Appendix D:
Metric Definitions and Model Assumptions

ARLA

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Prepared for:

Deborah Bloome

Accelerate Resilience L.A.

Tel. 310.400.6715

Prepared by:

Members of the Technical Team

Craftwater Engineering, Inc.

San Diego | Los Angeles

Tel. 805.729.0943

www.craftwaterinc.com

Emergent Strategy

San Diego

Tel. 248.302.7518

Executive Summary

This document defines ARLA's Safe Clean Water Program (SCWP or Program) Working Group Project metrics and details the modeling assumptions, data sources, and methodology associated with modeling each metric to provide technical clarity to the Working Group and the public. Only metrics that can be quantified (can be used in modeling) are discussed in detail within this report. Programmatic and policy-related recommendations will be carried in the Working Group's final report to the Los Angeles County Flood Control District. Table E-1, Table E-2, and Table E-3 summarize the metrics selected by the Working Group and the data sources used to model the metrics for the SCWP Water Quality, Water Supply, and Community Investment Benefits Goals, respectively. The tables also indicate whether each metric can be quantified at a project scale and rolled up to the Program scale, or can only be appropriately quantified at either the project scale or Program scale.

Table E-1. Data sources for the SCWP *Water Quality* Goal

Metric	Metric Definition	Data Sources and Methodology	Project Level	Program Level
Total Long-Term Pollutant Load Captured (e.g., pounds/year)	The quantity of pollutants captured and prevented from entering the storm drainage system and/or receiving waters; will include pollutants associated with listed impairments	• **Baseline pollutant loading:** Hydrologic response units from the L.A. County Watershed Management Modeling System (WMMS 1.0) • **Best Management Practice (BMP) performance:** For infiltration-based BMPs, assume 100 percent removal rate of loading diverted into the BMP. For filtration-based BMPs, use Effluent Concentration Limits (ECLs) of industry standard filtration devices • **Note:** Based on the Upper Los Angeles River (ULAR) Enhanced Watershed Management Program (EWMP) (which encompasses the Alhambra Wash pilot watershed), zinc is one of the limiting pollutants during wet weather conditions. Therefore, there is confidence that BMPs optimized to capture zinc should capture non-modeled constituents that have similar fate and transport mechanisms to zinc.	X	X
Volumetric Capture Proxies (e.g., acre-feet/event)	The volume of water captured over a specific time period as a surrogate for pollutant capture; often expressed as a 24-hour volume managed/treated	• 85th percentile, 24-hour isohyet data from L.A. County and standard unit rainfall 24-hour timeseries	X	X
Wet Day Long-Term Pollutant Load Captured (e.g., pounds/year)	The quantity of pollutants captured and prevented from entering the storm drainage system and/or receiving waters on days defined as "wet" using either precipitation records or stream gage records; will include pollutants associated with listed impairments	• **Baseline pollutant loading:** Hydrologic response units from the L.A. County Watershed Management Modeling System (WMMS 1.0) • **BMP performance:** For infiltration-based BMPs, assume 100 percent removal rate of loading diverted into the BMP. For filtration-based BMPs, use Effluent Concentration Limits (ECLs) of industry standard filtration devices • **Note:** Based on the Upper Los Angeles River (ULAR) Enhanced Watershed Management Program (EWMP) (which encompasses the Alhambra Wash pilot	X	X

Metric	Metric Definition	Data Sources and Methodology	Project Level	Program Level
		watershed), zinc is one of the limiting pollutants during wet weather conditions. Therefore, there is confidence that BMPs optimized to capture zinc should capture non-modeled constituents that have similar fate and transport mechanisms to zinc.		
Frequency Exceeding Numeric Water Quality Objectives (e.g., %)	Monitoring or modeling how often pollutant concentrations in a storm drain or receiving water body exceed the numeric objectives specified in the Basin Plan, Total Maximum Daily Loads (TMDLs), California Toxic Rules (CTR), Municipal Action Levels (MALs), etc. for listed impairments. Also includes frequency of unpermitted non-stormwater (dry weather flow) discharge	• Modeled zinc loadings were compared to modeled zinc targets where the numeric water quality objective is based on the California Toxics Rule (CTR) criteria used in the Los Angeles River & Tributaries Metals Total Maximum Daily Load (TMDL).		X
Attainment of Biological Objectives (units vary)	Biological indices used to describe the health of streams based on their benthic macroinvertebrates; typically based on observation of ecosystem structure and function, and measurement of the observed taxa in a receiving water compared to expected taxa (e.g., California Stream Condition Index)	• California Stream Condition Index (CSCI) scores map • Southern California Coastal Water Research Project (SCCWRP) Stream Classification and Priority Explorer (SCAPE) web app		X
Recreational Facility Closures (e.g., days/year or days/season)	The number of days per year when surface waters designated in the Basin Plan with recreational beneficial uses are closed to recreation due to water quality impairments	• Bacteria exceedances of MS4 outfalls within Alhambra Wash during dry-weather monitoring • **Note:** Unable to provide a causal analysis of bacteria exceedances in Alhambra Wash and contribution of Alhambra Wash drainage, if any, to the nearest recreational facility (Legg Lake) without further investigation and hydrodynamic modeling		X

