APPENDIX B

Advancing Regional-Scale Stormwater Management in San Mateo County: Business Case Technical Memorandum

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FINAL Memorandum

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1. INTRODUCTION

Geosyntec Consultants, Inc. (Geosyntec) is assisting the City/County Association of Governments of San Mateo County (C/CAG) with a project focusing on advancing regional stormwater capture projects in San Mateo County (County) through a regionally collaborative approach (the Project). An overview of the Project objectives was provided in the *Advancing Regional Stormwater Capture Projects: Drivers and Objectives Report* (Drivers and Objectives Report) (C/CAG, 2021a). The Drivers and Objectives Report described what could be addressed and achieved through regional-scale stormwater management (i.e., key objectives associated with identified drivers).

This memorandum describes the Business Case for regional collaboration. The Business Case provides a planning level cost-benefit analysis and qualitative assessment to demonstrate why a regional-scale stormwater management approach may provide cost efficiencies and added benefits to jurisdictions collaborating regionally to meet regulatory requirements for stormwater quality and to achieve other regional benefits. This memorandum is organized as follows:

- Section 2 provides an overview of the approach used to conduct the Business Case and a summary of the regional stormwater capture projects, including those previously identified in other efforts and additional potential opportunities, which are referenced in this comparative Business Case analysis.
- Section 3 presents the Business Case comparison by objective between a jurisdiction-by-jurisdiction approach and regional collaborative approach.
- Section 4 provides the Business Case summary.

2. BUSINESS CASE APPROACH

2.1 Drivers and Objectives

The Drivers and Objectives Report describes the key Project drivers, defined as the fundamental issues that provide impetus for managing stormwater on a regional scale, and objectives, defined as the desired outcomes from addressing the identified stormwater management drivers on a regional scale (C/CAG, 2021a). A summary of the identified drivers and objectives and how they interact is provided in Figure 1.

Figure 1: Drivers and Objectives

2.2 Analyses Methodology

Analyses have been conducted to compare metrics and other evaluation factors for two stormwater capture project implementation "scenarios:"

1. Scenario 1: Jurisdiction-by-Jurisdiction scenario under which stormwater management is addressed through jurisdiction-specific approaches.
2. Scenario 2: Regional Collaborative scenario under which regional-scale stormwater management is optimized to achieve identified drivers and objectives.

The Jurisdiction-by-Jurisdiction scenario is represented by existing studies and plans, including the *Countywide Reasonable Assurance Analysis* (Countywide RAA) (San Mateo County Water Pollution Prevention Program [SMCWPPP], 2020a) and the *Sustainable Streets Master Plan* (SSMP; C/CAG, 2021b), available *Storm Drain Master Plan* (SDMP) and *Green Infrastructure Plan* (GI Plan) information, and the Bay Area Water Supply and Conservation Agency (BAWSCA) *Long-Term Reliable Water Supply Strategy* (BAWSCA, 2015). The Regional Collaborative scenario was examined using outputs from analyses conducted for the Project by Craftwater Engineering (Craftwater), which has evaluated opportunities for regional stormwater capture projects countywide, building from the regional capture project identification and multi-benefit metrics-based analysis conducted as part of the San Mateo County *Stormwater Resource Plan* (SRP; SMCWPPP, 2017).

2.3 Objective-Based Metrics and Evaluation Factors

The metrics, or evaluation factors, that have been used to compare the benefits associated with each scenario for the identified objectives are provided in Table 1. Given the retrospective nature of the use of prior analyses and plans, not all objectives under the "Jurisdiction-by-Jurisdiction" scenario have corresponding metrics to those developed through new modeling results for the Regional Collaborative scenario.

Table 1: Metrics Corresponding with Identified Project Objectives

Objective	Jurisdiction-by-Jurisdiction Scenario		Regional Collaborative Scenario
	Proposed Metrics/Evaluation Factors	**Source**	**Proposed Metrics/Evaluation Factors** (*all developed through the Project*)
More Efficiently Use **Limited Resources**	• Costs (Capital and O&M)	• See Attachment A • Countywide RAA	• Costs (Capital and O&M)
Support Improvements to Alleviate Strain on **Existing Stormwater Infrastructure**	• SDMP upgrades to address localized flooding (qualitative evaluation)	• C/CAG Member Agencies SDMPs	• Peak flow reduction • Flood event management
Cost Effectively Comply with **Water Quality** Regulatory Requirements	• PCBs load reduction • Acres "greened" or treated • Volume Managed	• Countywide RAA • C/CAG Member Agency GI Plans	• PCBs load reduction • Acres "greened" or treated • Volume managed
Supplement County **Water Supply** Portfolio with Stormwater, Where Feasible	• Estimated stormwater capture through rainwater harvesting programs	• BAWSCA Long-Term Reliable Water Supply Strategy	• Volume recharged (where feasible) and reclaimed and associated cost benefit
Consider and, Where Appropriate, Design for Projected Future Impacts Resulting from **Climate Change**	• Green Stormwater Infrastructure Climate Change Offset per the Sustainable Streets Master Plan (C/CAG, 2021)	• SSMP	• Regional capture projects needed to achieve volume managed by green streets modeled for Sustainable Streets Master Plan (C/CAG, 2021)
Consider Local **Community Benefits** and Concerns in Project Implementation	• Qualitative Evaluation	• --	• Parks and public facilities identified as potential regional capture project location
Site and Design Projects to **Equitably** Serve and Protect Communities	• Qualitative Evaluation	• --	• Quantify number of potential projects located in DACs
Maximize **Other Benefits**, Where Possible	• Qualitative Evaluation	• --	• Qualitative Evaluation

Notes: DACs = Disadvantaged Communities; O&M = operations and maintenance; PCBs = polychlorinated biphenyls

2.4 Acres Greened

This Business Case examines the benefits of stormwater capture projects for a number of different metrics. Acres greened was used as the base metric for analyses relating to water quality cost-benefit. For this Business Case, acres greened are produced from stormwater capture facilities that meet the requirements of MRP Provision C.3.c (Low Impact Development), which requires that Regulated Projects "*treat 100% of the amount of runoff identified in Provision C.3.d in LID treatment measures,*" defined per C.3.c.(2)(c)(i) as "*harvesting and use, infiltration, evapotranspiration, and biotreatment.*" These types of facilities are also referred to as green stormwater infrastructure (GSI) in this Business Case.

MRP Provision C.3.d provides numeric volume and flow-based sizing criteria for stormwater treatment systems. The allowable sizing standard assumed for this Business Case analysis is the "*Combination Flow and Volume Design Basis*" defined per C.3.d.i.(3) as "*treatment systems that use a combination of flow and volume capacity shall be sized to treat at least 80 percent of the total runoff over the life of the project, using local rainfall data.*" The MRP Tentative Order also requires that GSI built to meet permittee numeric retrofit requirements of Provision C.3.j shall comply with Provision C.3.c and Provision C.3.d.

GSI includes infiltration, capture and use, biofiltration/biotreatment (through a non-proprietary biofilter), and diversion to sanitary sewer (for treatment and reuse). Other stormwater quality treatment measures that do not currently meet the MRP Provision C.3.c definition include large detention facilities that do not infiltrate, non-vegetated media filters, proprietary biotreatment facilities, and full trash capture devices. Notably, some locations in California allow for proprietary biofilters to be considered GSI; for example, the Los Angeles Regional Water Quality Control Board has issued approvals of proprietary biofilters under their Alternative Biofiltration Specification (LARWQCB, 2021).

These facilities that do not meet the MRP Provision C.3.c definition provide substantial other water quality benefits, including reduction of trash (required per Provision C.10 of the MRP), sediment, and other pollutants, and can provide additional multiple benefits when included in a treatment train. They can be used to meet load reductions for PCBs and mercury Total Maximum Daily Loads (TMDLs) for the San Francisco Bay, detain flood flows, and provide additional community amenities. It may be possible to demonstrate that these facilities can provide equivalent water quality and other benefits to the MRP Provision C.3.c defined facilities types when implemented at a regional scale with specific design parameters.

2.5 Prioritized Regional Stormwater Capture Project Opportunities

Craftwater conducted a regional stormwater facility identification and cost optimization exercise to identify facilities that could provide benefits in line with the objectives. As a result of their analysis, 74 potential regional facility locations and the associated proposed facility types were identified. It was assumed that regional stormwater capture projects analyzed by Craftwater would be designed to meet MRP Provision C.3.c standards or equivalent standards negotiated with the SFBRWQCB such that they would provide acres greened for the portion of average annual runoff captured. The regional stormwater capture project opportunities were modeled by Craftwater to estimate for each facility (per Craftwater, 2021b):

1. A cost-optimized storage volume.
2. Resulting average annual volume managed (i.e., captured).
3. Total PCBs load reduced annually.
4. "Acres greened," calculated as the percent of the average annual runoff volume captured by the facility, multiplied by the tributary impervious drainage area.[1]
5. Peak flow reduction and volume capture for the 10-year, 24-hour event.
6. Potential water supply benefit, based on infiltration feasibility (100% of captured volume assumed to be available as water supply) or potential to divert to the sanitary sewer for treatment at a publicly owned treatment works (POTW) recycled water facility for reuse (33% of captured volume assumed to be available as water supply).
7. Planning level cost estimates.
8. Potential aggregate area of medium, high, or very high trash generation areas in project drainage area and aggregate area of Caltrans area in project drainage area.

