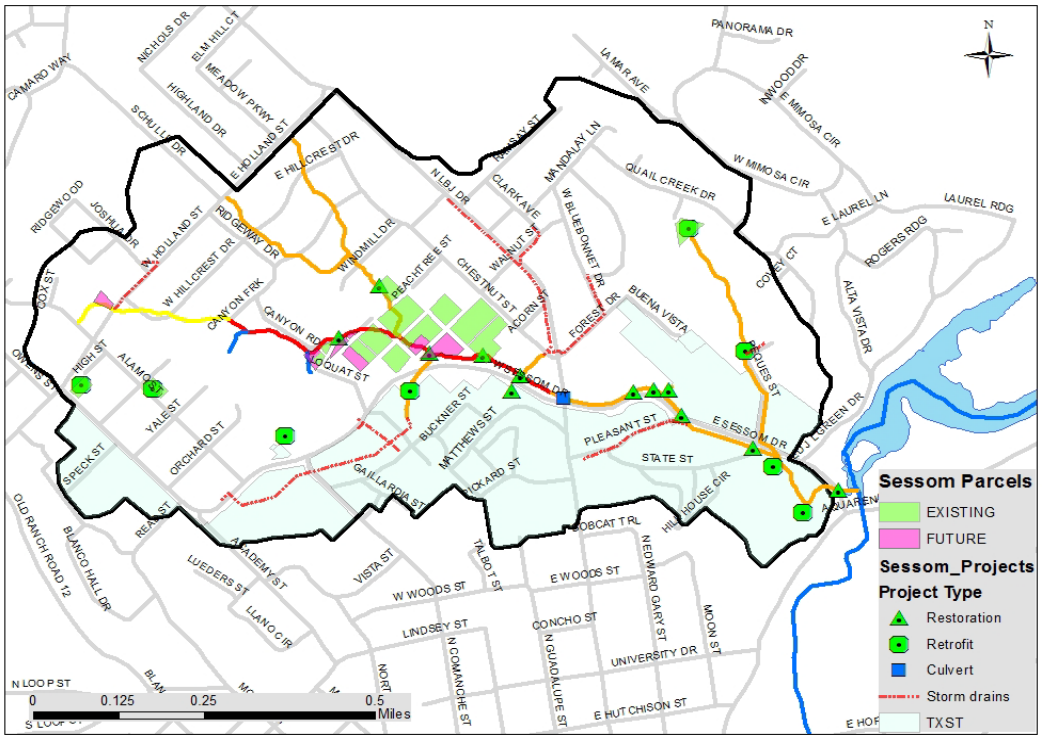


Figure 7. Sessom Creek Watershed WQPP/HCP BMPs

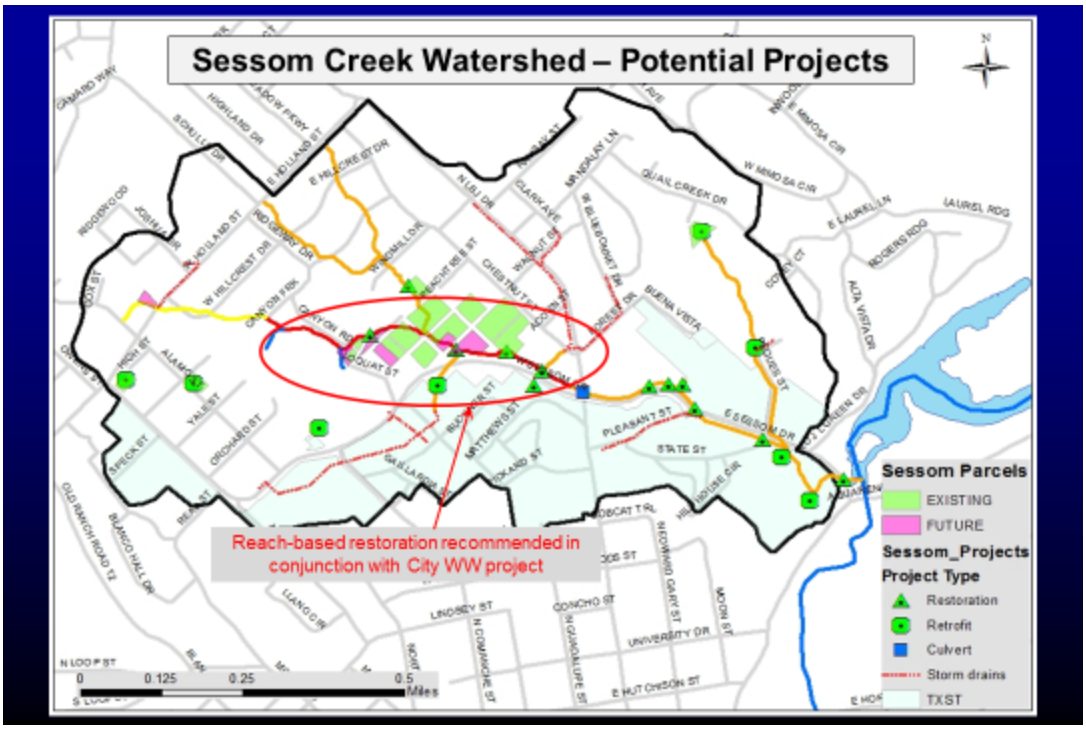


Figure 8. Sessom Creek high priority BMPs coupled with City project

Sessom Creek Stream and Riparian Restoration

Twelve Sessom Creek stream and riparian restoration efforts were identified in the WQPP and include one very high priority measure and several high priority measures on both City and University property, listed in Table 9. The project identified as "Restor9" is required to restore and stabilize the main channel, mitigating significant erosion, enhancing water quality, minimizing flooding, and providing other important community benefits (Figure 9). Restor 9 will be located on the Canyon Road reach of Sessom Creek and could specifically include removal of impervious cover, creation of stormwater control measures (including in-line detention) at one or more locations within the channel, laying back and stabilizing the slopes in places where erosion has occurred, and restoration of the riparian zone. Potential additional activities could include raising any remaining roadway out of the 5-year floodplain and creating hike and bike trails to enhance pedestrian access through the corridor.

"Restor10," can be considered an extension of the Restor9 project and has been prioritized for immediate implementation and can leverage city and HCP efforts and funding. Figure 10 and Figure 11 show four quadrants along Windmill Tributary, near Sessom Creek. Activities in these quadrants will include upland and riparian restoration (removal of invasive, non-native vegetation and replanting Central Texas native riparian and upland plants), as well as the placement of stormwater control brush dams and vegetative filter strips to enhance riparian function. Bank grading/contouring will mitigate streambank degradation, slow stormwater flows, enhance riparian function and protect from erosion that contributes to NPS pollution in the watershed. Using technical specifications, the bank will be shaped and planted or hardened (if necessary) to minimize erosion. Trail and signage placement will be included and partners and community members will provide planning input and assistance. Table 10 shows the estimated load reductions from these BMPs.

Table 9. WQPP Sessom Creek stream and riparian restoration projects

Project ID	Description	Priority
RESTOR 1	Repair and stabilize Sessom Creek outfall to San Marcos River (RPS Espey #1)	**HIGH**
RESTOR 2	Extend culvert at Sessom Drive and State Street (RPS Espey #2)	**MEDIUM**
RESTOR 3	Stabilize undercutting of box culvert (RPS Espey #3)	**MEDIUM**
RESTOR 4	Stabilize severely eroded Retaining Wall Tributary	**HIGH**
RESTOR 5	Stabilize channel and score hole downstream of N LBJ Drive culvert (RPS Espey #4)	**MEDIUM**
RESTOR 6	Stabilize edge of concrete channel bank (RPS Espey #5)	**MEDIUM**
RESTOR 7	Stabilize eroding N LBJ Tributary, in conjunction with RPS Espey projects 7, 8, and 9	**HIGH**
RESTOR 8	Replace or repair severely eroded flume from The Gulch detention pond (RPS Espey # 10)	**HIGH**
RESTOR 9	**Reach-based Natural Channel Design restoration of unstable reach, in conjunction with RPS Espey #6, 11, and 12**	**VERY HIGH**
RESTOR 10	Stabilize Windmill Tributary erosion, using Natural Channel Design	**HIGH**
RESTOR 11	Stabilize severely eroding slope on TXST campus, below "Hog Trap"	**HIGH**
CULVT 1	Replace and upgrade undersized culvert (RPS Espey # 13)	**MEDIUM**

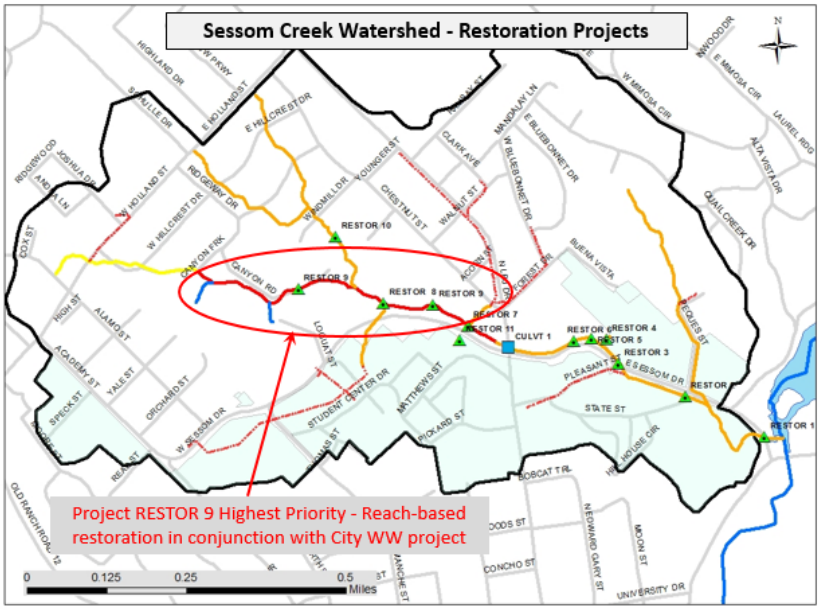


Figure 9. High priority Sessom Creek (Reach 2) restoration BMPs

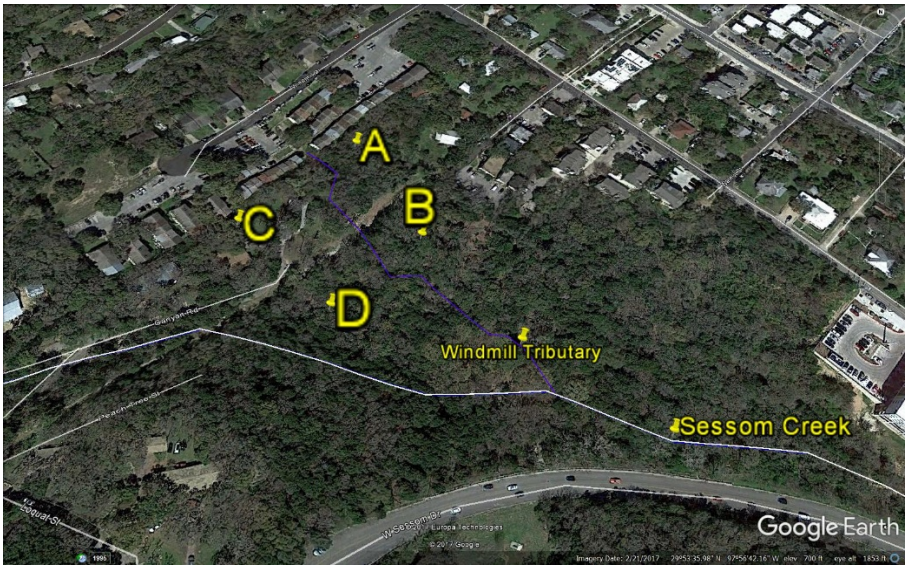


Figure 10. Windmill Tributary, site of proposed restoration (aerial view)