Table E-2. Data sources for the SCWP *Water Supply* Goal.

Metric	Metric Definition	Data Sources and Methodology	Project Level	Program Level
Magnitude of New Water Captured (e.g., acre-feet/year)	Acre-feet of new urban runoff and/or stormwater captured to replenish or augment local supply, or to sustain or improve environmental baseflows, on an average annual basis; includes all water infiltrated below the root zone (i.e., deep percolation) and all water delivered to a sewer tributary to an existing or planned reclamation/reuse facility	• Runoff outputs from the Loading Simulation Program in C++ (LSPC) model • Using custom BMP model, the Magnitude of New Water Captured is calculated by subtracting the "bypassing BMP" timeseries from the "diverting into BMP" timeseries, where the storage and outflow of the BMP governs what can be captured.	X	X
Magnitude of Water Use Offset (e.g., acre-feet/year)	Potable or non-potable water use offset by capturing and using local stormwater or urban runoff, including for irrigation of vegetation in both manmade and natural systems	• Baseline demand was calculated by estimating irrigation demand at the site based on the Simplified Landscape Irrigation Demand (SLIDE) rule and 10 years of evapotranspiration data from the California Irrigation Management Information System (CIMIS). Dry weather flows are typically used to supply irrigation demand.	X	X
Relative Water Demand Augmented or Offset (e.g., %)	Percentage of local water demand augmented/offset based on the sum of the two metrics above in this table; baseline local water demand estimated using residential per-capita potable water use	• Local water demand can be calculated by using the average residential per capita use (130 gallons per capita per day) (obtained from the Professional Engineer (PE) Civil Reference Manual) multiplied by the relevant population.		X

Table E-3. Data sources for the SCWP *Nature Based Solutions/Community Investment Benefits/Multi-Benefit/Public Health* Goals.

Metric Category	Metric	Metric Definition	Data Sources	Project Level	Program Level
Access to Green Space/Recreation	**People Within Walking Distance to Park/Green Space** (e.g., number of people or percent of population within a certain distance (depending on size of green space) by road network)	Total population within the "walkshed" of vegetated spaces of any size designated for passive or active recreation	• **Population data:** 2014 Los Angeles County Age/Race/Gender Population Estimates from the U.S. Census Bureau • **Baseline of green space:** Countywide Parks and Open Space Geographic Information System (GIS) shapefile (used in Park Needs Assessment), Park Access Points (used in Park Needs Assessment) • **Road network:** ArcGIS Online	X	X
	New Green Space Added Per Person with Access (e.g., acres per person)	Provision of public access to new park or green space previously not accessible (this includes public parcels *not* currently considered accessible recreation parks per Park Needs Assessments, which includes non-park public parcels and non-recreation parks). This definition does not consider private parcels.	• **Population data:** 2014 Los Angeles County Age/Race/Gender Population Estimates from the U.S. Census Bureau • **Baseline of green space:** Countywide Parks and Open Space GIS shapefile (used in Park Needs Assessment), Park Access Points (used in Park Needs Assessment) • **Road network:** ArcGIS Online	X	X
Tree Canopy	**Change in Tree Canopy Coverage** (e.g., acreage at project scale)	Total change in tree canopy coverage	• Los Angeles Region Imagery Acquisition Consortium (LARIAC) Land Cover 2016 raster dataset	X	X
Pervious Land Cover	**Change in Area of All Pervious Land Uses** (e.g., square feet at project scale)	Conversion of impervious surfaces (e.g. pavement, rooftops) to pervious surfaces (e.g. bare, gravel, vegetated, or permeable pavement)	• Los Angeles Region Imagery Acquisition Consortium (LARIAC) Land Cover 2016 raster dataset	X	X
	Change in Area with Groundcover (e.g., square feet at project scale)	Conversion of unvegetated impervious or pervious surfaces to pervious surface with vegetated groundcover (e.g. grass, forbs, shrubs)	• Los Angeles Region Imagery Acquisition Consortium (LARIAC) Land Cover 2016 raster dataset	X	X
Native Vegetation	**Change in Area of Native Vegetation** (e.g., square feet; square miles)	Conversion of unvegetated impervious or pervious surfaces to pervious surface with native vegetation, in which native vegetation is defined as an assemblage of plants in a specific place or region that has adapted	• United States Department of Agriculture EVeg Mid Region 5 South Coast shapefile	X	X