Additional details regarding Craftwater's methods and results are provided in the County of San Mateo Advancing Regional Stormwater Capture Projects Project Opportunities Analysis Memo (Craftwater, 2021b). The results of Craftwater's analysis were transmitted to Geosyntec through delivery of spreadsheets and other data (Craftwater, 2021a). These results were used to define the Regional Collaborative scenario for the Business Case and are referenced as such in Section 3. These results are considered generally representative of the Regional Collaborative scenario but are still preliminary. Further refinement of the identified regional stormwater capture project opportunities is ongoing, and additional, more detailed modeling, will be conducted for those projects that are ultimately recommended through the evaluation process.

2.6 Regional Stormwater Capture Project Case Studies

Regional stormwater capture projects within San Mateo County identified in the SRP and subsequent efforts are currently in varying stages of implementation. Studies and designs for these regional stormwater capture projects (which are currently in varying stages ranging from concept to final design) are referenced in this Business Case as additional inputs for the analysis.

[1] For this memorandum, this calculation is how "acres greened" are assumed for regional stormwater capture projects achieving less than 80% capture. For individual facilities, the calculation of "acres greened" may require further discussion with the SFBRWQCB and/or additional hydrologic and water quality modeling in later stages of design to demonstrate equivalency. This also assumes that these projects provide Provision C.3.c compliant treatment or are otherwise accepted as compliant with Provision C.3.c by the SFBRWQCB.

This section describes those regional stormwater capture projects and the output of analyses completed thus far.

Three regional stormwater capture projects were identified in the San Mateo County *Stormwater Resource Plan* (SRP; SMCWPPP, 2017). Of these, Orange Memorial Park in South San Francisco is moving forward to construction and is summarized herein. The other two regional stormwater capture projects are not included in this Business Case. One opportunity (Holbrook-Palmer Park in Atherton) has since been determined not to be feasible, and the concept for the other project (Twin Pines Park, Belmont) has changed substantially from the SRP. Since the SRP, two additional regional stormwater capture project concepts were identified and are also moving forward into design and construction phases; these two projects are included in this Business Case. The three projects summarized include:

- **Orange Memorial Park, South San Francisco** – This project, currently under construction, will divert flow from Colma Creek for treatment, beneficial reuse, and local flood reduction. The project includes a large grit/trash removal chamber, a cistern accompanied by an advanced filtration and disinfection system, and infiltration gallery (City of South San Francisco and Lotus Water, 2021).
- **Red Morton Park, Redwood City** – The project, currently in design, would divert runoff from the existing adjacent reinforced concrete box (Jefferson Branch Drain) to a subsurface storage facility located within Red Morton Park. The project is proposed to include some non-potable reuse and flow-through water quality treatment (City of Redwood City, 2021).
- **Caltrans Right-of-Way at I-280 and I-380 Interchange** – The project, currently in preliminary design, is proposed to include a subsurface infiltration gallery located in Caltrans right-of-way at the I-280 and I-380 interchange in San Bruno (SMCWPPP, 2020a).

A summary of the three regional stormwater capture projects is provided in Table 2, including: the total tributary drainage area and impervious portion of the drainage area; the storage volume; the facility cost; and the source of information for the facility. A summary of the potential benefits achieved through the projects, as provided in existing reports and documents, is included in Table 3. Table 3 includes: the facility volume managed; the percent capture; the "equivalent" drainage area (i.e., portion of the total drainage area multiplied by the facility percent capture) and equivalent impervious drainage area; the estimated annual PCBs load reduced; the "acres greened" (i.e., portion of drainage area assumed treated by GSI-equivalent treatment); and the estimated annual water supply benefit provided.

Similar to the prioritized regional stormwater capture projects, when capture is less than 80% average annual runoff volume, equivalent acres greened were calculated as the percent capture of the average annual runoff volume by C.3.c compliant treatment measures (or others deemed equivalent per the SFBRWQCB) multiplied by the impervious drainage area.

Table 2: Summary of Previously Identified Regional Projects at Varying Stages of Implementation in San Mateo County

Regional Project	Implementation Stage	Total Tributary Drainage Area (acres)	Total Impervious Tributary Drainage Area (acres)	Total Tributary Average Annual Runoff (ac-ft/yr)	Design Alternative	Storage Volume (ac-ft)	Estimated Capital Cost	Estimated O&M Cost	Source
Orange Memorial Park, South San Francisco	Under Construction	6,577	2,565	4,000	n/a	0.6 (cistern) 4.9 (infiltration gallery)	$15.5 million	$500,000 for first year[1]	City of South San Francisco and Lotus Water (2021)
Red Morton Park, Redwood City[2]	Preliminary Design Alternatives	1,682	409	529	Project Alternative 1 - 85th Percentile Alternative	9.5	$12.2 to $14.9 million[3]	$151,670 per year	City of Redwood City (2021)
					Project Alternative 2 - Single Field Maximization	23.5	$28.2 to $31.5 million[3]		
Caltrans I-280 @ I-380, San Bruno	Concept Design	942	254	n/a	n/a	21	$19.6 million	n/a	SMCWPPP (2020a)

[1] Obtained per e-mail communication with South San Francisco (2021).
[2] A third option is being considered that would include 30 acre-feet of storage and cost $35.6 to $38.9 million. This option entails a two-phase approach that would extend the project footprint of Project Alternative 1 or 2 to include another facility under an adjacent field.
[3] Cost estimate range for gravity diversion and pump diversion, respectively.
ac-ft/yr = acre-feet per year
ac-ft = acre-feet

Table 3: Identified San Mateo County Regional Projects – Benefits Estimated

Regional Project	Design Alternative	Volume Managed (GSI and non-GSI) (ac-ft/yr)	Equivalent Impervious Tributary Drainage Area (GSI and non-GSI) (acres)	Estimated PCBs Load Reduction (g/year)	Percent Average Annual Runoff Captured Through GSI Equivalent Treatment	Acres Greened (acres)	Cost per Acre Greened ($/acre)	Water Supply (ac-ft/yr)	Source
Orange Memorial Park, South San Francisco	n/a	640	969	10	7%	424[1]	$37,000	240 (groundwater recharge) + 40 (irrigation)	City of South San Francisco and Lotus Water (2021)
Red Morton Park, Redwood City	Project Alternative 1 - 85th Percentile Alternative	310	240	6.2	59%	140[2]	$106,000[2]	11.6	City of Redwood City (2021)
	Project Alternative 2 - Single Field Maximization	374	289	7.8	71%	204[2]	$154,000[2]	11.6	
Caltrans I-280 @ I-380, San Bruno[3]	n/a	226	254	8	100%	254	$77,000	Potential to irrigate adjacent parks and cemetery. Infiltration feasibility to be determined.	SMCWPPP (2020a)

[1] Acres greened calculated for Orange Memorial Park was based on assumption that 44% of the equivalent impervious tributary drainage (969 acres, provided by City of South San Francisco and Lotus Water, 2021) was treated with GSI-equivalent facilities (i.e., 16% watershed runoff diverted in total, 7% of watershed runoff treated through GSI-equivalent treatment).
[2] Acres greened and unit cost assumes that the Red Morton Park project design will be considered compliant with Provision C.3.c by the SFBRWQCB.
[3] The Caltrans I-280 @ I-380 project was assumed to provide 80% capture (i.e., capture of the 85th percentile, 24-hour storm event) through infiltration.
g/year = grams per year

3. BUSINESS CASE COMPARISON BY OBJECTIVE

This section provides the details of the Business Case. Metrics corresponding with objectives are compared for the Jurisdiction-by-Jurisdiction scenario and the Regional Collaborative scenario. The input for the Jurisdiction-by-Jurisdiction scenario has been compiled from various existing reports and resources, cited herein. The information for the Regional Collaborative scenario has been compiled from the identified San Mateo County regional projects (Table 2 and Table 3) and the results from the regional stormwater capture project opportunities modeling conducted by Craftwater.

3.1 More Efficiently Use Limited Resources

A key challenge for C/CAG member agencies is limited resources, specifically dedicated funding, for storm drain infrastructure and stormwater quality needs. Efficient use of limited resources can make the dollars that are available go farther. One way to use resources efficiently is to construct facilities that achieve multiple objectives and cost less than other options. To examine this, costs used for this Business Case analysis have been compiled from existing and new sources. These include cost estimates included in the *PCBs and Mercury Total Maximum Daily Load (TMDL) Control Measure Implementation Plan and RAA for San Mateo County* (TMDL Control Measure Plan; SMCWPPP, 2020b); statistical analyses of available GSI cost data conducted by Geosyntec in 2018 to examine costs of GSI at varying scales and additional data points from Southern California (Geosyntec, 2018); estimated costs for identified San Mateo County regional projects at varying stages of implementation (Table 2); San Mateo County Integrated Safe Routes to School and Green Infrastructure Project costs (C/CAG, 2021c); and the regional stormwater capture project opportunities planning level cost output (Craftwater, 2021a). A summary of the costs from each of these sources is provided in Attachment A. The capital and operations and maintenance (O&M) cost estimates used in this Business Case are summarized in the following sections.

