SAN LUIS OBISPO COUNTY

Functionally Equivalent Stormwater Resource Plan (FE-SWRP)

4.4.2 Technical Memo

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5/31/2018

INTRODUCTION

The main goals of the San Luis Obispo County Stormwater Resource Plan (henceforth in this document, the "SWRP") are to identify and prioritize stormwater and dry weather runoff capture projects in the county through detailed analyses of watershed conditions and processes, surface and groundwater resources, and the multiple benefits that can be achieved through stormwater-related capital projects and other programmatic actions. The form and content of this SWRP are guided by the State Water Board Guidelines for Storm Water Resource Plans (California State Water Board 2015; henceforth, the "Guidelines"), which in turn were developed to implement Senate Bill 985 (SB-985) with respect to stormwater resource planning. These requirements went into effect January 1, 2015, and requires a city, county, or special district to develop a stormwater resource plan as a precondition of receiving voter-approved bond funds for stormwater and dry-weather runoff capture projects. This SWRP is designed to meet those requirements on behalf of the cities and other public agencies and their partners within the county, while also providing a concise body of information on the county's watersheds and water resources that should serve a variety of additional purposes in the years ahead.

Section VI of the December 2015 SWRP Guidelines requires that "Plans shall include a metrics-based and integrated evaluation and analysis of multiple benefits to maximize water supply, water quality, flood management, environmental, and other community benefits within the watershed. (Wat. Code, § 10562, subd.(b)(2).)" This memo summarizes the selected modeling tools and proposed framework, making use of both quantitative and qualitative criteria, that will be used for the integrated identification and screening, scoring, and prioritization of multiple-benefit projects and programs. The goal of this framework is to ensure the SWRP will achieve the objectives set forth in the SWRP Guidelines.

OUTLINE OF THE APPROACH

The plan will take a sequential approach to the identification and evaluation of projects and programs. Unlike many other prior SWRP's, that for San Luis Obispo County does not begin with a large inventory of previously identified projects awaiting evaluation. Thus, parallel paths are anticipated: one, a process to evaluate those projects that have been previously identified by project partners (which number, at most, a few dozen); and a second, a process for identifying promising localities where the need for stormwater management can be recognized and the opportunities for developing multi-benefit projects are present. We also recognize the need to evaluate non-structural Stormwater Control Measures (SCM's) that have been proposed or contemplated in the County, but these typically resist meaningful metric-based quantification of performance or value. A third approach for these stormwater-related programs is also provided.

The outline for this section of the Plan is provided below, followed by graphical flow chart of the overall process of screening, scoring, and prioritizing of SCM's (Figure 1). A more complete narrative discussion of the key elements in this process is then provided:

SCREENING, SCORING, AND PRIORITIZING OF SCM's

4.1. METHODOLOGY FOR PROJECT SCREENING, SCORING, AND PRIORITIZATION

4.1.1. Types of Projects and Programs

4.1.2.Screening and Scoring of Identified Projects

4.1.2.1. Screening Criteria (by individual project type)

4.1.2.2. Quantified Project Performance

4.1.2.3. Quantified Scoring of Projects

4.1.3.Screening and Scoring of Prospective Focus Areas

4.1.4.Evaluation of Programs (non-capital projects)

4.1.5.Prioritization of Identified Projects and Programs

4.1.5.1. Project Rankings using Quantified Metrics—by Watershed Group and County-Wide

4.1.5.2. Integration of Non-Quantifiable Criteria

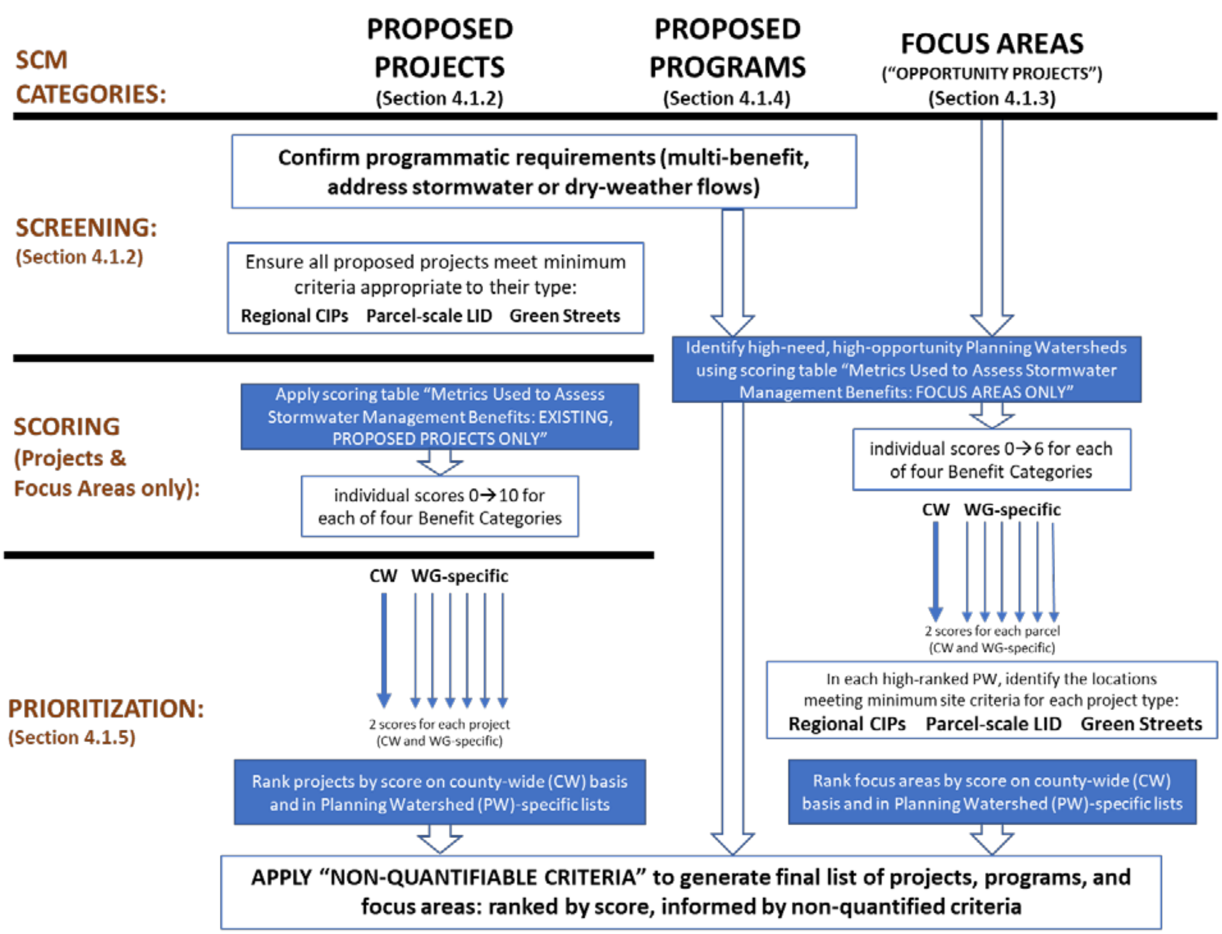


Figure 1. The process of screening, scoring, and prioritizing of SCM's for the San Luis Obispo County Stormwater Resource Plan. Section numbers reference the following text.