Metric Category	Metric	Metric Definition	Data Sources	Project Level	Program Level
		to environmental and biological conditions			
Flood Management	**Peak Flow Rate Reduction** (e.g., cubic feet per second)	Reduction in the flow rates discharged from a watershed under specific storm conditions; high peak flow rates during storms can overwhelm the drainage system and cause localized or regional flooding	• 85^{th} percentile, 24-hour isohyet data from L.A. County and standard unit rainfall 24-hour timeseries	X	
Local Economy	**New Full-Time Equivalent (FTE) Jobs Added** (e.g., number, differentiating between capital planning/design/construction and operations/maintenance)	Total number of new, sustainable jobs supported by SCWP projects differentiated by job type	• City of San Diego Operational Cost Database	X	X

The findings from this pilot watershed study ("Pilot Analysis") will help provide recommendations to adaptively manage the SCWP and meaningfully measure progress toward the SCWP's fourteen Goals. The recommendations provided through this project will serve as one source of input to the District's updated guidance, anticipated in April 2022, as well as the District's Metrics and Monitoring Study (MMS).

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1 Overview

The purpose of this report is to document the modeling approach, data sources, methodology, and example outputs that will be generated from the pilot watershed study (the "Pilot Analysis").

1.1 Working Group Process

ARLA and the Technical Team developed the following process as illustrated in **Figure 1-1** to:

- Ensure that Working Group members were well-informed of the background and nuances behind the prioritized SCWP Goals;
- Gather feedback and values from the Working Group; and
- Select appropriate, quantifiable metrics that could not only be modeled but also were monitorable at multiple spatial scales.