3.1.1 Capital Costs Used in Analysis

The costs used in the analysis and the justification for using these costs are provided in Table 4 and discussed below.

Table 4: Unit Capital Costs Assumed for Business Case

Facility Type	Cost or Range	Unit	Sources
Parcel-based or "Other GSI"	$165,000	Cost per acre greened	TMDL Control Measure Plan, escalated to 2021 dollars
Green Streets	$230,000 - $301,000	Cost per acre greened[1]	TMDL Control Measure Plan, escalated to 2021 dollars, San Mateo County Integrating Safe Routes to School, and Green Infrastructure Project costs
Regional Projects	$37,000 - $154,000	Cost per acre greened	Most Recent San Mateo County Regional Project Information, see Table 3
	Average $69,000	Cost per acre greened	Craftwater Analysis (see Attachment A of this memo)

[1] Included as "cost per acre treated" in the TMDL Control Measure Plan. This is assumed treated per the MRP Volume Hydraulic Design Basis or Flow Hydraulic Design Basis and therefore equivalent to "cost per acre greened" for the purposes of this Business Case.

- **Parcel-based or "Other GSI"** – when parcel-based or "Other GSI" costs are identified, the parcel-based average cost per treated acre identified in the TMDL Control Measure Plan, escalated to 2021 dollars, is used for consistency with that Plan (see Attachment A). This is applied as cost per acre greened in this analysis.
- **Green Streets** – Local San Mateo County Integrated Safe Routes to School and Green Infrastructure Project cost data (average of $301,000 per impervious acre treated) is reflective of current implementation costs (a summary of this data is provided in Attachment A). However, a cost range is provided to allow for the potential for cost efficiencies over time and for consistency with the cost identified in the TMDL Control Measure Plan, escalated to 2021 dollars (see Attachment A). This is applied as cost per acre greened in this analysis.
- **Regional Projects** – Regional project costs used in the Business Case are those estimated by the regional stormwater capture project opportunities analysis where those potential facilities are referenced; or the estimated costs of San Mateo County regional projects, where those identified facilities are referenced, scaled based on the benefit provided. See Attachment A for a statistical summary of Craftwater model-estimated optimized regional project costs; the average cost per acre greened is provided in Table 4 for reference. Estimated costs associated with San Mateo Regional Projects moving forward in design and construction are summarized in Table 2.

Comparing the optimized regional project cost (an average of $69,000 per acre greened) to costs associated with parcel-based facilities and green streets projects, regional projects are generally significantly less expensive to implement on a per acre greened basis. As shown in Table 4, the cost per acre greened or regional projects is approximately 40% of the cost of parcel-based facilities and approximately 25% to 30% of the unit cost of green street projects.

3.1.2 Operations and Maintenance Costs

In addition to capital costs savings, O&M cost savings should also be realized through the use of regional projects. O&M costs used in this Business Case are summarized in Table 5. Estimated O&M costs for the identified San Mateo County regional projects are included in Table 2. Although regional projects can have greater facility-specific O&M costs, cumulative O&M costs on a countywide scale should be less because fewer projects would be implemented for the same overall benefit. Regional collaboration approaches would allow for pooling of maintenance funds for regional facilities to allow for additional efficiencies and consistency (also see Section 4.1).

TMDL Control Measure Plan Costs

The TMDL Control Measure Plan referenced Geosyntec's 2018 suggested O&M cost of approximately 4% of the capital cost of these facilities on an annual basis (SMCWPPP, 2017). The resulting annual O&M costs used in the TMDL Control Measure Plan are summarized in Table 5 and have been escalated to 2021 costs.

Table 5: TMDL Control Measure Referenced O&M Costs

Control Measure	2021 Dollars	Units	Source
GI - Private/Parcel-based Redevelopment	$6,610	$ per acre greened per year	Geosyntec 2018
GI - Public Right of Way Retrofits (Green Streets)	$9,200	$ per acre greened per year	Geosyntec 2018
GI - Regional Projects	$4,360	$ per acre greened per year	Geosyntec 2018

The 4% of capital costs value assumption for O&M is consistent with the assumed O&M for the Orange Memorial Park project, which is estimated to have a first year O&M cost of $500,000 (City of South San Francisco, 2021) or a little more than 3% of capital costs. The Red Morton Park Preliminary Design Report indicates an O&M cost of $151,670 per year, which is approximately 1% or less of the capital costs, depending on design alternative (City of Redwood City. 2021).

3.2 Support Improvements to Alleviate Strain on Existing Stormwater Infrastructure

As summarized in the Drivers and Objectives Report, storm drain infrastructure improvements costing hundreds of millions of dollars have been identified as needed to alleviate flooding and capacity issues with existing storm drains. The following table summarizes the costs identified in available plans for necessary infrastructure improvements, broken down by high, medium, and low priority projects, where available, along with dedicated stormwater fee revenue, if any[2].

Table 6: Summary of Storm Drain Master Plan Costs and Dedicated Revenue

	Date of Study	Storm Drain Master Plan Cost (total) [1,2]	High Priority Projects[1,2]	Med Priority Projects[1,2]	Low Priority Projects[1,2]	Dedicated Annual Revenue[1]
Atherton	2015	$45	$18	$24	$3	$0.000
Belmont	2009	$57	$13	$13	$31	$0.300
Brisbane	2003	$20	$15	$3	$2	$0.055
Burlingame	2009	$39	$20	$10	$9	$1.500
East Palo Alto	2014	$39	$31	$5	$3	$0.125
Hillsborough	2015	$58	$26	$14	$18	$0.030
Menlo Park	2003	$39	$23	$16		$0.335
Millbrae	2018	$42	$3	$30	$9	$0.240
Pacifica	2012	$11	$9	$2		$0.178
San Bruno	2014	$26	$19		$7	$0.575
San Carlos	2017	$56	$43	$13		$0.435
San Mateo (City)	2004	$57	$33	$16	$8	$0.000
South San Francisco	2016	$54	$23	$27	$4	$0.425
Total		**$543**	**$276**	**$173**	**$94**	**$4**

[1] All values in $ millions.
[2] Values are reflective of individual Storm Drain Master Plan year.

Multi-benefit regional stormwater capture projects can be designed with adaptive diversion intakes to capture portions of smaller flood events, including the shaving of peak flows if capacity is available. When these regional projects are upstream of needed storm drain improvements, such as those identified in SDMPs across the County, they may be able to reduce the investment needed for downstream infrastructure improvements. Many of the identified regional capture projects are estimated to provide some level of peak flow reduction and volume capture for the 10-year, 24-hour flood event (Craftwater, 2021a).

All 74 regional stormwater capture project opportunities are estimated to manage runoff during the 10-year, 24-hour storm event. Per Craftwater (2021a), the regional stormwater capture projects are estimated to manage between 3% and 100% of the 10-year, 24-hour storm event. In addition, 39 of the regional stormwater capture project opportunities are estimated to reduce 10-

[2] Many of these master plans were completed five or more years ago, and listed costs are not escalated to current dollars. In addition, many member agencies do not have storm drain master plans, or they were not available for review for the purposes of this report.

year, 24-hour peak flows, with reductions ranging from 0.03 to 58.5 cubic feet per second (cfs), managing <1% to 68% of the peak flow.[3] The large range is reflective of the relationship between the drainage area and the available area for the facility footprint. Facility footprints were cost-optimized per Craftwater's analysis and can achieve less peak flow reduction when they are smaller in comparison to the tributary drainage area. Facilities that can manage a significant portion of 10-year, 24-hour peak flow could alleviate some downstream flooding during these storm events.

The cost offset of this benefit cannot be quantified for the regional stormwater capture project opportunities, as the flood management benefits would be modeled individually for each project during their respective design phases, and the resulting downstream storm drain benefits identified at that time. However, flood flow management could be considered an additional benefit on top of the other benefits achieved through the implementation cost of the facility (i.e., pollutant load reduction, acres greened, and water supply). As described in the following section, the estimated benefits of the Regional Stormwater Capture Project at I-280/I-380 demonstrate how these cost offsets could be realized.

3.2.1 Regional Project Case Study

One example of an identified San Mateo regional project that is anticipated to provide SDMP cost offset is the Regional Stormwater Capture Project at I-280/I-380, located in the City of San Bruno. In the San Bruno SDMP (City of San Bruno, 2014), the City of San Bruno identified two potential improvements to alleviate flooding along 7th Avenue: a detention basin in Crestmoor Canyon costing an estimated $2.9 million or approximately one mile of storm drain improvements downstream of Crestmoor Canyon in the vicinity of I-380 between I-280 and CA-82 (El Camino Real), entailing upgrades of undersized pipes in the area. The estimated cost of the storm drain improvements was $10.9 million in 2014 dollars (City of San Bruno, 2014). Preliminarily, it is thought that the regional stormwater capture project, just downstream of Crestmoor Canyon, in addition to providing other water quality and possible water supply benefits, could provide some upstream detention to reduce some of the downstream impacts.