Section 4.1.1 Types of Projects and Programs

This section of the plan will begin with a summary presentation of the variety of SCM's that are available and suitable for achieving multiple benefits from the management of stormwater and dry-weather flows. The plan is using an intentionally broad definition of "stormwater," insofar as much of the County is not "urban" in character but nonetheless has widespread land uses, particularly agriculture, that generate runoff with the potential to be used as a resource. It also places strong value on the protection and restoration of aquatic resources that may be directly or indirectly affected by runoff from both agricultural and urban land uses, which requires a holistic view of stormwater management within a watershed context.

As an addendum to this memo, a discussion of the variety of SCM's (both project types and programs) drawn from existing literature, examples within and beyond San Luis Obispo County, and professional experience of this plan's technical team, is provided as a supplement (Appendix A).

Section 4.1.2 Screening and Scoring of Identified Projects

4.1.2.1 Screening Criteria for Projects

For screening proposed projects, the Guidelines require only two basic criteria:

- Must provide at least two "Main Benefits" per Table 4 of the Guidelines
- Must address hazards, opportunities, and/or resources affected by stormwater or dry weather runoff.

Beyond these fundamental programmatic requirements, a more focused project-specific evaluation of minimum criteria will also be applied as a second step in the screening (although it is anticipated that proposed projects will, in general, have already been determined to meet these criteria). Based on prior work, the following criteria are anticipated to reflect minimum requirements for successful implementation of multi-benefit projects, as discriminated by their three main types:

<u>Regional CIP's</u>

1. Public parcel ownership
2. Minimum parcel size 0.25 acres
3. Undeveloped or only lightly developed land use (e.g. parkland)
4. Feasible infiltration (as identified by suitable soil type, WMZ, or prior testing)
5. Parcel slope <10%

<u>Parcel-Scale LID</u>

1. Public parcel ownership
2. Small parcel size (<0.25 acres, to discriminate from "regional" projects)

<u>Green Streets</u>

1. Neighborhood arterials or less intensely used roadways
2. Road slope <5%
3. Other recognized neighborhood/street limitations

4.1.2.2 Quantified Project Performance

For those identified projects that meet the above screening criteria, their anticipated performance across the Benefit Categories of Water Quality, Water Supply, and Flood Management will be evaluated to the extent possible with available information, using the following approaches:

- Measures of pollution reduction will be quantified for each appropriate project using information on the project's design (as available) and a spreadsheet-based model of runoff volumes and literature-based event mean concentrations for a selected group of pollutants (see "Modeling of Pollutant Loading and Removal using TELR," below). Where more precise estimates of TSS load removal are available through prior application of TELR, these will be included as well. The availability and magnitude of these values will inform the final step of project evaluation, prioritization (see Section 4.1.5) and will be available for subsequent stages of project definition and development (including preparation of proposals for grant funding).

- Quantified measures of water-supply augmentation will make use of TELR predictions of runoff volumes, as available, for projects designed to infiltrate some or all of that volume. A presumptive availability of 65% of the infiltrative volume will be applied, based on Munévar and Mariño (1999) as used in the Ventura County SWRP (Geosyntec Consultants 2016). Such evaluations, as available, will be used to inform project prioritization.

- Quantified measures of flood management will be highly dependent on information provided by project proponents, but the potential for flood reduction will be quantified through the TELR prediction of runoff volumes, as above. There is no intention to make detailed evaluation of flood-level reductions in downstream receiving waters in this plan, however, unless hydrologic and hydrologic modeling has already been accomplished by project proponents.

4.1.2.3 Quantified Scoring of Projects

Following the requirements of the Guidelines to provide a metric-based evaluation of projects, four of the five Benefit Categories (Water Quality, Water Supply, Flood Management, and Environment) will be quantified and scored using specific elements appropriate to each category (see "Metrics Used to Assess Stormwater Management Benefits: EXISTING, PROPOSED PROJECTS ONLY," below). The fifth Benefit Category, "Community," is considered in the non-quantifiable project evaluation process and is incorporated into the final prioritization of projects (see Section 4.1.5). The critical characteristics of the project and its location in the watershed, as relevant to each of the Benefit Categories, will be evaluated and scored with each category's total ranging from 0 (no benefit) to 10 (maximum benefit).

How to combine those four benefit-category scores into a single numerical result depends on how each category is weighted. This approach is discussed in Section 4.1.5, below.

Section 4.1.3 Screening and Scoring of Prospective Focus Areas

Equivalent criteria used for determining project feasibility will also be applied on a County-wide basis, through GIS, to identify those areas (hereafter termed "Focus Areas") judged to have both high need and potential suitability for hosting future multi-benefit projects or programs. Because a potentially large number of parcels, County-wide, likely meet any initial screening criteria, the process for screening and scoring Focus Areas is the inverse of that for identified projects: first, the high-scoring areas of the County will be identified; then, individual (public) parcels will be flagged that meet the screening criteria for feasibility. The details of that process are as follows:

The basic unit of County-wide analysis of stormwater management needs and opportunities is the CalWater "Planning Watershed" (PW) (each covering approximately 10,000 acres), of which there are 297 across San Luis Obispo County (see Figures 1 and 2 in "Modeling of Pollutant Loading and Removal

Using TELR," below). Each PW will be evaluated in GIS and scored (see (Metrics Used to Assess Stormwater Management Benefits: FOCUS AREAS ONLY," below). For the urbanized areas, where both this regional application of TELR and the more detailed scale of swTELR overlap, the more detailed results from swTELR will be applied.