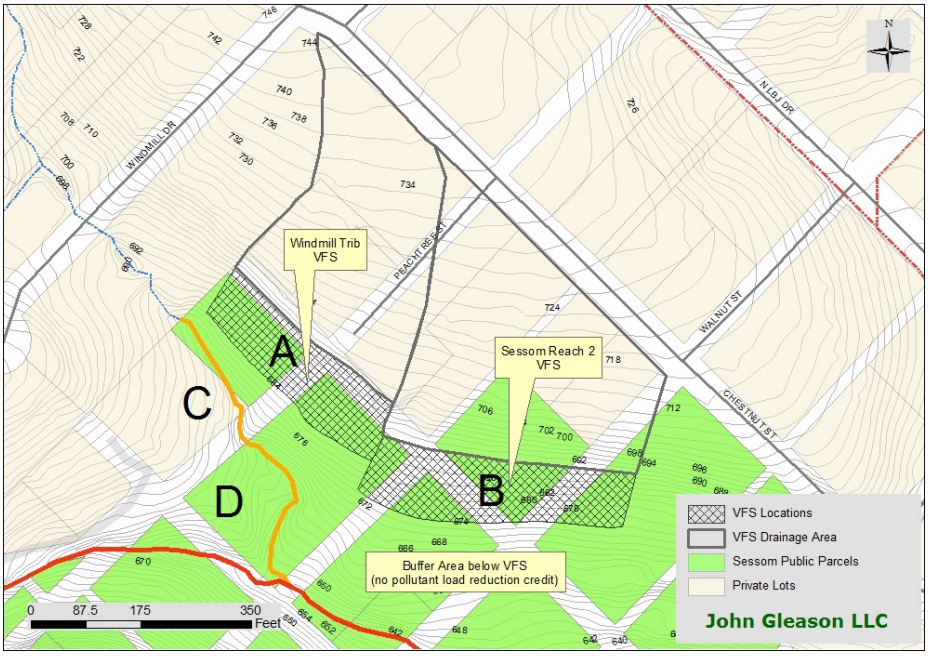


Figure 11. Windmill Tributary & Sessom Creek reach, site of proposed restoration (schematic view)

Table 10. WQPP load reduction modeling results for Windmill Tributary and Sessom Creek reach 2

Metric	Unit	Windmill Tributary	Sessom Creek Reach 2
Average Annual Runoff Volume entering VFS	Inches	4.46	9.22
	Cubic Feet	36,917	96,754
Average Annual Runoff Infiltrated	Inches	2.93	4.64
	Cubic Feet	24,227	48,669
Average Annual Runoff Discharged	Inches	1.53	4.58
	Cubic Feet	12,690	48,085
Infiltration/Runoff Capture Efficiency	Percent	66%	50%
Total Suspended Solids (TSS)			
• Runoff Concentration	mg/L	166	166
• Average Annual Runoff Load	lb/yr	382	1000
• Load Removal	lb/yr	250	503
• Load Removal Efficiency	Percent	66%	50%
Total Phosphorus (TP)			
• Runoff Concentration (mg/L)	mg/L	0.396	0.396
• Average Annual Runoff Load (lb/yr)	lb/yr	0.91	2.39
• Load Removal (lb/yr)	lb/yr	0.60	1.20
• Load Removal Efficiency	Percent	66%	50%
Total Nitrogen (TN)			
• Runoff Concentration (mg/L)	mg/L	2.22	2.22
• Average Annual Runoff Load (lb/yr)	lb/yr	5.10	13.37
• Load Removal (lb/yr)	lb/yr	3.35	6.72
• Load Removal Efficiency	Percent	66%	50%

Sessom Creek Stormwater Retrofits

Eight stormwater retrofits were identified across the small, urban watershed and would result in the treatment of more than 5 acres, shown in Figure 12.

There is significant potential for many more small-scale GI projects, both on public/City property and on campus. These projects could demonstrate GI techniques, providing valuable public outreach and education.

Table 11. WQPP Sessom Creek stormwater retrofit projects

Project ID	Name	Description
RETRO 1	Sessom Wet Pond	Existing, undersized wet pond on TXST campus, in need of sediment removal. Could be retrofitted to improve performance.
RETRO 2	The Gulch	Existing detention pond on TXST campus. Outfall to Sessom Creek is severely eroded and needs repair or replacement. Could be retrofitted as an extended detention pond to provide control of "channel forming" flows
RETRO 3	Hummingbird Hollow	Existing City detention pond in need of maintenance. Channel on private property immediately below the pond is eroding, and generating high sediment loads. Biofiltration retrofit is recommended, that could reduce erosion of downstream channel.
RETRO 4	Peques Street	An extended detention retrofit is possible, that would capture sediment generated above by eroding channel. Site is located on private property.
RETRO 5	Water Tower	Driveway to tower is "directly connected" impervious cover, and could be easily "disconnected" by diverting runoff to vegetated area at bottom of driveway. Rain garden and/or infiltration BMP recommended.
RETRO 6	Alamo Neighborhood Garden	GI demonstration site - rain garden next to entrance gate, and/or Rainwater Harvesting with "Smart" controller system for storage shed.
RETRO 7	Fire Station	GI demonstration site - rainwater harvesting with "Smart" controller system and/or rain garden.
RETRO 8	Freeman Aquatic Biology Building	Rain garden opportunity on TXST campus to treat parking lot runoff, and a GI demonstration site

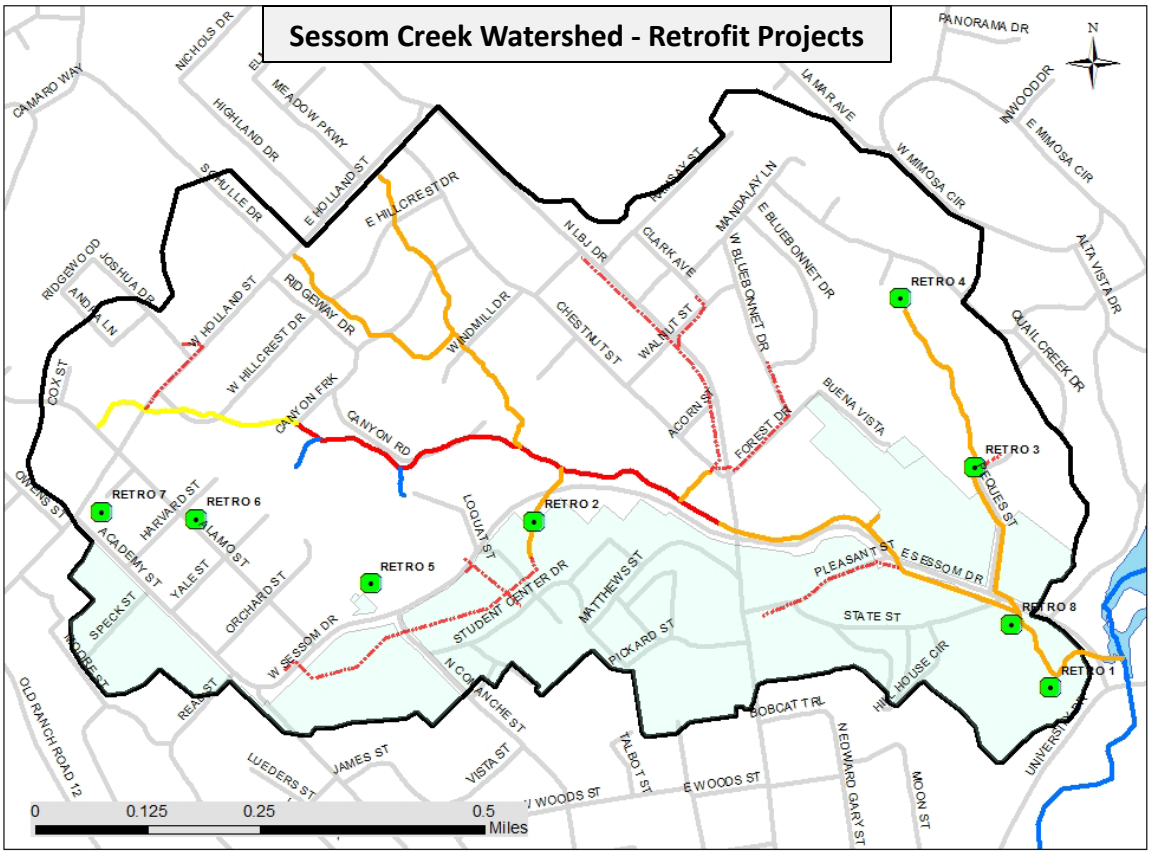


Figure 12. High Priority Sessom Creek stormwater retrofit BMPs

Sessom Creek Land Conservation

Two priorities for land conservation were identified in the watershed through the WQPP and Sessom Creek restoration planning process. Recommended greenbelt expansion and headwater protection is shown as pink parcels in Figure 13 and summarized in Table 12. These measures are also described in Section 6. Land Conservation and Management Section.