3.3 Cost Effectively Comply with Water Quality Regulatory Requirements

As described in the Drivers and Objectives Report, C/CAG member agencies are subject to the MRP as well as TMDLs for PCBs and mercury for the San Francisco Bay (Bay), for Bay-draining jurisdictions; and sediment and bacteria for certain Pacific Ocean-draining creeks and adjacent lagoons and beaches. There is also a Diazinon and Pesticide-Related Toxicity TMDL for San Francisco Bay Urban Creeks, however, this is primarily addressed through outreach and source control. PCBs TMDL load reduction goals, acres greened, and trash reductions are discussed in this section.

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[3] In some cases, the regional projects treat (i.e., manage) runoff for the 10-year, 24-hour event, but discharge the runoff relatively quickly, hence the peak flow is not managed. This is why the volume managed may look much higher than the peak flow reduction.

3.3.1 PCBs TMDL Load Reduction

Bay-draining portions of San Mateo County are subject to the San Francisco Bay PCBs TMDL. A total PCBs load reduction of 1.5 kilograms per year (kg/year) is required to be achieved in urban stormwater discharges from Bay-draining San Mateo County permittees by 2030, per the TMDL Control Measure Plan (SMCWPPP, 2020b). The MRP (Provisions C.11 and C.12) required Permittees to develop an RAA that quantitatively demonstrates that the proposed control measures will result in sufficient load reductions of PCBs and mercury to meet the municipal stormwater wasteload allocations (WLAs) for the San Francisco Bay, as well as reduce a certain portion of PCBs load by 2040 through GSI. Actions required to achieve the PCBs TMDL WLAs were analyzed and summarized in the TMDL Control Measure Plan (SMCWPPP, 2020b).

PCBs Load Reduction Through GSI by 2040 Goal

A portion of the overall load reduction required to achieve the PCBs WLA should be addressed through GSI. For San Mateo County, 230 g/year should be reduced through GSI by 2040, as described in the TMDL Control Measure Plan (see Figure 4-1). After accounting for existing projects and future redevelopment, it was estimated that an additional 96 g/year of PCBs should be reduced through GSI or other treatment projects by 2040 at a minimum in San Mateo County. Some portion of this was assumed to be reduced through regional stormwater capture projects that are already moving forward in the County (summarized in Section 2.6). Notably, the PCBs load estimated to be reduced through regional stormwater capture projects in the RAA included projects that have been revised, are no longer moving forward, or otherwise have reduced GSI capacity. Further analysis would require assumptions made in the RAA to be adjusted to reflect the latest status of the regional stormwater capture projects.

Per the RAA, the remaining PCBs load that should be reduced through green streets by 2040 is approximately 25-30 g/year (i.e., after accounting for load reductions through existing projects, future redevelopment, and concept-level load reductions for the five regional projects assumed in the RAA. This was assumed to be 30 g/year for this Business Case to be conservative (SMCWPPP, 2020b; see Figure 4-1 for load reduction breakdown). The RAA looked at cohesive sediment reduction to estimate GSI treatment needs and calculated the needed capacity of green streets and other GSI projects for two implementation scenarios to achieve the PCBs load reduction through GSI by 2040 goal: (1) a proportional jurisdiction-based approach and (2) a countywide approach. The required green streets capacities estimated by the RAA are summarized in Table 7 below. Also estimated in Table 7 is the extrapolated acres greened, based on the average acres treated per acre feet GSI capacity provided in Table 9-1 of the RAA (SMCWPPP, 2020a), along with the total estimated cost of the GSI facilities.

Table 7: Estimated Cost of Additional Green Streets and Other GSI Required to Achieve PCBs Load Reduction Through GSI by 2040 Goal

RAA Scenario Modeled	Green Streets Capacity Required (ac-ft)	Additional GSI Capacity Required (ac-ft)	Acres Greened per acre-feet capacity[1] (acres/ac-ft)	Total Equivalent Acres Greened[1] (acres)	Total Estimated Cost of Required GSI[2] ($)
Jurisdiction-Based Green Streets	112.1	11.8	9.1	1,122	$251 million – $324 million
Countywide Green Streets	93.9	4.3	9.4	927	$209 million – $272 million

[1] Calculated based on the total treated impervious acres and the total GSI facility capacity provided in Table 9-1 of the RAA.

[2] Calculated using the range of average cost per impervious acre treated provided in Table 4.

For comparative purposes, this analysis will focus on the 30 g/year identified as required to be achieved through GSI by the TMDL Control Plan and analyzed through the RAA. The regional stormwater capture project opportunities modeling results demonstrate that approximately 30 g/year could be achieved with far fewer regional facilities and at a considerably lower cost than the jurisdiction-by-jurisdiction approach analyzed in the RAA. Of the top 12 Bay-side prioritized regional stormwater capture project opportunities from the 74 identified, 10 are estimated to achieve more than 11 g/year of PCBs load reduction each (Craftwater, 2021a). If three of these top prioritized facilities were ultimately implemented, they would likely provide sufficient pollutant load reduction to meet the 30 g/year PCBs load reduction needed. A summary of the costs to achieve the 30 g/year through the Jurisdiction-Based scenario and the Regional Collaborative scenario is provided in Table 8.

Table 8: Cost per gram of PCBs Reduced by Scenario

RAA Scenario Modeled	Total Estimated Cost to Achieve 30 g/year PCBs load Reduction[1]		Cost per gram PCBs reduced[1]	
	Low	High	Low	High
Jurisdiction-Based through GSI by 2040 in RAA	$251 million	$324 million	$8.4 million	$10.8 million
Regional Collaborative	$5.4 million	$59.1 million	$121,000[2]	$2.0 million

[1] Per cost range analyzed, see Table 4.

[2] Cost per gram removed based on most efficient modeled regional project, a single project which is estimated to remove 45 grams per PCBs per year at a cost of $5.4 million.

Implementation of the Regional Collaborative approach is estimated to cost 75% to 95% less than the jurisdiction-based approach to achieve the same load reduction. The cost per gram per year calculations account only for the water quality associated benefits and does not account for the value of other benefits being achieved through these regional facilities.

TMDL Wasteload Allocation (WLA)

Beyond the MRP-required PCBs load reduction through GSI by 2040 goal, the TMDL WLA must also be achieved. San Mateo County has an estimated required load reduction of 1.5 kg/year to meet its WLA of 0.2 kg/year. The TMDL Control Measure Plan estimated the total PCBs load reductions achieved through source control measures, full trash capture systems, and GSI planned to be implemented as part of new and redevelopment projects. Based on the estimates included in the TMDL Control Measure Plan, additional load reduction would be required beyond these measures to achieve the WLA (approximately 950 grams per the TMDL Control Measure Plan), and requires additional measures to address. The estimated load reduction achieved through source controls and development projects, along with the proposed control measures to meet the WLA is shown in Figure 4-2 from the TMDL Control Measure Plan (SMCWPPP, 2020b).

PCBs and Mercury TMDL Control Measure Implementation Plan and RAA for San Mateo County