Depending on the distribution of Focus Area scores, a selected number of the highest scoring PW's will be further explored at a parcel scale to identify potentially feasible sites for the three main project types, using criteria parallel to those applied to previously identified projects, but as modified for widespread implementation in GIS:

<u>Regional CIP's</u>

1. Parcel ownership (i.e., public)
2. Parcel size (>0.25 acres)
3. Parcel land use (undeveloped or only lightly developed, e.g. parkland)
4. Infiltration feasibility (suitable soil type or WMZ)
5. Parcel slope (<10%)

<u>Parcel-Scale LID</u>

1. Parcel ownership (i.e., public)
2. Parcel size (<0.25 acres)

<u>Green Streets</u>

1. Road type (neighborhood arterials and less intensely used roadways)
2. Road slope (presumed feasible with <10% hillslope gradient)
3. Other recognized neighborhood/street limitations

It is assumed that any project that ultimately arose out of this process would meet the fundamental requirements of the Guidelines (i.e., providing multiple benefits and addressing hazards, opportunities, and/or resources affected by stormwater or dry weather runoff). Any newly proposed projects in these Focus Areas that are developed during the course of preparing this SWRP will need to meet these fundamental requirements, and they will be further scored using the "Identified Project" criteria (Section 4.1.2) as feasible within the period of initial plan development.

Section 4.1.4 Evaluation of Programs (non-capital projects)

Following the lead of other SWRP's, programs and other non-structural projects will be evaluated using non-quantified criteria only. An additional screening, that of the priority PW's from the procedure outlined in Section 4.1.3 (above), will inform the prioritization of these types of actions.

Section 4.1.5 Prioritization of Identified Projects and Programs

4.1.5.1 Project Rankings using Quantified Metrics—by Watershed Group and County-Wide

The quantification of benefits for both previously identified projects (Section 4.1.2) and Focus Areas (Section 4.1.3) will have individual scores for each of the four Benefit Categories being measured. For purposes of combining the quantified scores from each of these categories into a final value, "weightings" for the scores in each category will be assigned. These weights have been assigned by the

TAC and will be applied in two separate lists: (1) those projects only within each of the nine[1] Watershed Groups (WG's), using the weightings recommended by the TAC member(s) from that group; and (2) as part of a County-wide list, using the average of all weighting recommendations from the TAC as a whole:

- Water Quality = 25%
- Water Supply = 35%
- Flood Management = 20%
- Environment = 20%

The sum of the four weighted benefit-category scores will constitute the project or PW's final "score." Note that each project/area will have two such scores, based on the County-wide weightings and the WG-specific weightings (Table 1).

Table 1. Weightings, by Watershed Group (WG), for the four quantified Benefit Categories based on the results from TAC polling of recommended weightings.

BENEFIT CATEGORY	**County-wide weighting (%)**	**WG-specific weightings (in %)**					
		1	**2**	**4**	**5**	**7**	**8**
Water Quality (W%)	**25**	**15**	**30**	**20**	**20**	**25**	**15**
Water Supply (X%)	**35**	**35**	**25**	**40**	**20**	**30**	**60**
Flooding (Y%)	**20**	**35**	**20**	**20**	**40**	**25**	**10**
Environment (Z%)	**20**	**15**	**25**	**20**	**20**	**20**	**15**

4.1.5.2 Integration of Non-Quantifiable Criteria

This procedure will result in lists of projects, programs, and prospective project areas that can be sorted and grouped in any way desired by the TAC and future users of the plan, with a clear and quantified ordering of projects/sites according to their anticipated benefits. However, a variety of non-quantifiable considerations typically enter into the final prioritization of a list of projects or programs, considerations that typically defy a simple numerical rating but nonetheless can determine final outcomes. This plan intends to make those considerations visible to all current and future users using a simple, three-level rating for those considerations that the TAC has judged to be most important in San Luis Obispo County. Those evaluation elements are shown (with a few hypothetical examples) in "NON-QUANTIFIABLE CRITERIA," below.

[1] Although the County is divided into nine Watershed Groups (see the Task 3.2 report), only six are reported here: projects in WG 3 (San Luis Obispo Creek) are addressed in the San Luis Obispo Creek Stormwater Resource Plan (July 2017), and no projects or desired weightings were identified for WG 6 (Cuyama River) or 9 (Carrizo Plain).

REFERENCES

Geosyntec Consultants (2016). Ventura Countywide Municipal Stormwater Resource Plan, Ventura County, CA. Prepared for Ventura Countywide Stormwater Quality Management Program, September 20, 2016. Available from https://wcvc.ventura.org/documents/PDF/Final_MSWRP_2016.pdf.

Munévar, A. and M.A. Mariño (1999). Modeling Analysis of Ground Water Recharge Potential on Alluvial Fans Using Limited Data. Groundwater, 37(5) 649-659.

Metrics Used to Assess Stormwater Management Benefits: **EXISTING, PROPOSED PROJECTS ONLY**				
BENEFIT	**METRIC**	METRIC VALUES (sum for total)	WG weightings (W+X+Y+Z sum to 100%)	Score (multiply columns)
Water Quality: must remove pollutants from stormwater or dry weather runoff via chemical, physical, and/or biological processes				
	Uses treatment of the 85% 24-hr storm volume from the contributing catchment for design	3/0		
	Uses treatment of the 95% 24-hr storm volume from the contributing catchment for design	1/0		
	Sensitive downstream receiving water (WMZ's 1, 2, 3, 5, 6, 8, or 9)	2/0		
	Treats specific TMDL or 303(d)-listed pollutants in downstream receiving water	2/0		
	Treats dry-weather flows	1/0		
	Located in high TELR-predicted pollutant loading catchment	0→1		
		SUM (0→10)	W %	
Water Supply: must reduce net municipal or agricultural consumption through direct reuse or aquifer recharge of stormwater runoff				
	Designed to infiltrate or otherwise reuse the 85% 24-hr storm volume from the contributing catchment	3/0		
	Designed to infiltrate or otherwise reuse the 95% 24-hr storm volume from the contributing catchment	1/0		
	Designed to reduce net consumption from any source	1/0		
	In current supply-limited area (scaled, ground subsidence from 0 to maximum value)	0→3		
	In projected future supply-limited area (scaled, groundwater dependence index)	0→2		
		SUM (0→10)	X %	
Flood Management: must reduce runoff rates or volumes of stormwater runoff				
	Designed to infiltrate or otherwise detain the 85% 24-hr storm volume from the contributing catchment	3/0		
	Designed to infiltrate or otherwise detain the 95% 24-hr storm volume from the contributing catchment	1/0		

	Addresses existing flooding and/or sedimentation risks to public property and/or human health and safety	4/0		
	TELR-predicted runoff in catchment (scaled, minimum to maximum runoff)	0→2		
		VALUE (0→10)	Y %	