Table 12. Proposed Sessom Creek land conservation measures

Type	Description
Greenbelt Expansion	Acquisition of 8 privately-owned parcels (totaling less than 2 acres) would complement the proposed Natural Channel Design (NCD) stream restoration project (Project ID RESTOR 9), while increasing public recreation and education opportunities. A primary goal of the NCD project would be to accelerate natural re-stabilization of Sessom Creek, which would reduce stream erosion and resulting sediment loads discharged to critical habitat on the San Marcos River. Under NCD, the creek should be allowed to move laterally as it adjust to a more stable regime, thus it is recommended that the adjacent riparian zone be dedicated as open space, rather than allowing structures or infrastructure to be located in this geomorphically-active zone.
Headwater Protection	Preservation of this tract would retain its function of providing headwater protection, thus preventing downstream erosion in Sessom Creek. The heavily vegetated tract dissipates concentrated flow from an upstream concrete channel, a classic example of "headwater protection." There appear to be limited protection of this tract from development, though it clearly is flood prone. If development occurred that "improved" the drainage, it is likely that stream erosion downstream of W. Holland Street would increase. The "headwater protection" tract size is about 0.25-acre in size, but is located within a larger, 1.5 acre privately-owned parcel.

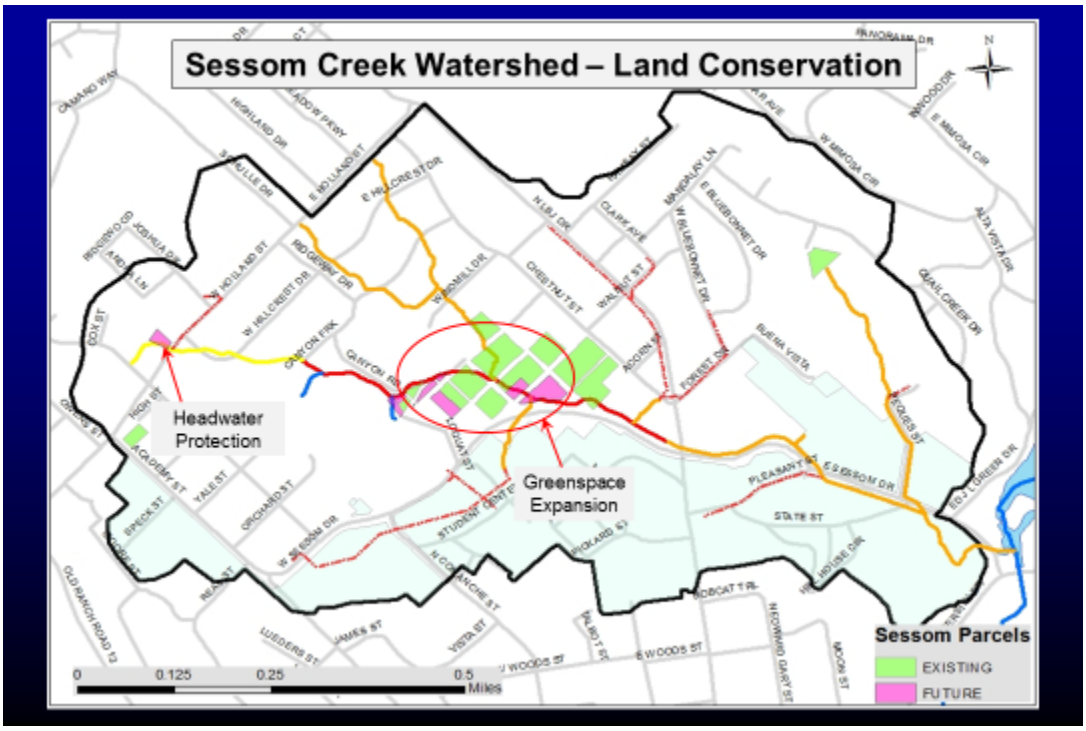


Figure 13. Sessom Creek land conservation priorities

BMP Alignment with Related Efforts

The recommended stormwater management measures in the WQPP are designed to be compatible with, and build on, the State of Texas stormwater programs, activities and requirements noted in Table 13. The requirements of each are provided as a comparison to WQPP recommendations. The Plan recommends that the measures are adopted within time frames that are congruent with the review periods for each of the documents referenced. Please note that WQPP and WPP activities are intended to align with and be coordinated with MS4 efforts, but will not overlap or be combined.

Table 13. Texas State University and City of San Marcos stormwater measures alignment with other activities

Program or Activity	TPDES MS4 Permit TXR 040000	TPDES Construction General Permit TXR 150000	TCEQ Edwards Aquifer Rule Water Pollution Abatement Plan (WPAP) §213	WQPP Recommendations
Public Education, Outreach	Required	-	-	Proposed
Public Participation/Involvement	Required	-	-	Proposed
Illicit Discharge Detection and Elimination	Required	-	-	Proposed
Construction Site Runoff Control (Temporary Stormwater Controls)	Required for all sites. SWPP and coverage under TXR 150000 required for ≥ 1 acre *	Required for sites ≥ 1 acre*	Required but no area threshold defined	Required for any land disturbing activity
Post-Construction Runoff Control (Permanent Stormwater Controls)	Required for sites ≥ 1 acre*	-	Required for sites adding > 20% impervious cover	Required for sites disturbing ≥ 5,000 ft^2
Pollution Prevention/Good Housekeeping	Required	Required	Optional	Required
Stormwater Retrofit Projects	-	-	-	Recommended
Geologic Assessment	-	-	Required	Required in EAZ
Stream Buffers	-	-	Optional	Required
Buffers around recharge features	-	-	Required	Required in EAZ
Buffers around wetlands and other critical ecological area	-	-	-	Required

* Superseded in the Edwards Aquifer Zone (EAZ) by 30 TAC 213 (Edwards Aquifer Rules)

4. Additional Potential Water Quality Retrofits for the City of San Marcos and Texas State University Campus

Many of the measures listed in this section may also be found in the WQPP and many also include specific BMPS listed in 1. Stakeholder Selected Regionally Appropriate Measures section above.

Educational Facilities and Demonstration Sites

The City has begun to develop plans for a new Nature Center that would serve as a watershed protection demonstration site. Educational materials and exhibits would be included, as well as onsite LID/GI measures, such as rainwater harvesting, rain gardens, xeriscaping, berms/swales, constructed wetlands, permeable pavement, and other features.

In addition, the City will incorporate water quality protection demonstration measures at new or retrofitted buildings and parks in town. Several downtown spaces are also slated for incorporation of BMPs listed in Table 2 (individual stakeholder ranked BMPs).

County buildings can also be retrofitted to include onsite LID/GI demonstrations. Signage would accompany all demonstrations and applicable sites will be incorporated into the watershed tour.

The Meadows Center for Water and the Environment at Texas State University is planning for additional educational facilities that will serve as a demonstration site for multiple LID/GI measures and treatment trains. Facilities will also provide classroom and training spaces for university students, municipal staff, and developers.

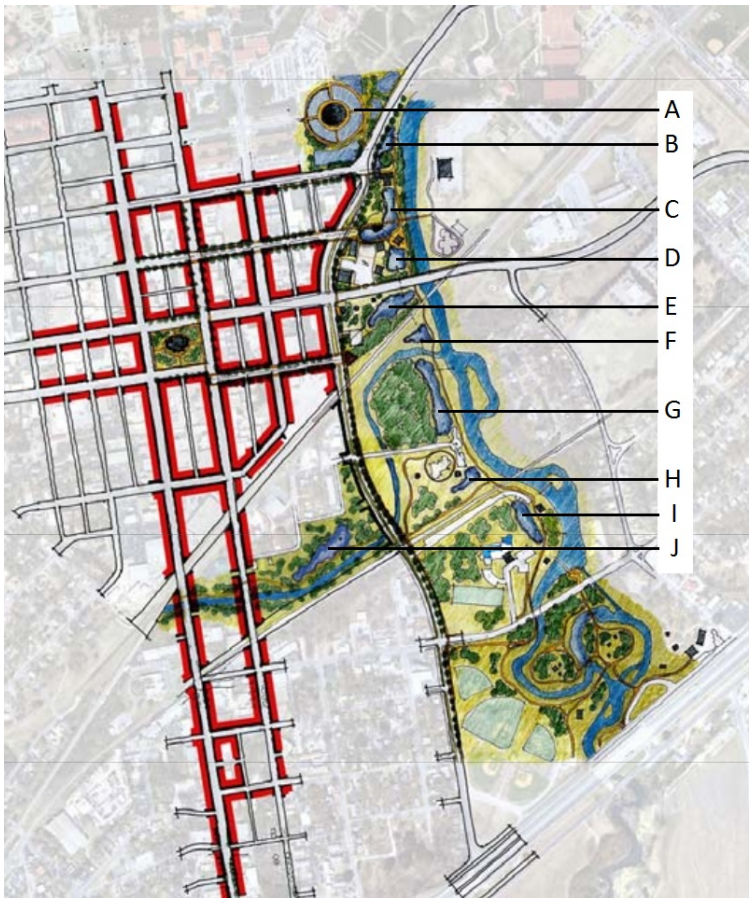
Downtown Master Plan Ponds

The current City of San Marcos Downtown Master Plan was prepared by Broaddus & Associates in 2008. The plan recommends that a “chain of ponds” be placed on the land between the Central Business District (CBD) and the River. This idea for a chain of ponds is offered by the consultant as the primary mechanism to serve the necessary functions of flood detention and water quality treatment for downtown runoff and is a high-level planning suggestion that offers a collection of potential solutions for treating downtown stormwater runoff. The WQPP has reviewed them to determine which of the ponds may be realistic project sites. The Downtown Master Plan doesn’t label specific pond sites, however the blue shapes on the plan offered by the consultant give the viewer an indication of potential size and location. The WQPP Project Team has conducted an initial assessment of some of the sites indicated in the Master Plan. Figure 14 shows the Chain of Ponds Plan prepared by Broaddus & Associates and includes labels added by the WQPP consulting team identifying potential pond sites.