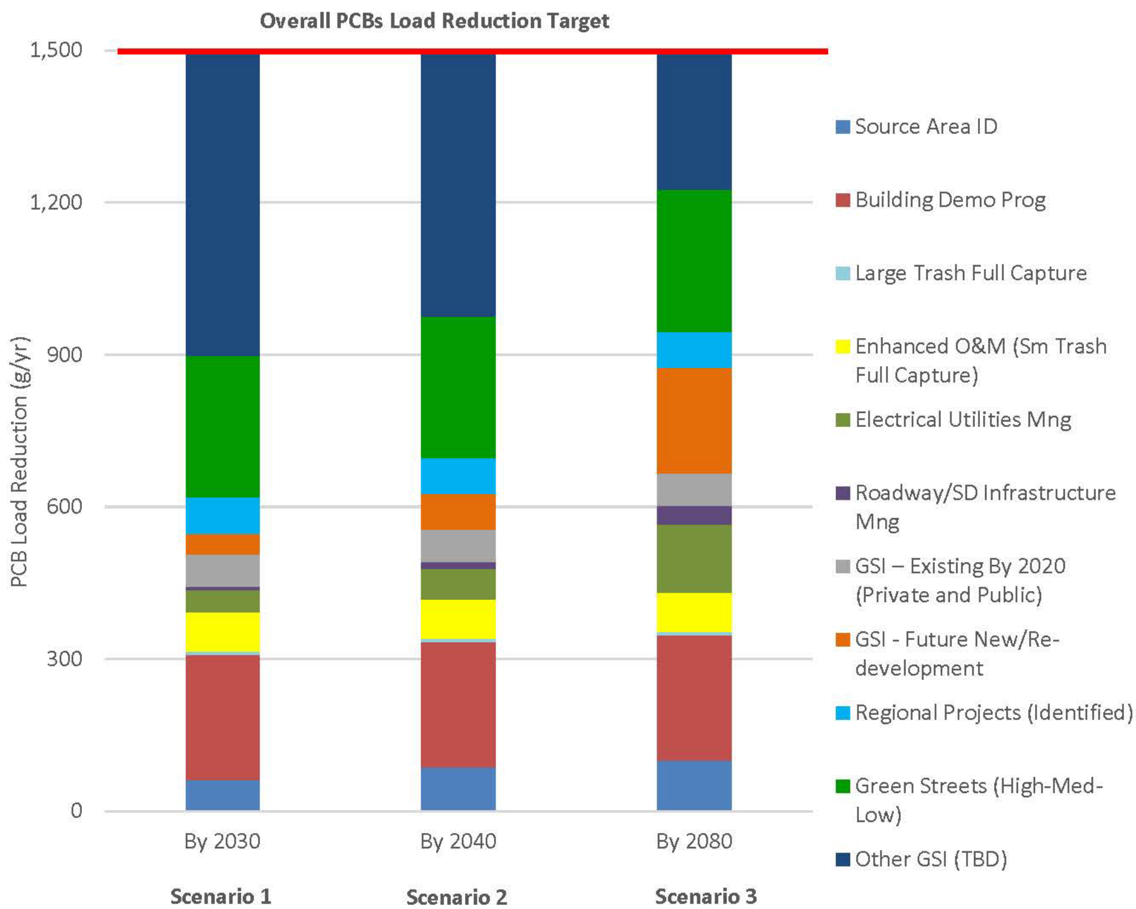

Figure 4-2. Scenarios for combinations of control measures projected to achieve San Mateo County PCBs TMDL load reduction target (i.e., 1.5 kg/yr) by 2030, 2040 and 2080.

Figure 1: Scenarios for PCBs Reducing Control Measures from SMCWPPP (2020b)

The load reduction proposed to be achieved by identified regional projects, green streets, and other GSI (to be determined) is inclusive of the PCBs load reduction through GSI by 2040 goal. In the control measure plan, the additional public GSI required to achieve the load reduction by 2030, 2040, and 2080, along with the costs, was estimated. A summary of the TMDL Control Plan findings is provided in Table 9.

Table 9: Estimated TMDL GSI Implementation Needs from TMDL Control Plan (SMCWPPP, 2020b)

Year	Area Treated (acres)	PCBs Loads Reduced (g/year)	Capital Cost (total)	Capital Cost per Gram	Annual Ongoing O&M Cost
2030	8,341	0.95	$1.14 billion	$1.2 million	$46 million
2040	7,930	0.87	$1.1 billion	$1.3 million	$44 million
2080	4563	0.62	$760 million	$1.2 million	$30 million

The PCBs load reduction efficiency must be very high to achieve these targets, in both PCBs reduced per acre treated as well as cost per gram of PCBs removed. A number of the regional stormwater capture project opportunities identified could provide this level of PCBs removal efficiency.

3.3.2 Acres Greened

The RAA output identified projects with a total of 385 ac-ft capacity in 196 subwatersheds within 20-member agency jurisdictions to achieve the required PCBs load reduction through GSI by 2040 goal. These 385 ac-ft capacity projects will capture 4,493 ac-ft of stormwater runoff per year on average. Of that, 124 ac-ft is required in green streets and other GSI, or a total of 1,122 acres greened. As summarized in Table 7, this is estimated to cost $251 million – $324 million.

When examining the top 14 prioritized projects identified, the average acres greened per facility is approximately 320 acres (assuming that GSI-equivalent treatment is provided) (Craftwater, 2021a). To achieve equivalent to 1,122 acres greened, implementation of approximately three to five of the 74 regional stormwater capture project opportunities would be needed. Using the average cost per acre treated of $69,000, implementation would cost approximately $77 million, a cost savings of 70% – 75%. In addition to providing equivalent capture of stormwater runoff in many fewer facilities (allowing for cost efficiencies for capital and O&M costs), the regional stormwater capture project opportunities are estimated to provide additional benefits.

Regional Project Case Study
The Orange Memorial Park project, currently under construction, is estimated to provide trash and sediment capture and treatment to an equivalent impervious treatment area of 969 acres and GSI-equivalent treatment (i.e., acres greened) for 424 acres of those impervious acres via capture and non-potable reuse or infiltration. With a total project cost of $15.5 million, the cost per acre greened is estimated to be $37,000 (for capital costs only). This calculation does not isolate the costs associated with the portion of runoff just receiving sediment and trash capture; the true cost per acre greened is likely lower when considering the costs associated with that treatment separately. Notably, O&M costs for the project are projected to be quite high for an individual facility ($500,000 per year), but estimated at approximately 3% of the capital facility cost. These O&M costs are quite low per acre greened ($1,179 per acre greened), lower than the average O&M cost included in Table 5.

3.3.3 Trash Capture

Trash management is a requirement per Provision C.10 of the MRP, which requires substantial trash load reductions. Where visual inspections demonstrate that full trash management systems must be installed, these facilities must meet requirements for screening (i.e., trapping of particles retained by a 5-millimeter mesh screen) and design sizing (i.e., the 1-year, 1-hour storm event peak flow rate). GSI facilities, including bioretention, capture and use systems, and infiltration facilities, are considered certified multi-benefit trash treatment systems by the State Water Resources Control Board (2019). This means that most to all of the GSI implemented in San Mateo County would be considered full trash capture. However, regional projects could provide additional trash reduction benefits through less expensive non-GSI portions of the treatment train. The Regional Collaborative scenario examined the medium, high, and very high trash-generating areas in the project watersheds, and additionally examined the area owned by Caltrans in each project watershed. As Caltrans has programs for partnerships with local municipalities to reduce trash from Caltrans-owned area, these projects could provide a funding pathway. A summary of the trash-generating area and Caltrans area within projects identified as the most-downstream in the analysis is provided in Table 10.

Table 10: Potential Acreage of Trash Benefit through Regional Stormwater Capture Project Opportunities

Project Drainage Areas	Number of Regional Stormwater Capture Project Opportunities with Identified Area in Drainage Area[1]	Average Area in Project Drainage Area (acres)
Medium, High, and Very High Trash-Generating Area	22	299
Caltrans-Owned Area[2]	37	195

[1] Represents most-downstream identified project opportunities only to avoid bias of averages from double counting.
[2] Represents overall ROW, not just high-trash generating areas.

Regional Project Case Study
The Orange Memorial Park project, currently under construction, includes sediment and debris capture and treatment to an equivalent impervious treatment area of 969 acres. Additionally, Caltrans is receiving 68 acres of full trash capture credit toward trash reduction compliance for the project[4].

3.4 Supplement County Water Supply Portfolio with Stormwater, Where Feasible

The BAWSCA Long-Term Reliable Water Supply Strategy identified that up to 680 ac-ft of supply could be achieved through rainwater harvesting in the BAWSCA service area

[4] The equivalent 1-year, 1-hour trash capture design storm is not fully captured by the project, hence the lower full trash capture credit.

(BAWSCA, 2015). The rainwater harvesting program represents an important incentive program that also acts as public education. The costs of the water supply achieved through the rainwater harvesting program are estimated by BAWSCA to range from $2,900/ac-ft to $4,800/ac-ft using an equipment life of 15 years and other assumptions.

Alternative water supply from stormwater could potentially be achieved at greater volumes through regional stormwater capture projects. Two pathways to supply—infiltration and sanitary diversion (i.e., diverting stormwater runoff to sanitary sewer for conveyance to publicly owned treatment works for treatment and reuse) — were modeled through the regional stormwater capture project opportunity analysis. Because stormwater capture for direct use requires demand calculations, which take place at later stages of design, stormwater capture and use water supply benefits were not modeled.

Of the 74 regional stormwater capture project opportunities identified, a total of 46 were identified as having potential water supply benefits through infiltration or sanitary diversions. The average water supply benefit provided through the most-downstream regional stormwater capture project opportunity for each of these supply pathways (i.e., considering that some regional stormwater capture project opportunities overlap) is provided in Table 11. As these facilities are primarily constructed to provide water quality benefits and often water supply infrastructure is a small additional cost, monetization of water supply provided could be considered cost savings realized through implementing these facilities.

Potential economic benefit can be estimated by examining the potential savings associated with using captured stormwater to replace other water supply sources. The modeling does not easily demonstrate the potential for capture and use of stormwater, which is a local water supply pathway for all 74 regional stormwater capture project opportunities if non-potable demand is present. Captured stormwater could be used for irrigation and other non-potable local uses and replace other water supply, providing a cost offset. Where captured stormwater is replacing potable water supply, savings can be very high (see Section 3.4.1 for the Orange Memorial Park example). Given modeling limitations, as well as differences in potable (and non-potable, e.g., recycled) water rates, the cost-benefit associated captured and locally used stormwater as a water supply source could not be quantified.