Environment: must restore/protect watershed and/or ecological processes impacted by stormwater or dry weather runoff				
	Designed to infiltrate the 85% 24-hr storm volume from the contributing catchment	3/0		
	Designed to infiltrate the 95% 24-hr storm volume from the contributing catchment	1/0		
	Restores/protects native vegetation as riparian buffer or wildlife corridor	1/0		
	Creates/enhances wetland or in-stream habitat	1/0		
	TELR-predicted runoff in catchment (scaled, minimum to maximum runoff)	0→2		
	Number of at-risk aquatic animal species (from EnviroAtlas) (scaled, 0 to maximum value)	0→2		
	Proximal to aquatic habitat (connectivity)	100/distance (in ft), max value = 1		
		SUM (0→10)	Z %	
TOTAL OF ALL BENEFIT SCORES:				
Community: must show benefits in one or more elements: urban greening, open space to DACs, public education, recreational and public use areas, employment opportunities, and/or community involvement				**Pass/Fail**

Results from TAC polling of recommended weighting (all values in percent):

BENEFIT CATEGORY	County-wide weighting (%)	WG-specific weightings (in %)					
		1	2	4	5	7	8

Water Quality (W%)	**25**	**15**	**30**	**20**	**20**	**25**	**15**
Water Supply (X%)	**35**	**35**	**25**	**40**	**20**	**30**	**60**
Flooding (Y%)	**20**	**35**	**20**	**20**	**40**	**25**	**10**
Environment (Z%)	**20**	**15**	**25**	**20**	**20**	**20**	**15**

Modeling of Pollutant Loading and Removal Using TELR

TELR is a spatially distributed hydrologic model, with landscape characteristics and processes represented explicitly throughout a network of urban catchments or regional subwatersheds to provide average annual runoff and pollutant loading estimates. The model has been developed as part of a web-based stormwater tools platform by 2NDNATURE to provide spatially explicit outputs to satisfy MS4 permit reporting requirements and track stormwater mitigation progress over time to reduce reporting compliance effort on the part of permittees (see www.2nform.com). TELR is integrated with a BMP asset management system so that structural BMPs and LID projects can be easily included to estimate stormwater mitigation benefits. Validation experiments have shown that both runoff estimates and BMP reductions align closely with high-resolution monitoring data as well as results generated from more complex, well-accepted continuous simulation models (Beck et al., 2017). This makes TELR well-suited to applications where annual-scale estimates are of sufficient time resolution, spatially explicit estimates are important, and there is a need for ongoing direct use by stormwater managers. TELR was included as a case study in a recent memo from the EPA on developing Reasonable Assurance Analyses (RAA) (EPA, 2017), and featured by the State Water Resource Control Board as part of their STORMS seminar series (SWRCB, 2017).

TELR employs well-tested algorithms for rainfall-runoff transformation and routing, using the USDA Curve Number technique (USDA-SCS, 1986). Hydrologic computations combine a set of metrics that describe a 30-year rainfall distribution with spatial drainage characteristics including impervious cover from the National Land Cover Dataset (NLCD), land use from local parcel assessor layers, soils from the Natural Resource Conservation Service (NRCS), and hydrography from the USGS National Hydrography Data Set (NHD) or local stormwater infrastructure and drainage mapping. Total Suspended Solids (TSS) estimates serve as a proxy for other hydrophobic particulate pollutants with a tendency to adsorb to soil participles (e.g., total nitrogen, total phosphorus, bacteria, metals, pesticides/herbicides) via land-use based characteristic runoff concentrations (CRCs). Initial runoff volumes and particulate pollutant loads are termed baseline outputs, which can be reduced with implementation of source control actions, decentralized BMPs, and centralized BMPs. Runoff and pollutants are routed downstream across urban catchments to receiving waters, accumulating both stormwater impacts and mitigation benefits. The conceptual basis and technical aspects of the model are described further in the technical report detailing its development by 2NDNATURE and the Central Coast RWQCB (2NDNATURE, 2017).

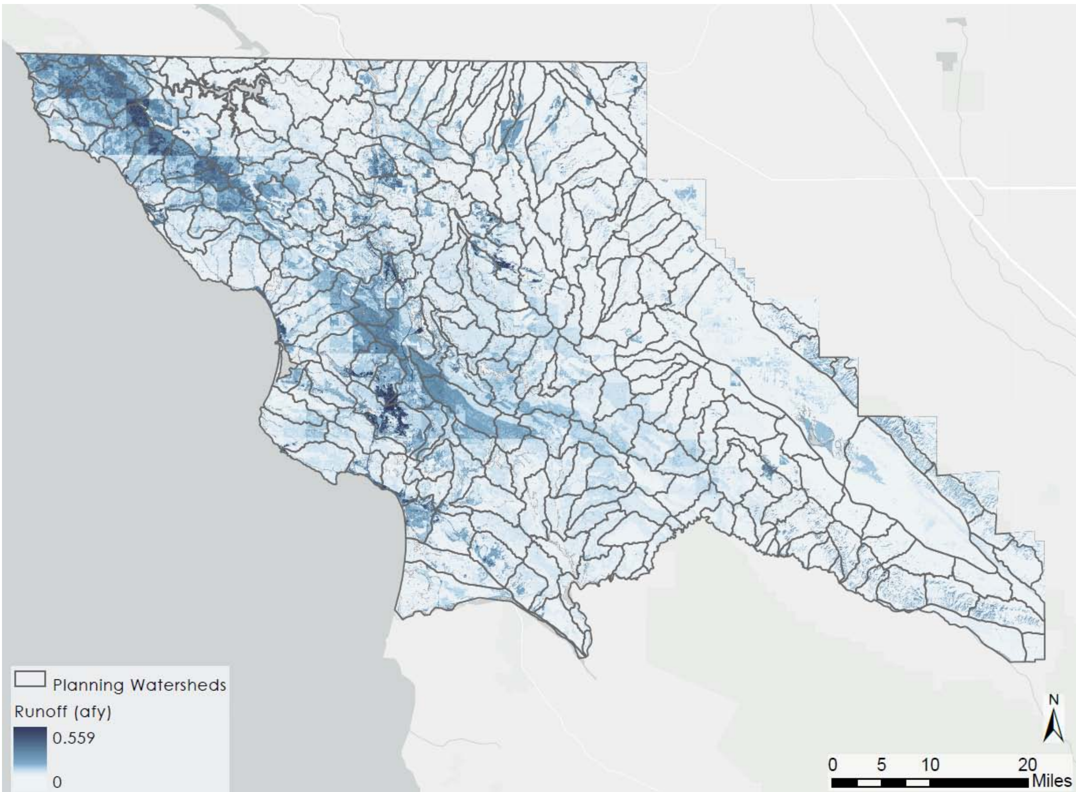
TELR is applied at two scales in this plan. Within MS4 Phase II permittees and other urban communities throughout the County, swTELR (“stormwater TELR”) is the model application applied at the scale of approximately 100 acres in predominantly urban areas (Beck et al., 2017). Outside of these areas, R-TELR (“regional TELR”) has been developed from the original swTELR framework for use over larger areas, calculated on 30-m pixels and aggregated to the scale of CalWater “Planning Watersheds” CalWater (v.2.2.1) (approximately 10,000 acres)