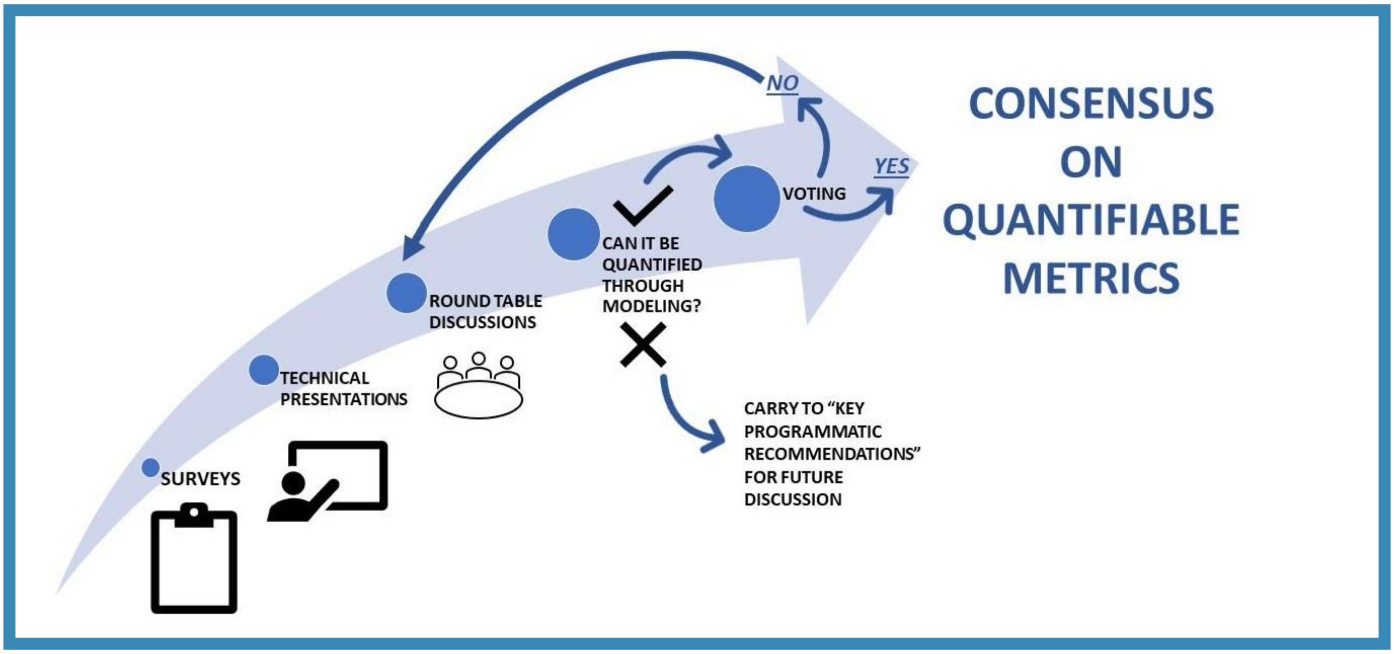

Figure 1-1. Working Group process for coming to a consensus on quantifiable metrics to be modeled in the pilot watershed.

The *Working Group Process Memo (Appendix B)* provides full details on the process illustrated in **Figure 1-1**. The Working Group process illustrated above has allowed Working Group members to be informed about several seemingly disparate topics integral to the success of the SCWP, attentively listen to and acknowledge each other's values respectfully, and come to a consensus on several decisions on behalf of their respective organizations.

Recognizing that not all key questions posed by the Working Group are able to be modeled or quantified (for example, some key questions are philosophical in nature), the Technical Team created a process identifying which aspects of the SCWP Goals could be quantified versus informed via programmatic recommendations using the modeling results. The following describes which Goals and corresponding metrics are able to be quantified versus informed.

Quantified

- ***Water Quality***
    - Total Long-Term Pollutant Load Captured
    - Volumetric Capture Proxies
    - Wet Day Long-Term Pollutant Load Captured
    - Frequency Exceeding Numeric Water Quality Objectives
    - Attainment of Biological Objectives
    - Recreational Facility Closures
- ***Water Supply***
    - Magnitude of New Water Captured
    - Magnitude of Water Use Offset
    - Relative Water Demand Augmented or Offset
- ***Nature-Based Solutions (NBS)/Community Investment Benefits (CIB)/Multi-Benefit***
    - Access to Green Space/Recreation
    - New Green Space Added Per Person with Access
    - Change in Tree Canopy Coverage
    - Change in Area with Groundcover
    - Change in Area of All Pervious Land Cover
    - Change in Area of Native Vegetation
    - Peak Flow Rate Reduction
- ***Disadvantaged Community (DAC) Benefits***
    - Definitions, spatial scale of benefits and to whom benefits accrue, 110 percent accounting
- ***Green Jobs and Career Pathways***
    - New Full-Time Equivalent (FTE) Jobs Added (differentiated between capital planning/design/construction and long-term operations and maintenance)
- ***Spectrum of Project Sizes***
- ***Operations and Maintenance***

Informed

- ***Disadvantaged Community (DAC) Benefits***
    - Measurement (related to equity)
    - Beneficiaries (who decides needs and benefits?)
    - Location (inside/outside of a DAC)
- ***Other Funding***
- ***Proportionally Benefitting Municipalities***

An example of this quantifying versus informing approach is demonstrated with elements of the DAC Benefits in **Figure 1-2**.