Figure 14 " Chain of Ponds" Plan and WQPP identified ponds

A. Pond A: "Fish Ponds" on the Texas State University campus
B. Pond B: small pond east of University Dr. at C.M. Allen Parkway
C. Pond C: Water quality pond east of Hutchison and C.M. Allen Parkway
D. Pond D: at the storm sewer outlet between the Parks & Recreation Bldg. and the River
E. Pond E: at the storm sewer outlet in Veramendi Park
F. Pond F: small pond in Bicentennial Park
G. Pond G: large pond in Bicentennial Park
H. Pond H: small pond in Children's Park
I. Pond I: in Rio Vista Park north of the swimming pool
J. Pond J: large pond near Purgatory Creek between Porter St. and C.M. Allen Parkway

Map by Broaddus & Associates, Inc. (text by John Gleason LLC)



River Access Points and Demonstration Sites

Cape's Camp, also known as John J Stokes Park at Thompson's Island, is a popular recreation spot on the San Marcos River upstream of the confluence with the Blanco River. This site is in a highly visible area utilized by residents, students, and tourists. Recent observations show increased erosion and volunteer collected data and water quality modeling efforts show that seasonal recreation may have an impact on total suspended solid concentrations in the river and bank erosion. New multi-family developments in the area have dramatically increased impervious cover and stormflows, degrading water quality.

A recent study (2015) by Dr. Barrett, "Stormwater Pollutant Removal in Roadside Vegetated Buffer Strips" found that for slopes up to 3:1 (consistent with the slope range along the river), a vegetated slope 15 feet wide was needed to obtain irreducible minimum concentrations, or in other words, background conditions. This and other similar studies report that potential TSS reductions of 70 to 80% can be achieved by introducing riparian zones, based on the slope length and bank slope. Pollution removal of additional constituents including nutrients and bacteria can also be achieved. Restricting access can remove the physical transfer of sediments by nearly 100%.

The Upper San Marcos River WPP stakeholders and partners determined that it is important to utilize and showcase to the public riparian protection measures and BMPs that promote safe and river friendly recreation. Strategies include limiting river access points by establishing native riparian areas and

promoting entry points to the river that minimize erosion and littering. Access points are shown in Figure 15.

The goals of this effort are to improve riparian function along Cape's Camp at the San Marcos River, to educate the public about NPS pollution prevention and watershed protection, to encourage future use of water quality protection practices in the Upper San Marcos Watershed and beyond, as well as to promote recreation that does not negatively impact water quality. Further, restoration of this site will serve as an example for other river access points in the City. Measures to be implemented:

- Introduce native vegetation to barren and degraded areas along Cape's Camp/Thompson's Island to promote healthy riparian zones that trap and filter NPS pollution from stormflows and prevent recreation access at points that could increase sediment introduction to the river.
- Create at least three access points designed to promote safe access to the river while minimizing the introduction of sediments to the river and preventing damage to riparian areas that mitigate NPS pollution.
- Install and maintain trash cans and at least one pet waste station near entry points to prevent pollution from litter and pet waste.
- Utilize volunteer and City of San Marcos monitoring efforts to track improvements in water quality in this reach of the river from minimized entry points/sediment disturbance and riparian filtering of stormwater.
- Develop and install informational signage at entry points.
- Use collected data and watershed information as part of an educational campaign to promote watershed stewardship on WPP website, partner websites, and other social media.

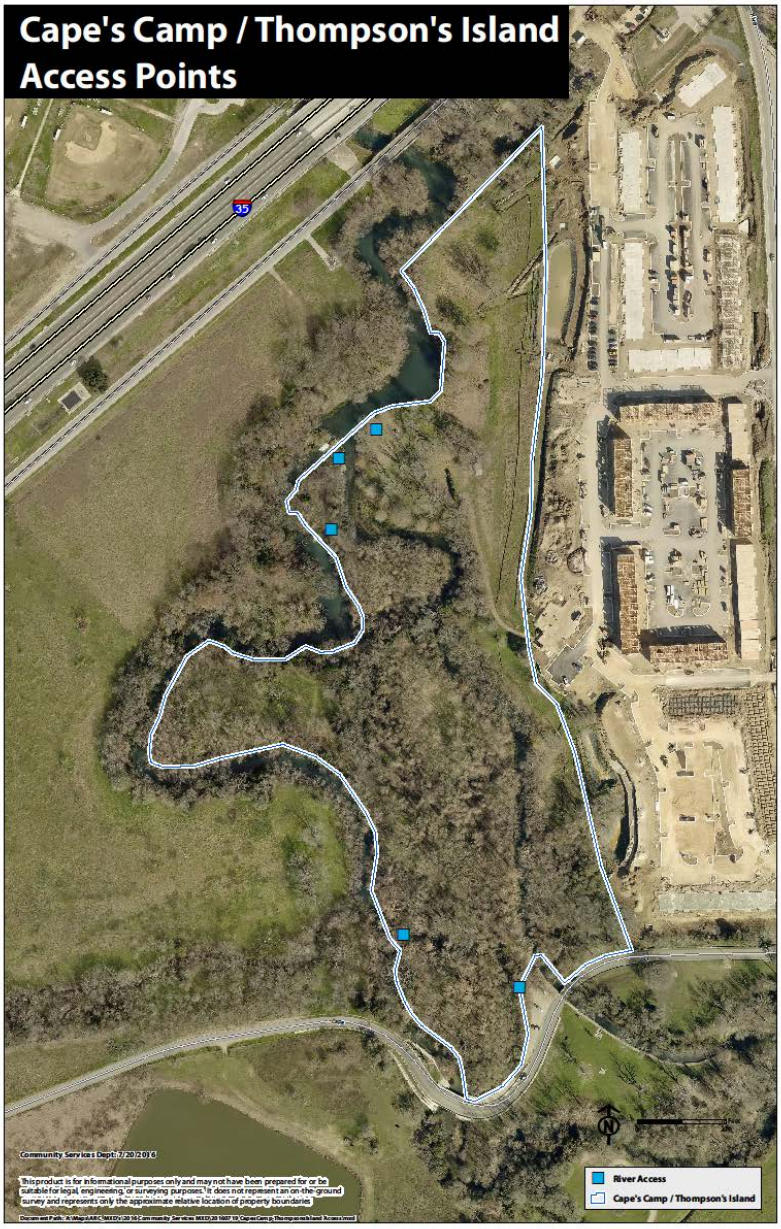


Figure 15. Cape's Access Points

City Stormwater Retrofit Opportunities

Table 14. City of San Marcos stormwater retrofit BMPs*

Project Name	Project ID	Receiving Watershed	Recommended Water Quality Treatment Measure
Water Quality Protection Plan			
The Big Ditch	10061	SMR	Biofiltration
Purgatory Creek Greenspace	10143	PGY	Biofiltration
Wastewater Treatment Plant	10573	SMR	Biofiltration
Veterans Memorial Park 1	10041	SMR	Rain Garden
Dunbar Park	10331	PGY	Rainwater Harvesting, Extended detention/vegetated channel
The Big Ditch Infiltration	10062	SMR	Biofiltration
Downtown Retrofit Biofilter	10351	SMR	Multiple
Spring Lake Preserve	10630	SNK	Multiple
City Park 5	10055	SMR	Multiple
City Park 7	10057	SMR	Multiple
City Park 1	10051	SMR	Biofiltration
Hummingbird Hollow	10250	SSM	Rain Garden
Hopkins Channel 2 (Veramendi Park)	10291	SMR	Biofiltration and extended detention
Mariposa Street	10550	WSP	Biofiltration
Hopkins Channel 1	10292	SMR	Extended Detention (Dry)
City Park 6	10056	SMR	Extended Detention (Dry)
City Park 8	10058	SMR	Biofiltration
Veterans Memorial Park 2	10042	SMR	Extended Detention (Dry)
City Park 4	10054	SMR	Biofiltration
City Park 2	10052	SMR	Extended Detention (Dry)
City Park 3	10053	SMR	Biofiltration
Downtown SmartCode Water Quality Plan			
San Antonio Street at LBJ Drive	2	SMR	Inlet Retrofit – Filterra System
San Antonio and Guadalupe Street intersection	3	PGY	Biofiltration

Hutchinson, LBJ, Guadalupe, and Hopkins Block	4	SMR	Green Alley
City Park at Hutchinson Street	n/a	SMR	Storm Drain Inlet System
City Memorial Park/RR ROW (Big Ditch, see WQPP)	32	SMR	Biofiltration
City Library Parking Lot	33	SMR	Rain Garden
City Activity Center Parking Lot	34	SMR	Rain Garden
City Hall	n/a	SMR	Rain Garden
West end of Pat Garrison Street	46	PGY	Inlet Protection/Planter
LBJ at IH-35 Truck Stop	51	WSPG	Rain Garden/Biofiltration
South Guadalupe Street at IH-35	54	WSPG	Green Channel Conversion
Guadalupe and LBJ Commercial Center	64	PGY	Rain Garden
Hutchinson Street at North Street	68	PGY	Downspout Disconnection
CM Allen at Purgatory Creek	100	SMR	Bioretention
City Hall at Hopkins Street	101	SMR	Rain Garden
Other from City of San Marcos Engineering Staff			
CM Allen Parkway	A	SMR	Green Street
Sessom Creek Restoration	B	SSM	Natural Channel Restoration

** From July 2015 Draft Water Quality Protection Plan Report, Draft Final Phase 2 Downtown SmartCode Water Quality Plan for the City of San Marcos, July 1, 2015, and the City of San Marcos Engineering Department. Additional measures may be available in the WQPP.*

Texas State Stormwater Retrofit Opportunities

Table 15. Texas State University stormwater retrofit BMPs*

Project Name*	Project ID	Receiving Watershed	Recommended Water Quality Treatment Measure
Water Quality Protection Plan			
Sessom Creek Wetpond 3	10233	SSM	Wet Pond
Sessom Creek Wetpond 2	10232	SSM	Wet Pond
Fish Ponds 3	10493	SMR	Wet Pond
Sessom Creek Wetpond 1	10231	SSM	Wet Pond
Fish Ponds 2	10492	SMR	Wet Pond
Fish Ponds 1	10491	SMR	Wet Pond
The Gulch 1	10431	SSM	Biofiltration
The Gulch 2	10432	SSM	Extended Detention (Dry)
Peques Street	10450	SSM	Biofiltration
The Glade 1	10441	PGY	Biofiltration
The Glade 6	10446	PGY	Multiple
The Glade 5	10445	PGY	Multiple
The Glade 4	10444	PGY	Biofiltration
Jowers Center 4	10474	SMR	Multiple
The Glade 7	10447	PGY	Biofiltration
The Glade 3	10443	PGY	Rain Garden
The Glade 2	10442	PGY	Rain Garden
Jowers Center 2	10472	SMR	Rainwater Harvesting
Jowers Center 1	10471	SMR	Biofiltration
Jowers Center 3	10473	SMR	Biofiltration
Texas State Staff Identified Sites			
Clear Springs Parking Lot	1	SMR	Porous Pave Surface
Golf Course Area Parking Lot	2	SMR	Pervious Paver System
Holland Street Sidewalk	3	SMR	Pervious Paver System
Meadows Center Parking Lot	4	SMR	Pervious Paver System, rain gardens
Meadows Peninsula ADA Walking Paths	5	SMR	Porous Pave Surface
Moore Street Parking Lot	6	PGY	Porous Pave Surface
Sewell Canoe Launch	7	SMR	Pervious Paver System
Smith House Parking Lot	8	PGY	Porous Pave Surface
South Stadium Drainage Improvements	9	SMR	Porous Pave Surface