The primary modifications that have been made to apply swTELR at a regional scale application are:

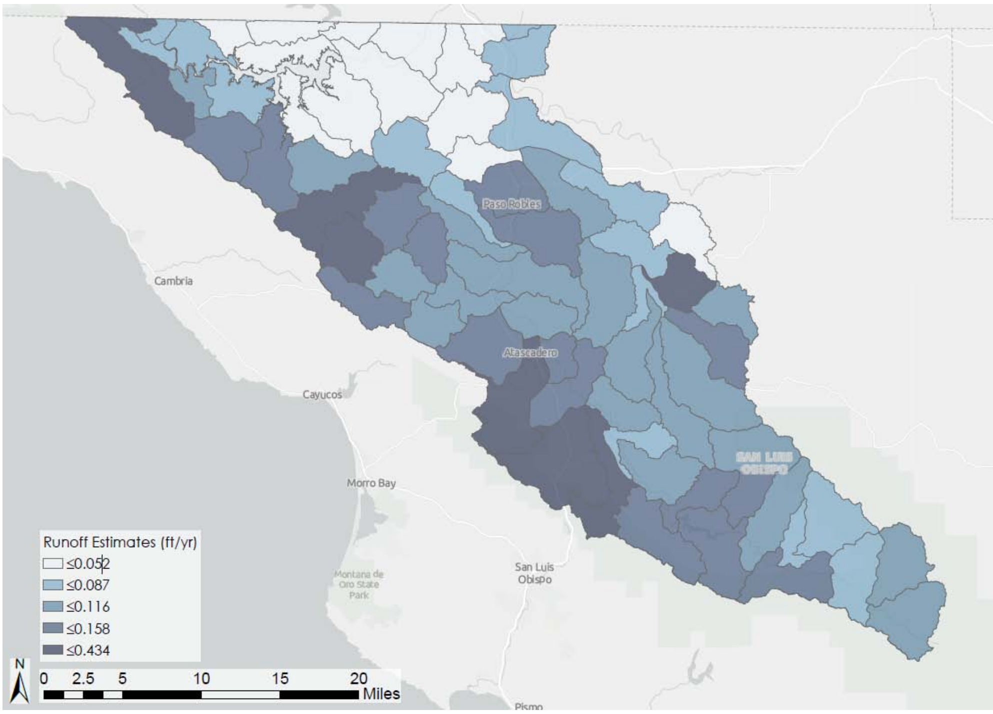
- Development of distributed rainfall inputs for the entire County

- Land-cover-based curve number specification in undeveloped areas
- Changes to runoff generation algorithms suitable for larger spatial scales
- Land-cover-based runoff concentrations suitable for larger spatial scales
- Incorporation of slope effects into the runoff and TSS loading calculations
- A simplified flow network to accommodate a more extensive drainage network

Examples of R-TELR outputs are shown below; additional discussion of the model architecture and approach are included in the Task 4.3 memo (April 30, 2018):



Spatially distributed average annual runoff throughout the County, expressed in acre-feet per year per 30-m pixel.



Runoff estimates from R-TELR aggregated to the Planning Watershed scale for the Salinas Watershed Group.

Metrics Used to Assess Stormwater Management Benefits: **FOCUS AREAS ONLY** (also needs to apply project-type-specific criteria for minimum parcel size, slope, etc.)				
BENEFIT	**METRIC**	METRIC VALUES (sum for total)	WG weightings (W+X+Y+Z sum to 100%)	Score (multiply columns)
Water Quality				
	Sensitive downstream receiving water (WMZ's 1, 2, 3, 5, 6, 8, or 9)	2/0		
	Specific TMDL or 303(d)-listed pollutants in downstream receiving water (including groundwater used for water supply)	2/0		
	Overlies infiltration-favorable WMZ (WMZ's 1, 2, 4, 5, 8)	1/0		
	TELR-predicted loading in catchment (scaled, minimum to maximum loading)	0→1		
		SUM (0→6)	W %	
Water Supply				
	Overlies infiltration-favorable WMZ (WMZ's 1, 2, 4, 5, 8)	2/0		
	In current supply-limited area (scaled, ground subsidence from 0 to maximum value)	0→3		
	In projected future supply-limited area (scaled, groundwater dependence index)	0→1		
		SUM (0→6)	X %	
Flood Management				
	Existing flooding and/or sedimentation risks to public property and/or human health and safety	4/0		
	TELR-predicted runoff in catchment (scaled, minimum to maximum runoff)	0→2		
		SUM (0→6)	Y %	
Environment				
	Number of at-risk aquatic animal species (from EnviroAtlas) (scaled, 0 to maximum value)	0→2		
	Length of identified critical steelhead habitat (scaled, 0 to maximum value, within catchment)	0→3		
	TELR-predicted runoff in catchment (scaled, minimum to maximum runoff)	0→1		
		SUM (0→6)	Z %	

TOTAL OF ALL BENEFIT SCORES:	

Non-Quantifiable Criteria:

	COMMUNITY	Provides habitat, urban greening, open space to DACs (State Board Priority)	Enhances/creates recreational and public use areas	Provides public education	Provides urban greening (aesthetic, shading, air quality, livability)	Provides community involvement
Project 1 (e.g., a green street)	●	X		X	X	X
Project 2 (e.g., a detention basin)	○					
Project 3 (e.g., Filterra installations)	○					
Project 4 (e.g., public education program)	⊙			X		

	PROJECT READINESS	Project site secured	Funding is leveraged	O&M funding secured (or not required)	Funding is committed	Benefits quantified
Project 1 (e.g., a green street)	○	X				
Project 2 (e.g., a detention basin)	●	X		X		X
Project 3 (e.g., Filterra installations)	●	X				X
Project 4 (e.g., public education program)	⊙			X		

	PROJECT VALUE AND PERFORMANCE	Projects located on public land (State Board Priority)	Cost <$50k or feasible w/o external funding	Supports regulatory compliance	Quantified reductions in pollutants or volume are significant	Efficient O&M (or none required)
Project 1 (e.g., a green street)	●	X		X		X
Project 2 (e.g., a detention basin)	●	X		X	X	X
Project 3 (e.g., Filterra installations)	●	X		X	X	X
Project 4 (e.g., public education program)	⊙			X		X