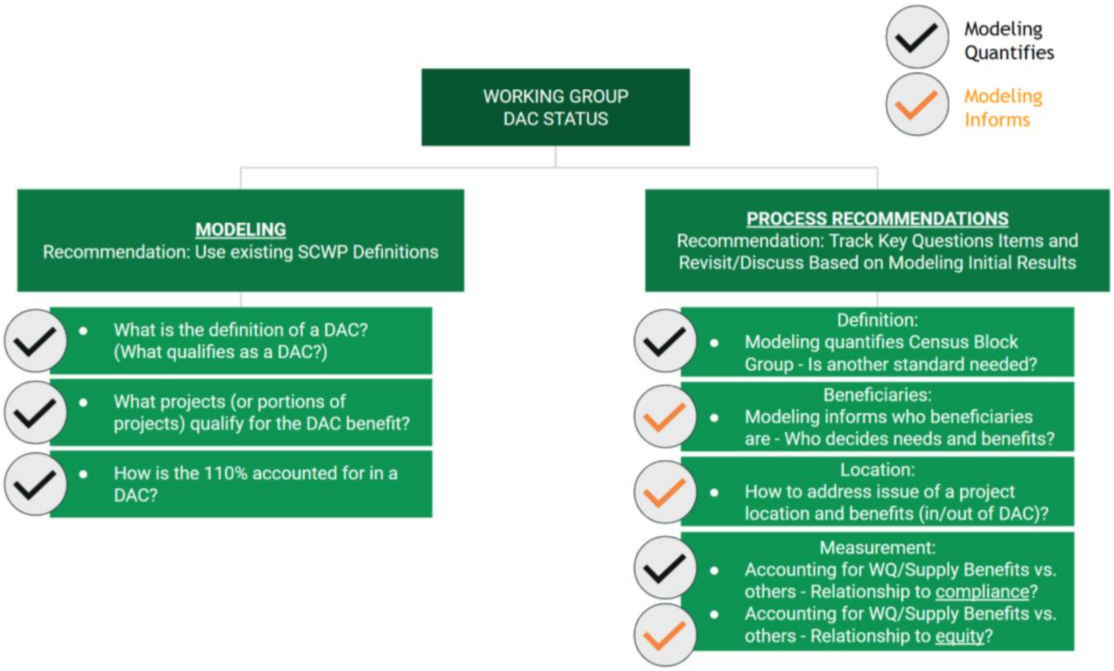

Figure 1-2. Example of DAC Benefits being quantified and informed through the modeling process.

1.2 Metric Definitions

Table 1-1, Table 1-2, and Table 1-3 display the metrics and their definitions for the Water Quality, Water Supply, and Multi-Benefit/Nature-Based Solutions/Community Investment Benefits Goals, respectively. After any metrics that were proposed were thoroughly discussed by the Working Group, Mr. Chad Helmle, Mr. Brad Wardynski, Ms. Bethany Bezak, Dr. Sarah Diringer, Jon Christensen, Vanessa Carter, and/or Dr. Gregory Pierce (depending on the subject matter) provided commentary regarding:

- If the proposed metric had sufficient locally available and accessible data;
- Whether the metric would be able to be modeled given the current best available tools;
- The appropriate scale for the metric;
- Whether the metric could be monitored; and
- Whether the metric meaningfully measures the intended benefit.

Through this expert-guided process, several proposed Community Investment Benefit metrics (including air quality, carbon sequestration, and urban heat island effect) were deemed infeasible to model or measure at the spatial scales needed for the modeled project. These were due to various reasons, such as lack of instrumentation, lack of an accessible model, or lack of complex life cycle accounting tools that would be able to attribute the benefit solely to the modeled project. For example, while the Working Group members agreed that carbon sequestration was important, the Working Group members acknowledged that it would be difficult to differentiate the benefit of carbon sequestration due to the planting of trees at the project site, reduced carbon emissions from cars taken off the road, or other outside factors not attributed to the project. For metrics unable to be quantified directly, the Working Group agreed on proxies to indirectly quantify those metrics. As such, the Working Group agreed that the benefits of added trees and vegetation could indirectly quantify the benefits of improved air quality, carbon sequestration, and reduced urban heat island effect. These directly- or indirectly-quantifiable metrics were then ultimately voted on by the Working Group to keep or to discard.

Several questions asked by the Working Group, particularly related to Disadvantaged Community (DAC) Benefits, were also deemed infeasible to be directly or indirectly quantified; rather, it was agreed that the modeling would be able to inform the Working Group's programmatic recommendations once the data was analyzed from the modeling. These questions were characterized as either definitions-based, process-based, or outcomes-based. Using an example from the DAC Benefits topic, the modeling would be able to determine the beneficiaries attributed to a project, but it would be unable to determine who should determine needs and benefits; instead, this would be considered a process-based question.

Table 1-1. Final metrics for the SCWP's Water Quality Goal, including metric definition, outstanding discussion, most meaningful/relevant scale, and whether the metric is monitorable and/or modellable.