For illustrative purposes, the cost benefit of captured stormwater replacing other water supply is quantified for another potential source – water transfers. The water purchase cost of a water transfer is explored in BAWSCA's *Bay Area Water Supply and Conservation Agency Long-Term Reliable Water Supply Strategy, Phase II* (BAWSCA, 2015). Water supply provided through regional stormwater capture facilities could avoid or reduce the need for a water transfer and therefore provide a monetary benefit. The base cost of a water transfer per BAWSCA (2015) is $50 - $350 per ac-ft in 2015 dollars. When East Bay Municipal Utilities District (EBMUD) wheeling costs, pump station and other operation costs, transmission pipeline fee, and San Francisco Public Utilities Commission (SFPUC) Wholesale Revenue Requirement are incorporated, the full cost of a water transfer, estimated at $935 - $1725 per ac-ft in 2015 dollars (BAWSCA, 2015). For conservatism, the base cost of $50 - $350 per ac-ft is considered as the cost benefit for water supply provided through regional stormwater capture projects, allowing that there would likely be pumping, conveyance, and treatment costs associated with the stormwater alternative supply that may not fully offset. If some of these additional transmission costs could also be avoided by capturing alternative supply locally, the water supply cost savings realized could be higher per ac-ft. The results of this exercise are provided in Table 11.

Table 11: Estimated Potential Water Supply Provided by Regional Stormwater Capture Project Opportunities

Water Supply Pathway	Number of Facilities Identified	Average Water Captured for Supply (average) (ac-ft/year)	Average Facility Water Supply Annual Cost Savings Based on Avoidance of Water Transfer[1]	
			Low (Avoids Water Purchase at $50/ac-ft)	High (Avoids Water Purchase at $350/ac-ft
Infiltration	11	118	$6,000	$41,000
Sanitary Diversion[2]	35	297	$15,000	$104,000

[1] Cost savings includes offset of water purchase only, i.e., does not include cost of EBMUD wheeling costs, pump station and other operation costs, transmission pipeline fee, and SFPUC Wholesale Revenue Requirement. Cost offset could be higher if treatment and pumping/conveyance costs are lower than other cost aspects of water transfer. Cost kept in 2015 dollars for calculation in table. Cost rounded to nearest $1,000.

[2] Sanitary diversion is currently not used in the County and POTWs with recycled water operations may not be open to this source of water supply.

The ability to provide sanitary diversion for these projects will require additional coordination and acceptance by local POTWs with recycled water operations (see Drivers and Objectives Report for additional information on these POTWs). Currently, many of the potential facilities are sited in areas with high underlying groundwater, hence the limited number of facilities that could provide infiltration benefit. However, if the local groundwater elevation was lowered due to increased use of groundwater, there could potentially be adequate separation to the groundwater table to allow for safe infiltration through these facilities.

3.4.1 Regional Project Case Studies

Water reuse is an important component of the Orange Memorial Park project, where approximately 15 million gallons (46 ac-ft) of potable water will be offset each year, resulting in an estimated savings of $140,000 annually. Captured stormwater will be used to irrigate Orange Memorial Park, including the recreation fields, picnic area, and sculpture garden, as well as the adjacent Centennial Way Trail and Sister Cities Park.

In addition to irrigation benefits, the project overlies the Westside Groundwater Basin and an estimated 240 ac-ft of groundwater will be recharged annually. Since the Westside Basin is a water supply source for the California Water Service and SFPUC, the project has the potential to reduce the need and use of imported water. There may be potential for monetization of groundwater recharge.

Multi-benefits from the Red Morton Park project in Redwood City also include water reuse. The project concept includes the capture and use of stormwater for on-site irrigation as well as for toilet flushing in the park bathrooms. In addition, a fountain and surface recirculation has been proposed to provide aesthetic, habitat, and educational benefits as well as a means to keep water moving through the subsurface storage unit and prevent public health issues with standing water.

Groundwater infiltration at Red Morton Park was initially thought to be possible, but further investigation has shown that it is currently is infeasible largely due to the high underlying groundwater (currently at 10 feet below ground surface [ENGEO, 2021]). Prior to the use of imported water from the Hetch-Hetchy Reservoir in the 1960s, the underlying groundwater basin (San Mateo Plain) was used for water supply (EKI, 2018). At the time of use, it is possible that water supplies were drawn down below sustainable levels (i.e., up to 90 feet in some places [EKI, 2018]). It is possible that a managed aquifer recharge program with groundwater extraction for local potable or non-potable use could balance the depth of the aquifer and allow for safe infiltration of stormwater to the basin, providing that geotechnical conditions support infiltration. Based on the geotechnical examination of the site, Red Morton Park is underlain by expansive clay, so infiltration still may not be feasible even with lower groundwater elevations (ENGEO, 2021).

Irrigation of neighboring parks (e.g., Commodore Park) and the Golden Gate National Cemetery is also being considered as part of the Regional Stormwater Capture Project at I-280/I-380 in San Bruno.

3.5 Consider and, Where Appropriate, Design for Projected Future Impacts Resulting from Climate Change

As part of the SSMP, Green Streets projects identified for the PCBs load reduced through GSI by 2040 RAA scenario (proportional by jurisdiction scenario) were modeled for 6-hour storm events corresponding to specific return frequencies. Historical 6-hour storm events and predicted larger 6-hour storm events (adjusted to account for climate change[5]) were modeled. Based on the analyses conducted for the RAA and the SSMP, an estimated watershed depth of 0.015 inches (135 ac-ft volume managed) can be captured by the identified green streets projects for the 2040 green streets implementation scenario at a countywide scale (C/CAG, 2021b; Craftwater, 2021a; SMCWPPP, 2020a).

Craftwater conducted an analysis to examine prioritized regional stormwater capture project opportunities in the Bayside communities that could achieve equivalent volume capture to the green streets identified for the RAA scenario. The analysis assumed that capture and management of equivalent volume within the Bayside communities by regional projects could provide equivalent offset of increased precipitation to that demonstrated in the Sustainable Streets Master Plan (Craftwater, 2021a). This assumption would also require that the runoff be

[5] Climate change scenarios modeled included a Representative Concentration Pathway (RCP) 8.5 scenario to year 2070.

adequately conveyed to the regional facilities (i.e., capacity constraints in the storm drain network upstream of a regional facility could impact the ability of the facility to capture the increased volume).

The results of this analysis demonstrated that equivalent volume could be managed in a smaller total combined storage capacity[6] and for lower cost. A summary of the comparison is provided in Table 12.

Table 12: Comparison of Estimated Regional Stormwater Capture Project Capacity and Cost Required for Equivalent Climate Change Offset to Green Streets Analyzed by SSMP

Scenario Modeled	Capacity Required (acre-feet)	Impervious Acres Treated (acres)	Total Estimated Cost of Required GSI ($)
Jurisdiction-Based through GSI by 2040 from RAA[1]	112.1	1,122	$251 million – $324 million
Regional Collaborative	79.4	4,594	$95.2 million

[1] See Table 7.

In addition to providing offset for increases in larger return frequency storm events, the regional facilities provide other multiple benefits related to mitigation of climate change impacts. These include some management of larger flood events, including the 10-year, 24-hour storm peak flow, and water supply resiliency.

3.6 Consider Local Community Benefits and Concerns in Project Implementation

Jurisdiction-by-jurisdiction implementation of green streets and other distributed GSI can provide benefits to adjacent communities, including heat island cooling and habitat through facility plant palettes, safety features, and public education. Green streets distributed throughout the County could provide wide coverage of such benefits.

Regional projects could also provide enhanced amenities for certain locations. Existing park locations or undeveloped parcels present opportunities to provide community amenities through park improvements as part of planning and installation. Six of the regional stormwater capture project opportunities are at existing parks, and 11 of them are proposed to be located in undeveloped parcels with the potential to be converted to a park.

3.6.1 Regional Project Case Studies

The regional projects moving forward at Orange Memorial Park and Red Morton Park provide examples of the community amenities that can be provided through these projects when implemented at a park location. At Orange Memorial Park, associated improvements include

[6] The smaller storage capacity results from a faster regional stormwater capture facility drawdown rate for some of the facilities.

new artificial turf fields, scoreboards, and other features. At Red Morton Park, a recirculation stream feature is also proposed.

3.7 Site and Design Projects to Equitably Serve and Protect Communities

As described in the previous section, jurisdiction-by-jurisdiction implementation of green streets and other distributed GSI can provide benefits to adjacent communities. Implementation of GSI facilities in vulnerable communities and disadvantaged communities can sometimes face specific challenges, including but not limited to: lack of adequate public outreach, which can be especially true in multilingual communities; and limited ability to site projects on the street due to community transportation and parking needs.

Regional projects implemented through a regional collaboration program could provide solutions to some of these concerns, including the ability for a larger, more focused public outreach budget, siting of facilities on parcels where they do not take up community parking spots, and fiscal benefits (also see Section 4.1).

The regional stormwater capture project opportunities identified are also located within or near a number of the vulnerable communities identified as part of the SSMP (C/CAG, 2021b). Three of the vulnerable community datasets sited in the SSMP were investigated as part of the regional stormwater capture project opportunities modeling. Of the 74 projects, 43 of them would be located within ½ mile of a Metropolitan Transportation Commission (MTC) Community of Concern; 17 would be located within ½ mile of an American Community Survey Disadvantaged Community (DAC); and 71 would be located within ½ mile of a San Francisco Bay Restoration Authority (SFBRA) Economic DAC. Sixteen projects would be located within ½ mile of communities identified by all three datasets. See Table 13 for this summary.