	ENVIRONMENT (non-water resource)	Offers climate change resiliency	Protects / increases native vegetation (TAC suggested)	GHG emission reduction	Provides a carbon sink	Reduces heat island effect
Project 1 (e.g., a green street)	●		X	X	X	X
Project 2 (e.g., a detention basin)	○					
Project 3 (e.g., Filterra installations)	○					
Project 4 (e.g., public education program)	○					

	COORDINATION & COLLABORATION	Meets multiple agency objectives	Supports regulatory compliance	Leverages funding	Supports a broader effort (e.g., creates a link in a contiguous wildlife corridor)	Identified in prior plan or planning process
Project 1 (e.g., a green street)	○					
Project 2 (e.g., a detention basin)	●	X				X
Project 3 (e.g., Filterra installations)	○			X		
Project 4 (e.g., public education program)	●	X		X	X	X

● more than 3 identified attributes, or all "primary" criteria met

⊙ 2-3 identified attributes

○ 0 or 1 identified attribute

"Primary" TAC-identified criteria

"Secondary" TAC-identified criteria

NOTES:
These non-quantifiable benefit categories as originally defined were compiled from those presented in other SWRP's reviewed during the preparation of this work (Ventura County, San Mateo County, San Diego County, Russian River). This list was presented to the TAC, who each identified those categories that they considered important criteria to consider. Those marked as "Primary" were so identified by 4 or more TAC members representing one of the 9 individual Watershed

APPENDIX A
Stormwater Management Strategies, Approaches, and Types

A. Stormwater Management Strategies

Early History of Stormwater Management

Stormwater management actions historically emphasized protection of public health, safety and property through stormwater flood control and, with the Clean Water Act in 1972, objectives to control point (e.g., wastewater treatment plant effluent) and nonpoint (e.g., municipal stormwater runoff) impacts to surface receiving waters (e.g., streams, rivers, lakes, wetlands, ocean). In this historical context, stormwater runoff was viewed as a waste product and the accepted management strategy was to essentially dispose of stormwater runoff by conveying it away from places of human habitat (e.g., businesses, roads, and residential areas). The conventional stormwater "toolbox" was primarily comprised of conveyance infrastructure, typically a system of curb, gutter and subsurface pipes that effectively routed stormwater runoff to a desired location such as a detention pond or direct discharge to a receiving water.

As awareness grew concerning the impacts of stormwater runoff to receiving waters, including runoff volumes/rates and pollutant delivery, regulatory requirements, primarily via the Municipal Stormwater National Pollutant Discharge Elimination System Permit Program (SW NPDES) required municipalities to implement a variety of water quality control actions to protect receiving waters that receive municipal stormwater runoff. Actions within the SW NPDES permits generally include a suite of good housekeeping practices (e.g., street sweeping, catch basin cleaning, public education, business inspections, illicit connection identification and removal) as well as post-construction requirements, triggered by certain new and redevelopment projects, that include site design and built facilities intended to mitigate any stormwater runoff impacts caused by the development.

Emerging Management Approaches

Low Impact Development

Low Impact Development (LID) principles and techniques emerged in the late 1990's as a design approach that mimicked natural hydrologic processes to better support watershed processes. LID principles and designs tend to limit the amount of impervious areas that generate runoff and for the runoff generated, the small storms (e.g., the 85th percentile, 24-hour storm event) are managed at the source (i.e. on-site) using designs that capture, hold, infiltrate and/or filter stormwater runoff. Designs such as bioretention, rain gardens, biofiltration, reduction of impervious surfaces and permeable pavements are all examples of LID. Because LID improves upon the conventional stormwater management toolbox, the California State Water Quality Control Board requires municipalities under the Phase I and II Municipal SW NPDES Permits to emphasize LID design as part of the Post-Construction Stormwater Quality Control requirements (i.e., PCRs for new and redevelopment).

Stormwater Capture and Use

The most recent evolution of the stormwater management strategies toolbox has been highly influenced by California's extended drought conditions and concerns regarding water supply, which have led to a reassessment of past stormwater management practices that viewed municipal stormwater runoff as a waste product and the awareness that stormwater is a valuable resource that can support water quality, flooding, water supply, natural resource and community objectives. Consequently, stormwater managers are now evaluating stormwater management strategies in the context of multi-benefit performance and implementation of projects that provide the highest value to the community and environment in a cost-effective manner. In 2017, the State Water Resources Control Board (SWRCB) put forward a White Paper concerning stormwater capture and use for multiple benefits ("Strategy to Optimize Resource Management of Stormwater, Projects 1a Promote Stormwater Capture and Use and 1b Identify and Eliminate Barriers to Stormwater Capture and Use. Product 1–Final Report: Enhancing Urban Runoff Capture and Use, April 10, 2017). In this paper, the SWRCB defined stormwater capture and use as "The intentional collection of urban runoff to augment surface water supplies, to recharge groundwater, or to support ecosystems." This definition recognizes both humans and other natural ecosystems as potential beneficiaries of stormwater management.

B. Current Approaches to Stormwater Management

The history and evolution of stormwater management continues to influence the array of policy, financial, regulatory, programmatic and capital project strategies that are used to manage stormwater. The subsections that follow provide an overview of the current stormwater management "toolbox" including:

- Baseline Stormwater Management Strategies (structural and non-structural as required by the SW NPDES Permit)
- Structural Stormwater Management Strategies
    - Benefits of Structural Stormwater Management Strategies
    - Stormwater Capture and Use Strategies
    - Top 10 Structural Stormwater Management Strategies for SLO County
- Programmatic Stormwater Control Strategies

Baseline Stormwater Management Strategies

The following is a brief list of the SCM's required by existing Phase II MS4 NPDES regulations in San Luis Obispo County:

New and Redevelopment (PCRs)
Education and Outreach
Public Involvement and Participation
Illicit Discharge id and elimination
Pollution Prevention / Good Housekeeping
SWPPPs for Pollution Hot Spots
Maintain MS4
Permittee O&M
Incorporate WQ and Habitat features into new and rehab flood management facilities
Landscape design
Construction Management and Inspections
Street Sweeping (?)
Trash Amendment
TMDL (various)

Structural Stormwater Management Strategies

Structural Stormwater Control Measures (SCM's) are constructed facilities that are implemented as part of new development or as retrofit within the existing urban landscape. Most stormwater structural projects implemented in California, including San Luis Obispo County, are the result of:

- State Water Quality Control Board Post-Construction Stormwater Control requirements (PCRs) for new and redevelopment.
- Local flood control requirements for new and redevelopment.
- Voluntary efforts to protect or enhance aquatic habitat through projects designed to improve ecosystem resiliency to stormwater runoff impacts via increased storage, improved in-channel or floodplain function, and restored/enhanced fluvial processes.
- Voluntary retrofit efforts, not required via local, state or federal law, intended to mitigate the water quality impacts of past, or legacy, practices. Retrofit projects fall into two categories based on their location in the urban landscape:
    - Retrofit of the existing urban land uses (e.g., street, parking lot, residential parcel). These projects may either be stand-alone (e.g., a rain garden integrated

into an existing commercial parking lot) or conducted as part of a more comprehensive capital project (e.g. bioretention facilities included as part of full street retrofit that also includes vehicle, transit, pedestrian and bike mobility objectives). These are typically implemented via grant funding or municipality capital program budgets.