Metric	Metric Definition	Most Meaningful/Relevant Scale				Physically Measurable, Monitorable	Modellable, Predictable
		Single Facility	Project	Neighborhood, Sub-Regional	Watershed, Regional		
Total Long-Term Pollutant Load Captured (e.g. pounds/year)	The quantity of pollutants captured and prevented from entering the storm drainage system and/or receiving waters; will include pollutants associated with listed impairments.	Y	Y			Y continuous monitoring requires proxies	Y
Volumetric Capture Proxies (e.g. acre-feet/ event)	The volume of water captured over a specific time period as a surrogate for pollutant capture; often expressed as a 24-hour volume managed/treated.	Y	Y			Y	Y
Wet Day Long-Term Pollutant Load Captured (e.g., pounds/year)	The quantity of pollutants captured and prevented from entering the storm drainage system and/or receiving waters on days defined as “wet” using either precipitation records or stream gage records; will include pollutants associated with listed impairments.	Y	Y			Y continuous monitoring requires proxies	Y
Frequency Exceeding Numeric Water Quality Objectives (e.g., %)	Monitoring or modeling how often pollutant concentrations in a storm drain or receiving water body exceed the numeric objectives specified in the Basin Plan, Total Maximum Daily Loads (TMDLs), California Toxic Rules (CTR), Municipal Action Levels (MALs), etc. for listed impairments. Also includes frequency of unpermitted non-stormwater (dry weather flow) discharge.			Y	Y	Y continuous monitoring requires proxies	Y

Metric Definitions & Model Assumptions

Metric	Metric Definition	Most Meaningful/Relevant Scale				Physically Measurable, Monitorable	Modellable, Predictable
		Single Facility	Project	Neighborhood, Sub-Regional	Watershed, Regional		
Attainment of Biological Objectives (units vary)	Biological indices used to describe the health of streams based on their benthic macroinvertebrates; typically based on observation of ecosystem structure and function, and measurement of the observed taxa in a receiving water compared to expected taxa (e.g., California Stream Condition Index).				**Y**	**Y** with definition of site-specific objectives	**Y** with predictive assumptions
Recreational Facility Closures (e.g., days/year or days/season)	The number of days per year when surface waters designated in the Basin Plan with recreational beneficial uses are closed to recreation due to water quality impairments.				**Y**	**Y**	**Y** w/ predictive assumptions

Table 1-2. Final metrics for the SCWP's Water Supply Goal, including metric definition, outstanding discussion, most meaningful/relevant scale, and whether the metric is monitorable and/or modellable.

Metric	Metric Definition	Most Meaningful/Relevant Scale				Physically Measurable, Monitorable	Modellable, Predictable
		Single Facility	Project	Neighborhood, Sub-Regional	Watershed, Regional		
Magnitude of New Water Captured (e.g., acre-feet/year)	Acre-feet of new urban runoff and/or stormwater captured to replenish or augment local supply, or to sustain or improve environmental baseflows, on an average annual basis; includes all water infiltrated below the root zone (i.e., deep percolation) and all water delivered to a sewer tributary to an existing or planned reclamation/reuse facility.		Y	Y	Y	Y	Y
Magnitude of Water Use Offset (e.g., acre-feet/year)	Potable or non-potable water use offset by capturing and using local stormwater or urban runoff, including for irrigation of vegetation in both manmade and natural systems.		Y	Y	Y	Y	Y
Relative Water Demand Augmented or Offset (e.g., %)	Percentage of local water demand augmented/offset based on the sum of the two metrics above; baseline local water demand estimated using residential per-capita potable water use.			Y	Y	Y	Y

Table 1-3. Final metrics for the SCWP's Nature-Based Solutions/Community Investment Benefits/Multi-Benefit/Public Health Goals, including metric category, metric definition, outstanding discussion, most meaningful/relevant scale, and whether the metric is monitorable and/or modellable.

Metric Category	Metric	Metric Definition	Most Meaningful/Relevant Scale				Physically Measurable, Monitorable	Modellable, Predictable
			Single Facility	Project	Neighborhood, Sub-Regional	Watershed, Regional		
Access to Green Space/ Recreation	**People Within Walking Distance to Park/Green Space** (e.g., number of people or percent of population within a certain distance (depending on size of green space) by road network)	Total population within the "walkshed" of vegetated spaces of any size designated for passive or active recreation.			Y	Y	Y	Y
	New Green Space Added Per Person with Access (e.g., acres per person)	Provision of public access to new park or green space previously not accessible (this includes public parcels *not* currently considered accessible recreation parks per Park Needs Assessments, which includes non-park public parcels and non-recreation parks). This definition does not consider private parcels.			Y	Y	Y	Y
Tree Canopy	**Change in Tree Canopy Coverage** (e.g., acreage at project scale)	Total change in tree canopy coverage.			Y	Y	Y	Y