** From July 2015 Draft Water Quality Protection Plan Report and sites identified by Texas State University staff.*

5. Land Development Codes

Code SMTX

The City of San Marcos has undertaken an in-depth land development code rewrite process which is likely to be completed in the fall of 2017, on a similar timeline to the WPP. WPP stakeholders participated in the code rewrite and development process and the two efforts are complementary. The stakeholder committee and partners strongly recommend that LID measures and GI be incorporated into all of the land development code chapters, but focused primarily on the Code SMTX's Chapter 6 – Environmental Regulations. Suggested improvements, technical advice, and other input was provided by stakeholders at every opportunity and many of these have made their way in to the final land development code (LDC) draft. Key recommendations include the incorporation of LID/GI practices throughout the LDC and:

- Adoption of the proposed City of San Marcos LDC revisions that will expand creek buffer zones on the Edwards Aquifer Recharge Zone and require stream protection volume across the City.
- Implementing TCEQ Edwards Aquifer Protection Rules Optional Enhanced Measures and expanding the measures beyond the recharge zone.
- Creation of a Sessom Creek special regulatory district to protect water quality.
- Adoption of improved flood ordinances and flood control standards that are inclusive of water quality protection measures and features.
- Stormwater Quality and Stream Protection Standards that remove 85% TSS and have an increased storm water quality volume (greater than the first 1.25 inches of rainfall from the site) and are more stringent in environmentally sensitive areas.
- Revision of City Land Conservation Program Open Space Standards to increase current City of San Marcos ratio from 5 park acres per 1,000 people to 10 acres. To provide a benchmark to other Texas cities, the Trust for public land produced the following data in 2012 regarding Total Park Acres per 1,000 residents: Arlington – 12.8; Austin - 37.0; Dallas -19.5; Fort Worth – 15.7; Houston – 23.6; San Antonio- 17.6.
- Revision of City Land Conservation Program Open Space Standards to increase open space dedication to other land uses instead of only residential subdivisions being required to dedicate parkland or pay a fee-in-lieu of dedication at the City.

Hays County Drainage Criteria Manual

The County is updating its drainage criteria manual and stakeholders recommended that, as with City regulations, GI and LID be incorporated where appropriate. In particular, it has been recommended that the County adopt creek buffer zone requirements to mitigate flooding and nonpoint source pollution.

6. Land Conservation and Management

While it often involves the purchase of land or purchase of development rights for land, natural area/open space preservation is considered a non-structural protection measure. Natural area conservation can accomplish the objective of no net increase in pollutant loadings by restricting development activities that would generate these additional pollutant loadings (Naismith Engineering, Inc., June 2005).

A majority of the open spaces in the watershed are privately owned and equipping and supporting land owners to best manage their properties can prevent and mitigate NPS pollution. Further, lands owned and maintained by the City, County, and other agencies can be managed to allow for open spaces, grasslands, riparian zones, and other natural features to properly function. Stakeholder selected land conservation and management measures are described below.

Land Conservation Initiatives

NGOs and land trusts in the watershed and in the region are working together to protect large tracts of land that have significant filtration features (e.g. natural grasslands and riparian areas), flood mitigation capabilities, and important recharge features.

The WQPP and stakeholders determined that initial land conservation program objectives are to:

- Develop a strategic plan for open space protection in the watershed, acquire land and establish conservation easements in environmentally sensitive areas to meet the goals of the WPP, Edwards Aquifer HCP, and the WQPP.
- Pull information from open space and comprehensive plans to create a composite map of potential conservation lands. Within this map, identify Primary and Secondary Conservation Areas. Compare with Meadows Center land conservation prioritization reports.
- Utilize recently completed land conservation prioritization and strategy studies to identify key areas and properties for management and conservation.
- Establish the resources necessary (money, personnel, etc.) to acquire land and conservation easements by identifying potential funding, grants, and collaborators.
- Finance land acquisition through issuance of open space bonds and/or pursuit of land acquisition grants.
- Consider a bond election similar to the City of Austin Water Quality Protection Land program to purchase conservation easements or conserve land.
- Coordinate with local land conservancies to generate funds and acquire priority properties or support private management of properties.
- Develop strategies to encourage private land easements for riparian buffers, floodplains, and recharge features (i.e. easement holding partner, funding, and promotion to landowners).
- Evaluate land along the river and consider land acquisition, building removal, and site restoration when suitable properties become available. (City of San Marcos Parks and Open Space Master Plan)
- Explore mitigation options for developments in areas that are planned for higher density.
- Explore regional stormwater detention fee-in-lieu program to fund flood mitigation projects, enhancements to the existing dams, and support land conservation.
- Integrate the program with a City payment-in-lieu for stormwater treatment by requiring that a minimum portion of the payments be dedicated to acquiring natural areas and open space.
- Consider an incremental sales tax increase similar to the City of San Antonio's approach that helps fund Edwards Aquifer protection land in the San Antonio region.
- Amend municipal zoning ordinances to establish the transfer of development rights (TDR) option and develop a market for TDRs. Educate landowners, realtors, developers on the advantages of TDR programs.
- Partner with local land trusts and the County to promote use of the TDR tool and help with program administration. Consider establishing a TDR bank for holding municipally acquired TDRs for future sale.

Potential funding & collaborators (sourced from the WQPP) for land conservation:

- General obligation bonds, which are repaid by property taxes.
- Governmental entities: Hays County, Natural Resources Conservation Service, National Park Service (Rivers, Trails, and Conservation Assistance Program)
- Non-Governmental Organizations: the Trust for Public Land, the San Marcos River Foundation, the San Marcos Greenbelt Alliance, the Hill Country Conservancy, the Nature Conservancy of Texas, the Guadalupe-Blanco River Trust, the Hill Country Land Trust, and more
- Development Interests: Conservation of land in connection with development activities may take a number of forms, including:
  - Required dedication of land as a condition of development approvals
  - Fee-in-lieu payments by developers used to acquire conservation land
  - The use of Conservation Development and/or LID practices, with open space areas being maintained in accordance with conservation standards

Please also see The Technical and Financial Assistance Section of the WPP.

Considerations for land conservation:

- Consider the proximity of potential land to other conservation property and the cost to buy and manage.
- Prioritize environmentally sensitive land with recharge features, such as caves, sinkholes, and seeps, that are characteristic of the Edwards Aquifer.
- Consider allowing public access with low-impact recreational and educational opportunities, provided such activities are compatible with the primary purpose of water quality protection. One such consideration is the Violet Crown Trail, a 30-plus-mile regional public trail system that will run from Hays County to Zilker Park in Austin.
- While the proposed Land Conservation Program in San Marcos would be primarily intended to protect listed aquatic species, there are numerous other species, both listed and unlisted, that the Program may collaterally benefit including the golden-cheeked warbler and black-capped vireo (species included in the Hays County HCP)

Resources beneficial to the establishment of land conservation initiatives include:

Conservation by Design: How it Works (http://www.natlands.org/services/for-municipalities/conservation-throughzoning/how-it-works/);

Growing Greener—Conservation By Design (http://conservationtools.org/libraries/1/library_items/732-Introductionto-Growing-Greener-Conservation-by-Design);

Conservation Subdivision Design Handbook (http://conservationtools.org/libraries/1/library_items/349-ConservationSubdivision-Design-Handbook);

Conservation Tools: Growing Greener: Conservation By Design (http://conservationtools.org/guides/show/9-Growing - Greener-Conservation-by-Design);

Ag Law Resource and Reference Center Transfer of Development Rights (http://law.psu.edu/_file/aglaw/ Transfer_of_Development_Rights.pdf);

Conservation Tools: Transfer of Development Rights (http://conservationtools.org/guides/show/12);

https://www.landcan.org/Land-Conservation-Tools/; http://www.chesco.org/DocumentCenter/View/5695

Prioritization of Conservation Lands

SMWI stakeholders identified land characteristics important to protecting the watershed from nonpoint source pollution, stormwater, and erosion associated with flooding. Areas in the watershed thought to be particularly sensitive to the effects of development were included, as were areas providing ecosystem services. Also prioritized were properties or areas of the watershed adjacent to other properties with current conservation strategies in place and inversely, large tracts with land management practices contrary to protecting water quality that could benefit from financial and technical assistance.

Attributes of concern include:

- ✓ Karst features, caves, and geological features that influence aquifer recharge, preserving/improving quality and quantity of stormflow recharging aquifers;
- ✓ Open spaces that affect stormwater flows, filtering of storm flows and groundwater infiltration, including riparian areas, flood plains, topography that slows runoff, soils that promote infiltration, and vegetation that filters pollutants from stormflow;
- ✓ Springs, seeps, and other geological or landscape features that promote source water infiltration and provide flow to the Upper San Marcos River; and
- ✓ Areas of the watershed or tracts with existing measures and natural features that mitigate effects of flooding and erosion.

Watershed Conservation Prioritization Efforts and Recommendations

In 2016 and 2017 The Meadows Center/Texas State University, City of San Marcos, and the San Marcos River Foundation partnered with environmental professionals and multiple land trust and land management organizations to assess and prioritize areas of the watershed for conservation, including purchase, easements, and other protection strategies and stewardship assistance/land management

approaches. Results from this effort can be used to guide future land conservation strategies in the watershed. Measures and recommendations for two key studies are summarized below. The first study identified conservation priorities based on comprehensive characteristics, with heavy emphasis on water quality. The second assessed conservation strategies and management activities for flood plains that would also promote watershed function and prevent or mitigate NPS pollution.