- Retrofit of existing municipal stormwater infrastructure (e.g., basins, catch basins, drainage inlets, conveyance lines

New and redevelopment projects represent by far the vast majority of structural SCM's due to the PCRs and local flood control regulations. SCM's to meet these regulations tend to combine LID infrastructure to manage the small storms to support water quality and watershed processes with conventional infrastructure (e.g., detention, retention, infiltration basins) to manage large storms for flood control.

Types of SCM's

SCM's can be categorized by their placement in the landscape:

Parcel-based SCM's, sometimes referred to as decentralized SCM's, can be located on private or public parcels and typically manage runoff from the parcel only. They can be effective on a project-by-project basis, but cumulative benefit must be evaluated on a wider local or regional scale due to feasibility challenges associated with long-term O&M, site constraints, and performance.

Neighborhood (or Street-scale) SCM's tend to be scaled-up versions of the parcel-based SCM's, typically addressing stormwater runoff from adjacent properties and the street right-of-way. Ownership and maintenance responsibility is generally the responsibility of the municipality, although private entities such Homeowner Associations may agree to long-term operations and maintenance.

Regional SCM's, sometimes referred to as centralized SCM's manage stormwater from multiple blocks or many tens (or hundreds) of acres. Typically, these basins were designed for flood control (peak flow management). More recent designs may include water quality, groundwater supply and community benefits. Significant capture and use performance for irrigation and water supply are often best achieved with Regional SCM's. They are similarly best suited for creating public/wildlife open spaces such as wetlands, and/or for educational purposes.

Table 1 provides an overview of common SCM's and their associated functions.

Table 1. Structural SCM's and their primary management components. Adapted from SWQCB's Strategy to Optimize Resource Management of Stormwater, Projects 1a Promote Stormwater Capture and Use and 1b Identify and Eliminate Barriers to Stormwater Capture and Use. Product 1–Final Report: Enhancing Urban Runoff Capture and Use, April 10, 2017)

STORMWATER CONTROL MEASURE	**MANAGEMENT COMPONENT**					
	Treatment	**Shallow Infiltration / Evapotranspiration**	**Deep Infiltration**	**Direct Use**	**Open Storage**	**Enclosed Storage**
Parcel-Based						
Detention Vault / Cistern				X		X
Biofiltration or bioretention	X	X			X	
Infiltration Trench	X	X				X
Impervious Surface Reduction/Disconnection		X				
Soil Amendments	X					
Trees		X				
Permeable Pavement	X	X				
Neighborhood Scale (can include parcel-based SCM's)						
Settling Basin (chamber, forebay, etc.)	X					
Drywell	X		X			
Biofilter	X					
Trash Capture Devices	X					
Media Filters	X					

Subterranean Storage/Infiltration gallery	X	X				X
Regional (can include neighborhood-level SCM's)						
Basin (Retention, Infiltration)	X	X				
Basin (Retention, wet pond)	X				X	
Basin (Detention)					X	
Flow Bypass to Spreading Grounds	X	X		X		

Benefits of Structural Stormwater Management Strategies

Depending on their design, SCM's provide one or more stormwater management functions, which in turn, provide primary and ancillary benefits. Primary stormwater management benefits include water quality, water supply, flood management and environment. Examples of structural SCM's that support capture and use objectives include re-route of stormwater to a WWTP, agricultural field, high infiltration area to support drinking water supplies or use for passive/active recreation. Concerning environmental benefit, the SWRCB Stormwater Capture and Use White Paper states "capture and use can support ecosystem functions and help maintain and restore stream, wetland, and estuary habitats for species of management concern. The role of capture and use for ecosystem support is best achieved through a watershed approach that recognizes the importance of water and sediment movement, infiltration, and groundwater recharge and discharge for supporting ecosystem processes and habitat. The state legislature affirmed the importance of watersheds in providing clean water in AB 2480, which recognizes watersheds as part of the California water system. Post-construction standards in some regions also embrace the premise of preserving or restoring existing watershed processes (Central Coast Regional Water Board 2013)."

Criteria for Selecting Projects

Selection of projects for implementation should include evaluation of water quality, water supply, flood management and environmental as well as other community and ancillary benefits. Evaluation for project implementation may also include assessment of feasibility factors that indicate increased certainty for project success:

Primary Benefits:

- WATER QUALITY
- WATER SUPPLY
- FLOOD MANAGEMENT
- ENVIRONMENT

Ancillary Benefits:

- COMMUNITY Provides habitat, urban greening, open space disadvantaged communities (DACs), public education, enhances/creates recreational and public use areas, creates employment opportunities, provides urban greening (aesthetic, shading, air quality, livability)
- PROJECT READINESS Projects located on public land, design complete (concept, benefits quantified, permits, easements acquired, O&M funding secured
- PROJECT VALUE AND PERFORMANCE Supports regulatory compliance, quantified reductions in pollutants or volume are significant,
- ENVIRONMENT (non-water resource) GHG emission reduction, protects or increases native vegetation, provides a carbon sink, reduces heat island effect\
- COORDINATION & COLLABORATION Leverages funding, supports a broader effort (e.g., creates a link in a contiguous wildlife corridor), meets multiple agency objectives, identified in prior plan or planning process

Highly Effective Structural Control Strategies for Municipal Stormwater Runoff Management (San Luis Obispo County)

The most cost-effective techniques will tend to be those that work in the realm of existing stormwater infrastructure within the urban landscape, because stormwater is already being “captured” via curb/gutter and routed to conventional infrastructure (e.g., subsurface stormwater conveyance lines, basins). Stormwater capture and management along rural roads, for example, can be very challenging due to the dispersed nature of flows and the challenges presented with routing stormwater runoff into/out of SCM facilities. Additionally, SCM’s that address runoff that is already being managed (e.g., roof runoff currently routed to a landscaped area) are ineffective investments.