Table 13: Regional Stormwater Project Opportunities Located within ½ Mile of San Mateo County Vulnerable Communities

Vulnerable Community Dataset	Number of Identified Regional Stormwater Capture Project Opportunties within ½ Mile of Communities
MTC Communities of Concern	43
American Community Survey DACs	17
SFBRA Economic DACs	71
Located within ½ mile of DAC identified by all three datasets	16

Many of the MTC Communities of Concern, as well as vulnerable communities identified in the other datasets, are directly adjacent to flood-prone streams or located within the 100-year Federal Emergency Management Act Flood Plain, which may be at greater risk of flooding with projected climate change impacts. Twenty-three of the regional stormwater capture project opportunities located within ½ mile of an MTC Community of Concern could provide some mitigation of the 10-year, 24-hour storm peak flow tributary to the facility, and nine could provide peak flow reductions greater than 25%, based on modeling results. These estimated peak flow reductions could provide some alleviation of flooding in these vulnerable communities.

Additional benefits to vulnerable communities provided by these facilities include coincident amenities, such as park, playfield, parking lot, and other infrastructure upgrades made as part of the implementation of regional projects, water supply benefits, including offset of nearby potable demand, and, for certain facility types, evapotranspiration-caused cooling effects due to installed vegetation.

3.8 Maximize Other Benefits, Where Possible

In addition to the benefits described in the previous sections, additional benefits are provided through these facilities. Regional projects that capture and retain or detain a portion of larger stormwater flows can also alleviate erosive flows in channels where this is a concern. Another example is sediment management, which has been the primary focus of the Orange Memorial Park project, for example. The regional project case studies are predicted to remove a considerable amount of sediment from the drainage area (e.g., approximately 100 tons/year at Orange Memorial Park and 112 tons/year at Red Morton Park, for the single field project alternative). Removal of sediment provides removal of entrained pollutants from downstream receiving water bodies, hence water quality benefits, and it can also provide added benefits due to the removal of the sediment itself. For example, the Orange Memorial Park project captures sediment that would have otherwise been discharged to San Francisco Bay via Colma Creek. Ongoing maintenance of Colma Creek includes dredging at multiple locations (SMCFSLRRD, 2021). The capture of this sediment could potentially reduce downstream dredging costs.

Beneficial reuse of this captured sediment is a possibility, though the sediment would require robust quality checks of physical and chemical characteristics[7] and the process is complicated regulatorily. Additional sediment is critically needed to protect Bay Area baylands and increase their resiliency. SFEI published *Sediment for Survival: A Strategy for the Resiliency of Bay Wetlands in the Lower San Francisco Estuary* in 2021, which estimates that many hundreds of million metric tons of sediment are needed to maintain tidal marshes and tidal flats in the Bay, which protect property and infrastructure and provide crucial habitat (Dusterhoff et al, 2021). A significant portion of this sediment is needed before the year 2050 based on sea level rise projections.

4. SUMMARY OF BUSINESS CASE

In general, the regional stormwater capture project opportunities implemented through the Regional Collaborative approach would cost less as compared to the Jurisdiction-by-Jurisdiction

[7] Including examination of pollutant concentrations on sediment, which must be lower than regulatory thresholds.

approach to achieve similar benefits. The cost savings achieved through the regional stormwater capture project opportunities are estimated to range from 60% to 90+% of the capital cost depending on the benefit, and could provide additional cost offsets (e.g., monetization of water supply), depending on the specific objective. These regional facilities also provide increased opportunity for multiple benefits to be achieved by the same project, such as water supply and/or flood reduction benefits in addition to water quality and climate resiliency benefits.

Additional savings may be achieved through the Regional Collaborative approach by enabling streamlining of procurement, environmental review and outreach processes, construction, inspection, and operations and maintenance. The ability to leverage stormwater investment region-wide can also allow for programmatic approaches that can incorporate additional feature such as local workforce training and development.

A summary of the Business Case for all of the objectives is provided in Table 14 below. Project delivery considerations are described in section 4.1.

Table 14: Summary of Business Case

Objective		Jurisdiction-by-Jurisdiction Scenario	Regional Collaborative Scenario
More Efficiently Use **Limited Resources**		Distributed GSI facilities cost about $165,000 per acre greened for parcel-based facilities and $230,000 to $302,000 per acre greened for green streets. O&M costs are estimated to scale with capital costs (e.g., 4% of capital costs estimated in Geosyntec, 2018).	***Average cost savings of approximately 60% to 75% per acre greened*** Regional stormwater capture projects are estimated to cost approximately $69,000 per acre greened. Individual regional facility O&M may be quite high but are expected to be lower per acre greened.
Support Improvements to Alleviate Strain on **Existing Stormwater Infrastructure**		SDMP Findings: Substantial grey storm drain infrastructure upgrades are needed to alleviate flooding concerns throughout member agency jurisdictions (see Section 3.2 for summary of completed SDMPs).	***Additional opportunities for projects to provide flooding alleviation*** Regional projects may be able to provide some management of flooding through retention and detention of smaller flood peak flows, potentially allowing for avoidance of some infrastructure capacity upgrades. The Regional Collaborative Scenario provides more options with siting and facility or treatment train type to alleviate flooding.
Cost Effectively Comply with **Water Quality** Regulatory Requirements	PCBs	RAA Scenario Results: Investment in green streets to achieve 30 grams of PCBs load reduction results in an average cost per gram removed of $8.4 million to $10.8 million (per analysis of SMCWPPP, 2020a).	***Estimated cost savings of 75% to 95+% to achieve equivalent PCBs load reduction through GSI as RAA scenario***[1] Cost to achieve 30 grams of PCBs removal using top prioritized regional projects is estimated to range from $120,000 per gram to $1.9 million per gram with an average of $1.0 million per gram.
	Acres greened	RAA Scenario Results: A total of 1,122 acres greened would be required to meet the PCBs load reduction through GSI by 2040 goal. This would require 385 ac-ft capacity in 196 subwatersheds within 20-member agency jurisdictions (per analysis of SMCWPPP, 2020a).	***Estimated cost savings of approximately 70% to 75% to provide equivalent acres greened as RAA scenario, along with reduced ongoing inspection costs***[1] Approximately 3-5 regional stormwater capture projects could achieve 1,122 acres greened, reducing implementation and inspection costs.
	Trash	Distributed GSI typically provides full trash capture.	Regional projects can be designed to provide trash management for a large drainage area (*roughly equivalent to jurisdiction-by-jurisdiction scenario based on available data and analysis*).

Objective	Jurisdiction-by-Jurisdiction Scenario	Regional Collaborative Scenario
Supplement County **Water Supply** Portfolio with Stormwater, Where Feasible	Stormwater capture could be achieved through rainwater harvesting programs at a cost of $2,900 to $4,800 per ac-ft (BAWSCA, 2015).	***Opportunities for water supply to offset project costs*** Water supply can be provided as an additional benefit for feasible projects through capture and use or recharge (where feasible), and provide potable water offset or avoidance of other water supply at a cost offset.
Consider and, Where Appropriate, Design for Projected Future Impacts Resulting from **Climate Change**	Green Streets required to achieve the PCBs load reduction through GSI by 2040 goal[2] could achieve offset of climate impacts for smaller return storms (see SSMP, C/CAG, 2021b).	***Estimated cost savings of 60% to 70% for equivalent climate change impact offset*** Regional projects can provide equivalent volume management to the modeled jurisdiction-by-jurisdiction scenario in approximately 70% of the capacity and with cost savings of 60% to 70%.
Consider Local **Community Benefits** and Concerns in Project Implementation	Distributed facilities can provide distributed community benefits including heat island cooling, habitat through facility plant palettes, safety features, and public education.	In addition to providing many of the benefits that distributed facilities can, regional facilities could provide enhanced amenities in park locations. Six of the regional stormwater capture project opportunities identified are proposed to be located in an existing park, and eleven of them are proposed to be located in undeveloped parcel with the potential to be converted to a park *(qualitative analysis, equivalent or better to jurisdiction-by-jurisdiction based on assessment)*.
Site and Design Projects to **Equitably** Serve and Protect Communities	Distributed facilities can provide distributed community benefits including heat island cooling, habitat through facility plant palettes, safety features, and public education.	Many of the regional stormwater capture project opportunities are located within ½ mile of an identified vulnerable community. Regional projects may be able to provide enhanced implementation of GSI in vulnerable communities *(qualitative analysis, equivalent or better to jurisdiction-by-jurisdiction based on assessment)*.
Maximize **Other Benefits**, Where Possible	Distributed facilities can provide distributed community benefits including heat island cooling, habitat through facility plant palettes, safety features, and public education.	Regional stormwater capture project opportunities can provide other benefits including but not limited to sediment management and reduction of erosive flows *(qualitative analysis, equivalent or better to jurisdiction-by-jurisdiction based on assessment)*.

[1] The RAA scenario focused on the PCBs load reduction through GSI by 2040 goal, a goal required under the current MRP. This specific requirement is changing per the MRP Tentative Order; however, substantial PCBs load reduction via GSI facilities is still expected to be needed to meet TMDL goals. The Regional Collaborative Scenario findings are considered representative of an approach that includes targeted siting of larger facilities to reduce PCBs load.
[2] The RAA scenario was modeled for the SSMP and was thus used to represent the "Jurisdiction-by-Jurisdiction" Scenario compared against.