Blanco and Upper San Marcos Watershed Strategic Conservation Prioritization Study
Goals of this study included:

1. Using the best data and analysis methods available to inform good decision making and the efficient use of resources associated with conservation projects in the Blanco and Upper San Marcos Watersheds with a focus on water resources.

2. Conducting an overall characterization of land use and natural resources in the watersheds to inform conservation efforts.

3. Creating an informative, compelling tool that identifies areas of highest conservation value in the watersheds to support and catalyze action by stakeholders, decision makers, and conservation practitioners.

The prioritization results identify those areas most in need of conservation as seen in Figure 3. These results are based on 20 conservation resources; nine associated with water resources, six associated with cultural resources, and five associated with ecological resources. Collectively 46,227 acres, or 12.9% of the study area, are determined to be of high conservation value. These priority areas contain the greatest co-occurrence of conservation resources and their protection will provide the greatest acre-for-acre impact.

Within the high priority areas, water resources are strongly represented. This is expected because of the high value given to them in the prioritization process, the number of co-occurring water resources within the model, and the importance put on resources that protect spring flow, water quality, and flood mitigation. Four clusters of priorities that can serve as focus areas for conservation action were identified, one being in the Upper San Marcos Watershed. Figure 16 shows a ring around the San Marcos core associated with high conservation values linked to karst features, Spring Lake, riparian areas, Edwards Aquifer recharge, and trails buffer.

Undeveloped lands in this ring are recommended for immediate conservation actions that could include fee simple purchase, conservation easement acquisition, or land stewardship activities that protect, maintain, and enhance the conservation resources within the watersheds. Specific examples of these conservation activities are outlined in the Upper San Marcos River Watershed Flooding and Land Conservation Study Recommendations report below, as well as in several of the following sections.

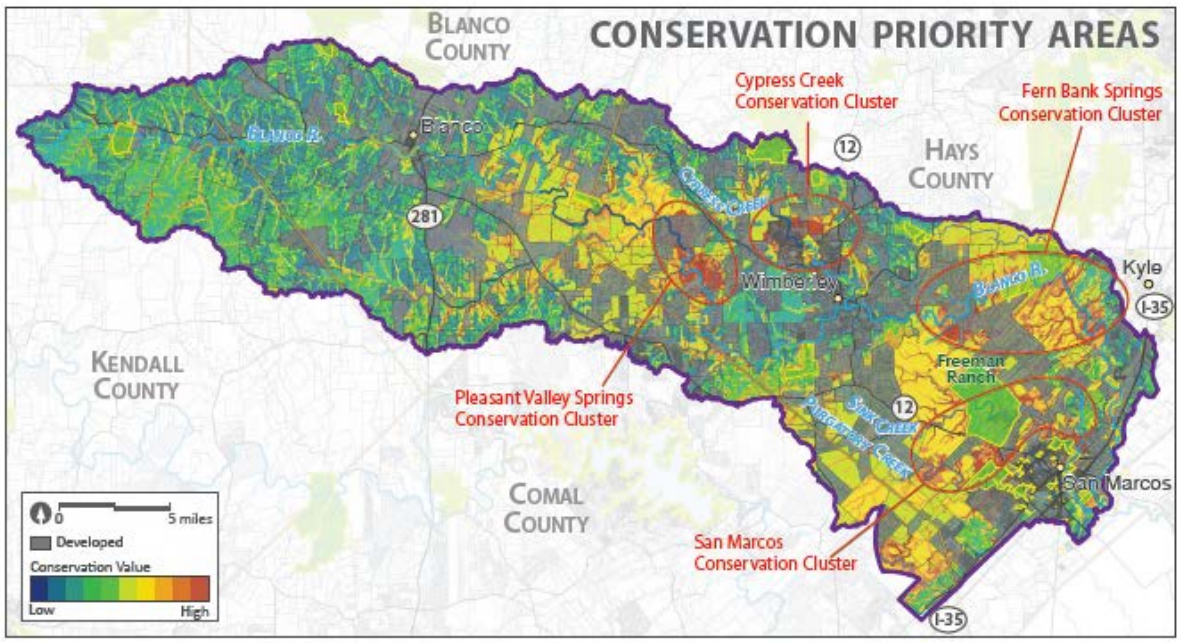


Figure 15. Conservation priority areas

Upper San Marcos River Watershed Flooding and Land Conservation Study Recommendations

The purpose of this study was to identify conservation and land management priorities and strategies for flood mitigation that overlap with watershed protection. To potentially reduce flood levels, land conservation must be done in concert with land management activities, such as managing brush/shrub landscapes and converting this to meadow and native grasses on appropriate soils, slopes, and areas hydrologically connected to aquifers and creeks. Conservation and management activities for flood mitigation also have the potential to reduce stormwater runoff volume, increase recharge/water supplies, and improve stormwater quality. Findings are summarized below as measures for implementation within the WPP.

When assessing land conservation opportunities to determine priority locations to maximize water quality, water supply, and runoff management benefits, planners should target the following:

- Sink and Purgatory Creeks, 98 percent of their watershed area is in the Edwards Aquifer Recharge Zone;
- Creeks and tributaries, the majority of recharge is noted to take place in the stream beds;
- Existing USDA Soil Conservation Service (SCS) flood control dams, flood pools, and inundation easements;
- Shrub/scrub land cover that has a high potential for improvement through sound land management activities;
- Soils that have a higher potential for infiltration and water storage and are hydrologically connected to local streams and aquifers; and

• Flatter topographic areas down-gradient of steep slope terrain that are hydrologically connected to local streams and aquifers so these localized ecosystems can be enhanced to increase water retention and yield.

Alternatives to land conservation/land management activities to maintain existing floodplain levels include:

• Protection of riparian areas throughout the Upper San Marcos River watershed to ensure that trees, vegetation, and creek channel storage remain intact to slow flood velocities, provide channel storage, and retain sediment during floods. Beginning creek buffer zones at a watershed area of 32 acres indicated that almost 18 percent of the watershed would be in a buffer zone;

• Continuing the practice of requiring stormwater detention for land development and redevelopment activities through the City of San Marcos and Hays and Comal counties' ordinances and technical criteria to prevent development projects from increasing peak flow rates;

• Continue the TCEQ Edwards Aquifer Protection Program that requires new development with impervious cover greater than 20 percent to include built water quality treatment measures;

• Continuing effective construction plan review and construction inspection to ensure that erosion control practices are properly installed and maintained;

• Continue effective construction plan review and construction inspection to verify that stormwater detention and water quality basins are properly designed and maintained to manage post-development peak flow rates to existing levels;

• Establishing and enforcing stormwater detention basin maintenance; and

• Continuing the monitoring and maintenance of the five SCS flood control dams.

Stakeholders approved recommendations to consider the following next steps to manage floodplain levels and maximize water resource protection in the Upper San Marcos River watershed:

• Development of a flexible and effective conservation development ordinance that can be adopted by the City of San Marcos and Hays and Comal counties to encourage and incentivize conservation developments to extend land conservation efforts in the watershed;

• Prepare a land conservation/land management plan/LID plan for the Freeman Ranch, a 4,262-acre property owned by Texas State University;

• Initiate a Hays County Water Supply Enhancement Project with the Texas State Soil and Water Conservation Board to assess the stormwater runoff, water quality, and water supply benefits of brush and land management activities;

• Evaluate the creation of a Regional Stormwater Management Program in the Upper San Marcos River watershed with the City of San Marcos and Hays County to generate revenue from new land development projects for flood control dam maintenance and land conservation; and

• Consider the creation of an USMR/Blanco Watershed Improvement District to support the planning and implementation of flood, water quality, riparian habitat, and land conservation projects.

Practices and land management strategies to prevent/mitigate flooding that also protect water quality:

- Stormwater detention ordinances for new development that includes thorough plan review and construction monitoring to ensure that the detention basin design and construction meets the flood mitigation requirements;

- Creek buffer zones along creeks, rivers, and tributaries to store flood flows, manage flood velocities, and retain sediments to minimize sediment accumulation at bridges, culverts, and in the channel;

- Creek bank erosion control regulatory criteria (stream protection volume) to manage frequent storms to maintain the natural stream system;

- LID design guidelines that not only manage runoff volume but also encourage protection of environmentally sensitive areas, woodlands, and minimize cut and fill;

- Encouragement of sound hydrologic design practices to follow natural drainage patterns to avoid constructing roads and conveyance systems that short-cut the natural drainage flow path and rapidly covey runoff to receiving streams. Maximize usage of the "stair-stepped" topography of the Edwards Region to retain runoff;

- Land conservation connected with sound land management activities such as brush management in concert with vegetation enhancement and coordinated grazing practices to maximize rainfall retention and minimize runoff; and

- Consideration of a regional stormwater detention program in concert with the existing flood control dams to evaluate the development of a fee-in-lieu program to help fund land conservation, land management, and dam improvement activities. However, this must be carefully assessed and be done in combination with the TCEQ Edwards Aquifer Protection Rules and the City of San Marcos Stormwater Technical Manual requirements to ensure that stream protection volume measures are part of each development project to prevent accelerated creek erosion.

Recommendations for land management activities and conservation strategies and potential funding strategies related to flood mitigation/prevention, watershed protection, and land preservation in the Upper San Marcos River include:

- Priority areas – soils, vegetation enhancement potential, riparian buffers, floodplains from the Blanco and Upper San Marcos Conservation Plan;

- Regional stormwater detention fee-in-lieu program to fund flood mitigation projects, enhancements to the existing dams, support land conservation;

- Consider an incremental sales tax increase similar to the City of San Antonio's approach that helps fund Edwards Aquifer protection land in the San Antonio region;

- Consider a bond election similar to the City of Austin Water Quality Protection Land program to purchase conservation easements or conserve land;

- Request and help fund a Hays County Brush Management Study through the TSSWCB to increase the potential for enhanced land management funding in the Upper San Marcos River watershed similar to the Pedernales River Project;

- Continue to implement the USMR Watershed Protection Plan;
- Continue to implement the EAHCP with a focus on land conservation/land management;
- Partner with the Trust for Public Lands, Guadalupe Blanco Trust, The Nature Conservancy, Hill Country Conservancy, and other land conservation/easement entities;
- Coordinate and partner with the Hays County Habitat Conservation Plan that is designed for protecting bird and terrestrial endangered species habitat;
- Develop a land conservation/land management/LID plan for the Texas State University Freeman Ranch;
- Coordinate with the Edwards Aquifer Authority and the City of San Antonio to include western Hays County in the San Antonio watershed protection land program; and
- Consider the creation of an Upper San Marcos/Blanco Watershed Improvement District to help guide the protection and conservation of land in these watersheds.