The combination of significant area of impervious surfaces and their direct connectivity to a receiving water often creates the worst-case scenario for adverse impact (e.g., TELR predicts the high priority catchments for pollutant and stormwater volume loads based on the amount of impervious surfaces and the connectivity to the receiving water as a primary predictor). This combination tends to occur in municipal areas with existing stormwater infrastructure and routing to a receiving water such as a lake, stream, river, ocean. While basins may exist within this infrastructure to manage peak flows, small flows, typically represent the majority of average annual volume and pollutants, are not typically managed (e.g., by-passed).

The following "Top 10" structural stormwater control measures for SLO County (Table 2) take into account the limitations and opportunities of the urban landscape and include the following strategies:

Strategy A: Leverage existing stormwater conveyance and flood control infrastructure system for cost-effective performance and benefits.

Strategy B: Remove or disconnect the source of runoff generation.

Category C: Mitigate riparian and surface water habitat to increase ecosystem resiliency.

Category D: Flow-bypass for capture and direct and/or indirect use

Table 2. The top stormwater management strategies for SLO County

SCM	Description and Applicability	Pros/Cons	Applicable TAC Areas
Strategy A: **Leverage existing stormwater conveyance and flood control infrastructure system for cost-effective benefits**			
1. Green Streets	Where existing curb gutter or similar provides ability to directly route stormwater into areas within the street ROW. Existing landscape strips can generally be retrofit and/or extension as feasible with available street width, parking needs etc. Right-of-Way width needs to be sufficient to locate SCM's and meet other street uses. Collector and Light Arterial streets are most effective.	Pros: provides several multi-benefits; ability to leverage with transportation funding; often consistent with General/Specific or revitalization plans; bioretention/biofiltration emphasized in the Phase II Permit. Cons: can be expensive per square foot for construction, ability to maintain in the long-term may be difficult unless municipalities willing to take on O&M for street ROW vegetation.	Limited for most of the County with some opportunities in downtown Atascadero (e.g., El Camino Real), Arroyo Grande (South Halycon Road) Baywood Park (2nd Street), San Luis Obispo (Slack Street). Paso Robles tends to have more green street opportunities due a combination of sufficient street width and existing curb/gutter routing.
2. Dry well retrofit into existing stormwater conveyance system.	Where there is an existing system of curb/gutter/DI/subsurface stormwater pipe a pre-sedimentation chamber and vertical or horizontal dry well can provide	Pros: Cost-effective. Uses existing SW infrastructure. Vactor O&M familiar to municipalities. Cons: Little to no community benefits (e.g.,	Any streets with existing curb/gutter, DI. Arterials or Collector streets probably best in terms of inventory, maintenance, etc.

	WQ treatment and infiltration.	urban greening, aesthetics). Requires geology, soils, and GW depth conditions conducive to dry wells.	
3. Centralized basin retrofit	Most detention basins are lined and/or use orifice sizing that allows small-flow bypass. Retrofit with dry wells provides increased treatment and infiltration. a key recommendation from the SWCQB is to "Evaluate the regional and statewide opportunity to retrofit conventional detention basins to enhance capture and use. The number, location, and volume of stormwater/flood control basins are a prime opportunity for significant benefit." Publicly owned basins the best due to access, maintenance, etc. Next would be sub-division	Pros: Cost-effective. Taps into existing SW infrastructure. Basin can be retrofit to provide additional environmental and community benefits. Cons: Must be designed to maintain flood control capacity. As a centralized SCM, fewer ancillary benefits (community, habitat).	Any municipal owned detention basin.

	basins, which tend to manage a very large DMA and retrofit could be cost-effective.		
4. Biofiltration facilities	Where flow-through treatment is provided via off-the-shelf infrastructure (e.g., Filterra) or biofiltration designs. Best where infiltration benefits are infeasible or not needed (e.g., ocean discharges)	Pros: are generally smaller in footprint than bioretention type facilities so are easier to locate on parcels and street. Can provide community benefits such as urban greening. Cons: must have some kind of pre-sediment management as these facilities can clog easily.	Public streets and parcels within WMZs where retention not a priority. Example coastal Morro Bay.
5. Trash Racks	Most cost-effective manner to meet Trash amendment requirements. Placed at DI's and/or basins. Best located where outfalls to receiving water (creek)		
Strategy B: **Remove or disconnect the source of runoff generation**			
6. Remove Impervious Surface and Soil Amend.	Identify unused impervious surfaces that can be removed with no adverse impacts. Amend soil to improve natural watershed	Pros: Cost-effective. Not "engineered". Can potentially remove significant impervious surfaces and restore watershed	Where impervious area runoff is currently directly routed to the receiving water.

	processes. Amenable to programmatic efforts (e.g., owner incentives)	processes. Cons: “Extra” impervious surface usually private parcels and associated coordinating and willingness on the part of the owner. Once impervious surface removed, and soil amend, need to maintain any new vegetation	
7. Disconnect impervious surface runoff	Disconnect routing from receiving water in ways that support Watershed Processes and/or capture and use. Small projects can be implemented via a programmatic effort.	Pros: Can be small, decentralized or large, centralized facilities depending on objectives. Cons: Centralized facilities require available land where stormwater runoff can be directed. Need lots of small decentralized to make a difference.	Where adequate infiltration rates. Available land. For example, Los Osos and Oceano.
Category C: **Mitigate Riparian and Surface Water Habitat to Increase Ecosystem Resiliency**			
8. Reestablish Riparian / Floodplain Processes			
9. In-stream modification			
Category D:			

Flow-bypass to Capture and Use (Direct and Indirect)			
10.	Does not have widespread applicability in SLO County. Primarily because the amount of impervious surface and associated runoff in the Central Coast is not on par with larger metropolitan areas so therefore, the opportunities in SLO County for more significant sized capture and use is more limited.		

Non-Structural Stormwater Management Strategies

Non-structural stormwater management practices include an array of local policies, regulations, and programmatic efforts that are intended to support water quality and flood control objectives. Most for example, some municipal policies and regulations may not be the actual structural SCM's but do influence what those SCM's look like; how they perform; how they integrate with other municipal objectives.

Local Regulations, Policies, Partnerships and Incentives:

- Flood management requirements for new and redevelopment
- Codes/ordinances that support multi-benefit stormwater SCM's (e.g., landscape and LID requirements can be met in the same landscaped area)
- Funding incentives to support stormwater management objectives

Community Engagement:

- Outreach/Education
- Stewardship
- Volunteer efforts

Technical Growth and Capacity:

- Training
- Targeted outreach
- Monitoring and performance