4.1 Other Cost Efficiencies and Benefits of Regional Collaboration

Stormwater facilities, specifically GSI, are by their nature small, varied, and geographically dispersed, which has traditionally caused them to be planned, designed, and constructed individually. This is true in San Mateo County where multiple jurisdictions are individually planning, designing, and constructing their own GSI projects often within a shared watershed. Implementing small GSI on a project-by-project basis makes these projects even less cost effective because of the amount of overhead required to procure and manage multiple engineering and construction firms for project implementation and permitting. This project-by-project mentality has constricted innovation within the stormwater industry and has promoted the inefficiencies inherent in a piecemealed delivery approach.

The logical approach to lowering the cost and increasing the speed of GSI implementation is to consolidate the projects into fewer, larger, regional facilities located in the best geographic locations regardless of jurisdiction and to consolidate and streamline the procurement and management of the work. Much of this document focuses on the technical and environmental advantages of consolidating the projects into fewer, larger regional projects and the reduction of costs associated with this approach. However, incorporating different programmatic delivery models will provide additional benefits, including a reduction in overall GSI project costs, increased speed and efficiency in the implementation of the projects, and an opportunity to obtain additional socioeconomic and community-based benefits as a byproduct.

The most efficient way to implement GSI is to combine as many efficient practices as possible together, including locating projects in the areas that will provide the most environmental benefit, configuring the projects as large as possible, an using a delivery model that reduces overhead burden by streamlining procurement and management.

4.1.1 Alternative Delivery

Several alternative delivery models are available, and each provides advantages worth considering. Design build and its variations relieve some of the overhead burdens by providing a single point of responsibility for the implementation of a single project. This contributes to a more efficient delivery, but as mentioned previously GSI is best suited to a full programmatic delivery model that manages the implementation of GSI in a holistic way. This approach aggregates piecemealed projects into a performance-based, investable solution that achieves broader community and economic value. It achieves goals faster, in part, by stacking the efficiencies gained through private sector flexibility in project selection and aggregation, contractor procurement, economies of scale, and other similar tactics. The relatively small, individual efficiencies, when combined, create substantial time and cost savings.

These alternative delivery models include public private partnerships (P3s); design, build, maintain (DBM); and similar pay-for-performance models. Using these methods, the project owner contracts with a single entity that is accountable for all aspects of the project throughout the lifecycle, which reduces risk for the project owner. A unique P3 model developed specifically for stormwater implementation is called a Community-Based Public Private Partnership (CBP3). It was developed by the United States Environmental Protection Agency and has been quite effective in reducing the cost and delivery time of GSI while providing other benefits to the local community, like increased local participation of small and disadvantaged businesses, increased participation of local resident workforce, mentor protégé programs to train and build up small and disadvantaged businesses, and the equitable distribution of program benefits to all sectors of the community.

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ATTACHMENT A: COST DATA AND INPUTS

1. CAPITAL COSTS

Capital cost data examined to develop this Business Case is summarized in the following sections. The assumed cost per acre greened and/or treated applied to the Business Case is described therein.

1.1 GSI Statistical Cost Analysis Conducted by Geosyntec

Geosyntec conducted a comprehensive statistical cost analysis in 2018 using available GSI implementation cost data throughout the state. The results of that analysis, escalated to 2021 dollars, are provided in Table A-1.

Table A-1: Statistical Summary of Unit Capital Cost for GSI Project Categories (Geosyntec, 2018) Escalated to 2021 Dollars

Project Category	No. of Projects (n)	Unit Capital Cost ($/acre treated) in 2021 Dollars[1]					
		Minimum	25th-percentile	Median	75th-percentile	Maximum	Mean
Green Street	19	$27,000	$76,000	$148,000	$288,000	$1,393,000	$230,000
Distributed (i.e., Parcel-Based) GSI	21	$17,000	$97,000	$131,000	$190,000	$449,000	$165,000
Regional Stormwater Control	11	$16,000	$27,000	$66,000	$137,000	$461,000	$109,000

[1] Units have been rounded to the nearest $1,000. Cost data includes design and construction costs.

The escalated cost statistics provided in Table A-1 are used as a benchmark for the other cost estimates referenced throughout the Business Case.

1.2 TMDL Control Measure Plan Costs

The TMDL Control Measure Plan referenced Geosyntec's 2018 cost statistics as well as other cost analyses conducted as part of the accompanying RAA and the San Mateo County Stormwater Resource Plan (SMCWPPP, 2017). The costs used in the TMDL Control Measure Plan are summarized in Table A-2 and have been escalated to 2021 costs where applicable.

Table A-2: TMDL Control Measure Referenced Costs

Control Measure	Unit of Implementation	2018 Dollars	2021 Dollars	Units	Source
GI - Private/Parcel-based Redevelopment	Acres greened	$153,000	$165,000	$/acre	Average value for parcel-based (distributed GI) from Geosyntec, 2018
GI - Public Right of Way Retrofits (Green Streets)	Acres greened	$213,000	$230,000	$/acre	Geosyntec, 2018
GI - Regional Projects	Acres greened	$101,000	$109,000	$/acre	Geosyntec, 2018

1.3 San Mateo County Regional Projects

The costs associated with the San Mateo County regional projects, currently at varying phases of implementation, are provided in Table A-3 below, for comparison.

Table A-3: Summary of Cost per Acre Greened for Identified San Mateo County Regional Projects

Regional Project	Design Alternative	Total Cost	Acres Greened (acre)	Cost per Acre Greened ($/acre)
Orange Memorial Park, South San Francisco	n/a	$15.5 million	421	$37,000
Red Morton Park, Redwood City	Project Alternative 1 - 85th Percentile Alternative	$14.9 million	140[1]	$106,000[1]
	Project Alternative 2 - Single Field Maximization	$31.5 million	204[1]	$154,000[1]
Caltrans I-280 @ I-380, San Bruno	n/a	$19.6 million	254	$77,000

[1] Acres greened and unit cost assumes that the Red Morton Park project design will be considered compliant with Provision C.3.c by the SFBRWQCB.

1.4 Regional Stormwater Capture Project Opportunities

Planning-level costs were developed for the regional stormwater capture projects identified as part of the regional stormwater capture project opportunity analysis. These proposed regional projects were modeled to optimize the water quality and other benefits given the facility location, drainage area, and other factors (Craftwater, 2021a). As such, many of these projects do not capture 80% of average annual runoff (i.e., the Volume Hydraulic Design Basis as defined in MRP Provision C.3.d) if the site is either too space constrained or it would be uneconomical to do so.

Using the acres greened calculation for these regional stormwater capture project opportunities, the cost per acre greened was calculated for the 74 project opportunities. As described in Section

2.4, acres greened also require treatment through MRP Provision C.3.c compliant measures. For the unit costs provided in Table A-4, it was assumed that regional stormwater capture projects analyzed by Craftwater would be designed to meet MRP Provision C.3.c standards or equivalent standards negotiated with the SFBRWQCB such that they would provide acres greened for the portion of average annual runoff captured

Table A-4: Statistical Summary of Craftwater Planning-Level Costs for Regional Projects

Project Category	No. of Modeled Projects (n)	Unit Capital Cost ($/acre greened), Planning Estimates					
		Minimum	25th percentile	Median	75th percentile	Maximum	Mean
Regional Stormwater Capture Project Opportunities	74	$13,000	$36,000	$59,000	$79,000	$328,000	$69,000

[1] Units have been rounded to the nearest $1,000. Cost data includes planning level costs.

The statistical spread varies somewhat from the updated empirically derived regional stormwater cost statistics (Table 4), especially in the higher cost range, but overall the costs are very similar to the empirically based costs findings. The lower costs for the 75th percentile, maximum, and mean unit costs as compared to the actual cost data statistics are likely due to the cost-optimized nature of these modeled facilities. This unit cost check allows for confidence in using these planning level regional stormwater capture project opportunities cost values for the Business Case analysis.

1.5 San Mateo County Integrated Safe Routes to School Green Infrastructure Project Costs

C/CAG compiled GSI costs for eight Integrated Safe Routes to School and Green Infrastructure projects completed to date (of ten total projects). The green streets GSI typically consisted of bulbouts or linear planters in the street and were constructed within eight member agency jurisdictions in the County. A statistical summary of the unit cost (cost per acre treated) is provided in Table A-5.

Table A-5: Unit Cost statistics for San Mateo County Safe Routes to School Projects GSI

Project Category	No. of Modeled Projects (n)	Unit Capital Cost ($/acre), Planning Estimates					
		Minimum	25th percentile	Median	75th percentile	Maximum	Mean
GI - Public Right of Way Retrofits (Green Streets)	8	$85,000	$124,000	$189,000	$487,000	$632,000	$301,000

When compared to the green streets statistics compiled by Geosyntec (Table A-1), these facilities are more expensive to implement – with both the median and mean unit costs approximately 30% higher than the statistical results (escalated to 2021 dollars). This increased cost of green streets implementation in the San Francisco Bay Area is consistent with green streets costs compiled in other counties. This is a relatively small data set, but provides recent local implementation costs, so will be used as a cost input for this Business Case.