Sink Creek Land Conservation Recommendations

Much of the area within the Upper San Marcos watershed that was given high rankings for conservation lies within the Sink Creek watershed. There are many known significant recharge features and several reports and studies have noted that stormflows from Sink Creek carry suspended solids and other pollutants to Spring Lake. The Spring Lake Characterization report and WPP modeling show that increased urbanization and impervious cover will directly impact NPS pollution contributions (chiefly nutrients and sediment) to the slough arm of Spring Lake and the headwaters of the river. Further, development of this watershed will likely allow both higher rates of NPS pollution to infiltrate into groundwater via the many recharge features in the watershed and lower total recharge amounts due to changes in landscape and runoff patterns. The stakeholders identified that conserving open spaces in this watershed are paramount to keeping the river clean and flowing. Specific recommendations include conserving large parcels through easements, purchase of development rights, and purchase of properties through public private partnership options to ensure that:

- new road construction development of large multi-family complexes, and commercial developments are minimized,
- karst features, open spaces, and grasslands are protected, and
- There are connecting trail systems

Sessom Creek Land Conservation Recommendations

Two separate land conservation efforts were originally identified in the Sessom Creek Watershed Restoration Plan, as part of the WQPP. These efforts are described above in WQPP measures. Please see Table 12 and the pink parcels in Figure 17.

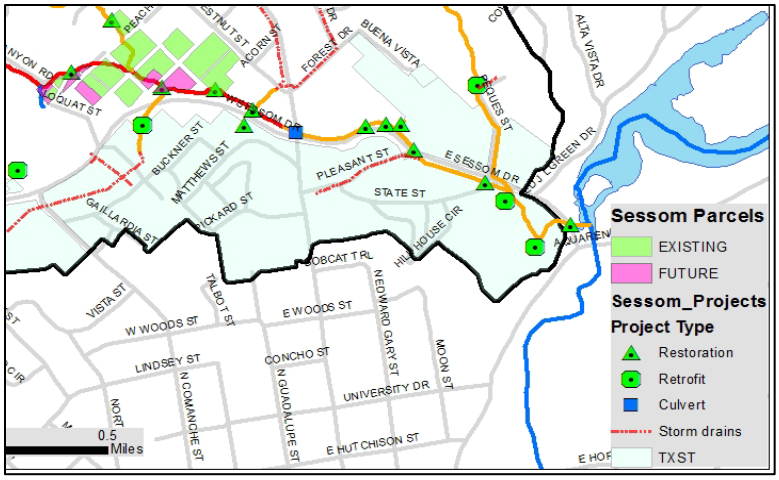


Figure 16. Subset of Sessom Creek Watershed highlighting potential parcels for conservation

Several tracts associated with the planned City of San Marcos wastewater improvements project were noted, and to the extent possible, the City has acquired or otherwise protected these tracts from development.

The Headwater tract is a high priority and is described in more detail below.

Sessom Creek Headwater Tract Preservation (provided by WQPP staff and partners)

Estimated Cost: $115,000

Time Frame: Complete by 2021

Description: The target tract is approximately ¼ acre in size and is contained within a larger 1.5-acre parcel. It is an excellent example of "headwater protection" as it dissipates concentrated flows entering from an upstream concrete channel, thus reducing downstream flooding and erosion. Even though a drainage channel runs through the property, it is not located in a designated floodplain. It appears that the ¼ acre parcel has no development restrictions. Given that assumption, the potential market value is used to estimate the cost of protecting or acquiring the parcel.

To estimate the cost for preserving the parcel in its current undeveloped state, three basic options exist:

1. A conservation easement is donated by the property owner
2. A conservation easement is purchased from the property owner
3. The parcel is purchased from the property owner.

Option 3 would be most expensive, and is used for planning purposes. The appraised value history of the entire 1.5-acre tract is shown in Table 16 (source - Hays Country Appraisal District).

Table 16. Appraised value history of Sessom Creek Headwaters Tract (Hays County Appraisal District)

Year	Improvements	Land Market	Ag Valuation	Appraised	HS Cap	Assessed
2017	N\A	N\A	N\A	N\A	N\A	N\A
2016	$250,700	$12,880	$0	$263,580	$0	$263,580
2015	$235,960	$12,880	$0	$248,840	$0	$248,840
2014	$221,210	$12,880	$0	$234,090	$5,554	$228,536
2013	$196,000	$11,760	$0	$207,760	$0	$207,760
2012	$186,670	$11,200	$0	$197,870	$0	$197,870
2011	$186,670	$11,200	$0	$197,870	$0	$197,870
2010	$186,670	$11,200	$0	$197,870	$0	$197,870
2009	$189,520	$11,200	$0	$200,720	$0	$200,720

Table 16 shows that the assessed value has increased by 33% in the last 4 years, an average of 7.5% per year. Assuming the preservation process requires 5 years to complete at 7.5% annual rate of increase, the projected assessed value would increase by almost 44%, to $378,000. Further if the assessed value is 60% of the market value (a common assumption), the latter would equate to about $630,000, or about $420,000 per acre. An assumption of $450,000 per acre is made, thus, for the ¼ acre parcel, the cost for acquisition would be about $112,500. For planning purposes, a value of $115,000 is proposed. As this is believed to be a conservative estimate, it should be adequate to account for all legal fees.

Fee, Fee in Lieu of, and Credit Programs for Watershed Lands

1. County Land Preservation Program Fee – Several counties across the nation participate in transactional fee programs to preserve agricultural land or open spaces. For example, several counties in Minnesota impose a fee of $5 per transaction on the recording or registration of a mortgage or deed that is subject to tax. They also provide reduced property tax rates, similar to agricultural and wildlife use exemptions, to properties that are left undeveloped. The fees charged help offset the cost to taxing jurisdictions for lost revenues from reduced tax rates associated with properties that are left undeveloped. Hays County could implement a similar program that provides tax incentives (in the form of lower tax breaks) to owners of large tracts of land (including those with conservation easements) that implement watershed protection BMPs (limited impervious cover, permeable surfaces, grassland conversion or maintenance, riparian buffers, karst feature protection, etc.).

2. City and County Land Preservation Fees for Purchasing Open Spaces – Similar to the program described above, the City and County could impose a small transaction fee for administrative services that could be used to purchase properties and assist NGOs and land trusts with financing conservation easements. Additionally, the City could impose fees on developers (permits).

3. City Open Spaces and Watershed Protection Lands Mitigation Banking/Fees and Fees in Lieu of - Mitigation banking is defined as "the restoration, creation, enhancement, or preservation of a wetland, stream or other habitat area undertaken expressly for the purpose of compensating for unavoidable resource losses in advance of development actions, when such compensation cannot be achieved at the development site or would not be as environmentally beneficial. Mitigation banking typically involves the consolidation of small, fragmented mitigation projects into one large contiguous site." The City could impose a fee for

development over sensitive recharge zones, contributing zones, or for development likely to increase NPS pollution. These fees could be used to purchase properties and assist NGOs and land trusts with financing conservation easements for land to protect watershed function, aquifer recharge, and mitigate NPS pollution. This could be combined with the City's existing impact fees for capital development.

As part of the LDC (see 5. Land Development Code), developers could be required to implement additional protection measures when developing in sensitive areas (also see the TCEQ Optional Enhanced Measures). The City could offer fees in lieu of some of the protection measures and use the funds to purchase properties with highly ranked conservation values.

4. City Density Transfer Credits – Urban sprawl creates impervious cover, reduces ecological watershed function and reduces habitat critical to the character of the Upper San Marcos River. It can have other costs as well, including increased transportation corridors and infrastructure needs. The concentration of development in growth centers can help preserve conservation lands and open spaces, as well as create vibrant downtown spaces and walkable communities. The City's Comprehensive Plan outlines several Development Zones where growth is preferred. Density transfer credits, DTR can encourage development in preferred areas, while discouraging or limiting development of large tracts of land or open spaces. It can also protect the equity of landowners in zones designated as not desirable for development. Figure 18 illustrates how developers building in denser areas can fund conservation of undeveloped land. Essentially, zoning in receiving areas is amended to allow an optional additional increment of development which can be accessed only by purchasing and using density credits. Some or all of the development rights are removed through a permanent deed restriction (conservation easement). The easement is purchased as a density credit (sourced from the Massachusetts Smart Growth Tool Kit).

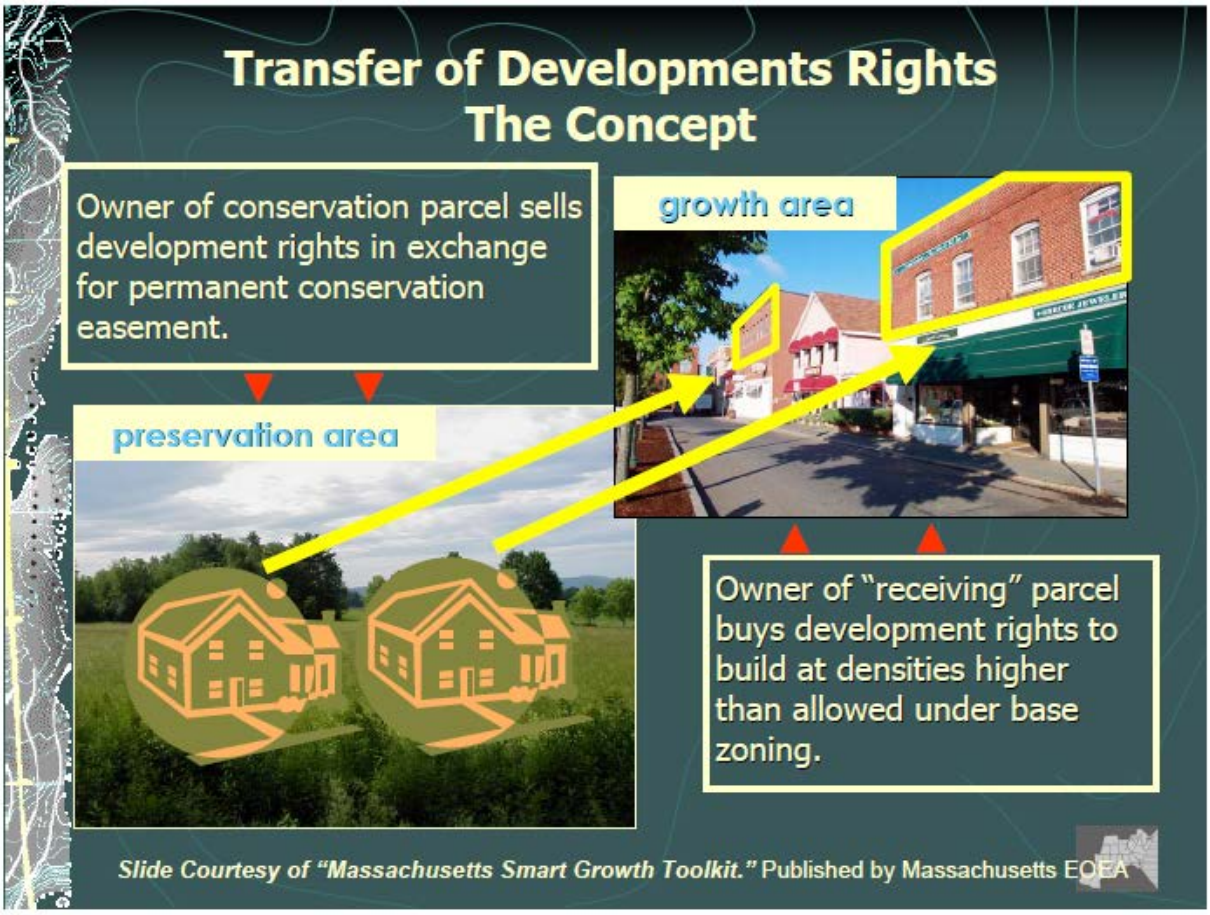


Figure 17. Transfer of Development Rights Concept

Continued Restoration and Management of Spring Lake Headwaters

Headwaters protection strategies to prevent NPS pollution include the conversion of the golf course to open spaces and native grasslands that can be managed to mitigate pollution. The University is currently developing a comprehensive plan to increase riparian buffers and restore the site. Management activities will include mowing schedules and integrated pest management strategies, as necessary. Educational signage could be included at the site, as well as added connectivity to the Spring Lake Natural Area.

Spring Lake and Purgatory Creek Natural Area Management Plans

The goals of the Land Management Plan for Spring Lake Natural Area are to protect and conserve water quality and quantity for the Edwards Aquifer, preserve and protect habitat for the Golden-cheeked Warbler and other endangered species, and provide an educational environmental experience for our citizens. The Sink Creek Natural Area also provides a permanent buffer from encroaching development of the area surrounding San Marcos Springs. Overall recommendations to guide the management of the Spring Lake Natural Area are as follows:

1. Prohibit the development or urbanization of land.
2. Manage the land to best improve and protect water quality and quantity for the watershed and endangered species habitat.
3. Ensure full mitigation of the effects of any improvements such as roads, trails, and other infrastructure.

The following recommendations can guide the selection of areas for brush removal as part of prairie and savanna restoration are as follows:

1. Prioritize sites where a high percentage of existing woody cover is second-growth, there is less than a 10% slope, and there is no occupied Golden-cheeked Warbler habitat.
2. Prioritize shallower soils in upland areas.
3. Avoid soil disturbance near sensitive sites such as riparian corridors and drainage basins associated with karst features.
4. Evaluate experimental treatments on a small scale to ensure desired results before widespread implementation.
5. Minimize significant soil disturbance by mechanical equipment. Ensure that limited soil disturbance needed for seed application or other activities is protected from erosion by slash or light mulch cover.
6. Ensure long-term maintenance of grassland health and brush reduction and monitor the results.
7. Minimize management to allow natural processes to continue without change.

The goals of the Land Management Plan for Purgatory Creek Natural Area are to protect and conserve water quality and quantity for the Edwards Aquifer, preserve and protect habitat for the Golden-cheeked Warbler and other endangered species, and provide an educational environmental experience for our citizens. The City of San Marcos entered into a Conservation Easement Agreement with the EAA and the EAA's recommendations are included within this plan to comply with that agreement. Recommended measures are identical to those outlined for the Spring Lake Natural Area above.

The monitoring of conditions for both natural areas should be ongoing with the data and information evaluated on a regular basis. Large scale monitoring to understand overall management progression is important and can be done regularly by City staff, contract ecologist, Texas State students, and community volunteers. Specific small- scale monitoring activities should be undertaken to add to the baseline studies previously conducted to gather more precise data. Surveys of vegetation and soil conditions (erosion) are critical to monitoring the effectiveness of management for water quality and quantity. Seasonal bird surveys should be conducted regularly to monitor the progress of habitat restoration. General flora and fauna surveys will also be important tools to determine the overall health of the ecosystem.

Brush management measures are recommended at both locations, specifically for Golden-cheeked Warbler management, but are also valuable to protect water quality and increase recharge include:

- Fuel reduction zones
- Prescribed burning
- Prescribed mowing
- Mechanical removal
- Chemical removal

Connected Trail System

The San Marcos Greenbelt Alliance, San Marcos River Foundation, and others have long been dedicated to the formation of a contiguous natural area and trail system for the City and the watershed. The City of San Marcos Parks, Recreation & Open Space Master Plan's vision is to "Create a unified parks and recreation system that serves the entire San Marcos community, supports tourism efforts and remains a good steward to the River and surrounding environment." Such a trail system would protect important areas that provide riparian zones, watershed buffers, groundwater recharge, stormwater detention and filtering, among other benefits to the watershed.

Planning goals include:

- Sustainability for the long-term health of the park and recreation system.
- Environmental sensitivity to natural areas, waterways, habitat, and the aquifer recharge zone
- Interconnected system of parks, trails, and greenbelts throughout the San Marcos ETJ
- Parkland Dedication through a revision/update to the current Parkland Dedication ordinance to reflect changing trends in San Marcos development/expansion.

County Efforts

The County is an active partner in the WPP and coordinates with partners regarding the Hays County Habitat Conservation designed for protecting bird and terrestrial endangered species habitat. When possible, conservation and management activities include watershed protection measures as well.

Many of the BMPs listed in Section 1. Stakeholder Selected Regionally Appropriate Measures may fall under the purview of the County and can be applied to County held easements and roadways. It is also recommended that the City and WPP stakeholder committee coordinate with Hays and Comal counties to implement creek buffer zones and stream protection volume compatible with the City of San Marcos proposed LDC revisions.

Toolboxes

The resource guides described below are applicable and promote education and cooperation for conserving and managing land within the Upper San Marcos watershed.

To the extent practicable, all of the measures described here should include integrated management strategies to protect water quality and watershed health, as outlined in "Integrated Approach to Landscape and Water Management: Greater Edwards Aquifer Alliance Watershed Stewardship for the Edwards Aquifer Region - A Low Impact Development Manual." This section was originally published in the GEAA Watershed Stewardship Manual and can be found at

Land Conservation and Management Toolbox for the City and County

Stakeholders felt that is was important to develop easy to use resources to guide best management practices on City/County owned land, promote examples of land stewardship and conservation for the community, and enhance/implement City and County programs to purchase land, easements, and development rights to protect source water and the watershed. Key concepts should include:

- Best practices for mowing, maintenance and restoration for parks, natural areas, and open spaces (will include a staff and contractor training component)
- Guidance and materials to promote conservation easements in the city, ETJ, and county

- Municipal and county programs to hold conservation and agricultural easements or outright purchase and manage key properties that protect recharge and/or act as critical filtration for stormflows
- Coordinate with San Marcos Greenbelt Alliance to assess existing parks, trails, and preserves and implement San Marcos Greenbelt Alliance's plan to link these open spaces to create additional greenways
- Pursue funding for improvements to park/trail/preserve network, including TWDB loans and grants

Municipal Toolbox resources include:

Conservation Tools (http://conservationtools.org/guides/show/19-Conservation-Easement);

Conservation Tools Library (http://conservationtools.org/libraries/1/topics/77);

The National Conservation Easement Database (NCED) (http://nced.conservationregistry.org/);

Using Conservation Easements to Preserve Open Space (http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_002310.pdf);

http://www.pewtrusts.org/en/research-and-analysis/analysis/2014/12/16/reaching-into-the-toolbox-to-protect-public-land; http://www.beginningwithhabitat.org/toolbox/osp8.html.

Land Conservation Toolbox for Land Owners and Managers

The stakeholder committee and key partners will develop an online tool box or collection of resources and information to provide land owners with information to promote conservation activities that protect recharge and water quality. Components will include:

- Best management practices for their property, including financial and technical resources to assist with conservation and management activities
- Informative articles about land management, conservation, and permanent protection
- Information about easements, purchase of development rights, and other land conservation tools
- Database of conservation programs, organizations, and land trusts

This effort would use the Guadalupe Blanco River Trust Conservation Easements Guide as a platform: http://www.gbrtrust.org/documents/easements/ConservationEasements.pdf.

Landowner Toolbox resources include:

https://www.landcan.org/;

http://www.landscapetoolbox.org/;

http://www.remarkableriparian.org/;

https://comptroller.texas.gov/programs/species-economy/landowners.php/;

http://tpwd.texas.gov/landwater/land/private/;

http://www.texaslandtrustcouncil.org/

http://www.aquiferalliance.net/Library/GEAAPublications/GEAA_Manual.pdf - Vegetation Management section

Agricultural Management Toolbox

Coupled with the Landowner Conservation Tool Box, the Agricultural Management Toolbox would provide resources and information, as well as technical guidance opportunities and funding assistance regarding BMPs for agricultural and ranch lands. Sample management plans, farm and ranch inventory, audits, and lists of BMPs with cost information will be included. Multiple resources from USDA/NRCS, TSSWCB, and TWRI already exist and can be easily packaged for the Upper San Marcos Watershed.

Urban Land Management Toolboxes

Stakeholders felt that it would be valuable to compile a community-friendly publication outlining WPP content and activities and offering NPS information and prevention strategies. This could be coupled with the self-guided tour of demonstration BMPs in the watershed, outlined in the Education and Outreach Plan. This document will be a compilation of text from the WPP and when possible, existing resource materials. Also from this material, technical resource guides for stormwater BMPs can be published for developers, engineers, and the public.