Metric Category	Metric	Metric Definition	Most Meaningful/Relevant Scale				Physically Measurable, Monitorable	Modellable, Predictable
			Single Facility	Project	Neighborhood, Sub-Regional	Watershed, Regional		
Pervious Land Cover	**Change in Area of All Pervious Land Uses** (e.g., square feet at project scale)	Conversion of impervious surfaces (e.g. pavement, rooftops) to pervious surfaces (e.g. bare, gravel, vegetated, or permeable pavement).			Y	Y	Y	Y
Pervious Land Cover	**Change in Area with Groundcover** (e.g., square feet at project scale)	Conversion of unvegetated impervious or pervious surfaces to pervious surface with vegetated groundcover (e.g. grass, forbs, shrubs).			Y	Y	Y	Y
Native Vegetation	**Change in Area of Native Vegetation** (e.g., square feet; square miles)	Conversion of unvegetated impervious or pervious surfaces to pervious surface with native vegetation, in which native vegetation is defined as an assemblage of plants in a specific place or region that has adapted to environmental and biological conditions.			Y	Y	Y	Y
Flood Management	**Peak Flow Rate Reduction** (e.g., cubic feet per second)	Reduction in the flow rates discharged from a watershed under specific storm conditions; high peak flow rates during storms can overwhelm the drainage system and cause localized or regional flooding.		Y	Y		Y	Y

Metric Category	Metric	Metric Definition	Most Meaningful/Relevant Scale				Physically Measurable, Monitorable	Modellable, Predictable
			Single Facility	Project	Neighborhood, Sub-Regional	Watershed, Regional		
Local Economy	**Jobs, new and green** (e.g., # per square mile, differentiating between capital/construction and operations/maintenance)	Total number of new, sustainable jobs supported by SCWP projects.		Y	Y	Y	Y	Y

1.3 Modeling Approach and Example Outputs

To test the efficacy of the Working Group's initial metrics, and evaluate how different SCWP project implementation scenarios could "move the needle" on those metrics in the real world, the Working Group selected the Alhambra Wash as a pilot watershed for this analysis (the "Pilot Analysis"). The Working Group came to a consensus that the Alhambra Wash should be used as a pilot watershed for this study based on the following characteristics:

- Hydrologically isolated (no runoff is flowing into the watershed from upstream areas and all runoff discharges to a downstream waterbody at one common point which enables watershed-scale analysis);
- Manageable size (approximately 15 square miles);
- Data availability (more data allows for more detailed and accurate results); and,
- Represents physical watershed and community conditions (including ratios of Disadvantaged Communities).

The Alhambra Wash contains eight jurisdictions: Alhambra, Monterey Park, Pasadena, Rosemead, San Gabriel, San Marino, South Pasadena, and unincorporated County land. Forty-seven percent (47%) of the population within Alhambra Wash is considered disadvantaged according to the State Water Code definition based on 2018 census blocks whose median income is less than 80 percent of the statewide median household income. This percentage closely aligns with the Countywide average of 46 percent of the population. Finally, land uses within the Alhambra Wash are closely aligned to the land use of the overall Rio Hondo Watershed Area.

The Pilot Analysis screened the subwatershed for hypothetical project opportunities, then modeled various combinations of those opportunities to evaluate how different investment/implementation scenarios advance the Working Group's initial metrics, and subsequently the Goals of the SCWP. To ensure that the analysis considers a technically and financially feasible portfolio of projects, the Technical Team limited the number of projects built during the simulation based on funding opportunities from Measure W's Regional Program. For this analysis, it was assumed that $125 million of Regional Program funds could be available to the Alhambra Wash (treating the pilot watershed as a hypothetical proxy for a full Watershed Area) over a 50-year period. It is acknowledged that if project applicants can leverage funds from outside sources, such as municipal returns from Measure W's Municipal Program, Measures H, A, and M, Caltrans, state grants, federal grants, or others, the number of project opportunities may increase.

The Working Group defined project opportunities as either stormwater capture (**Figure 1-3**) or surface improvements (**Figure 1-4**).

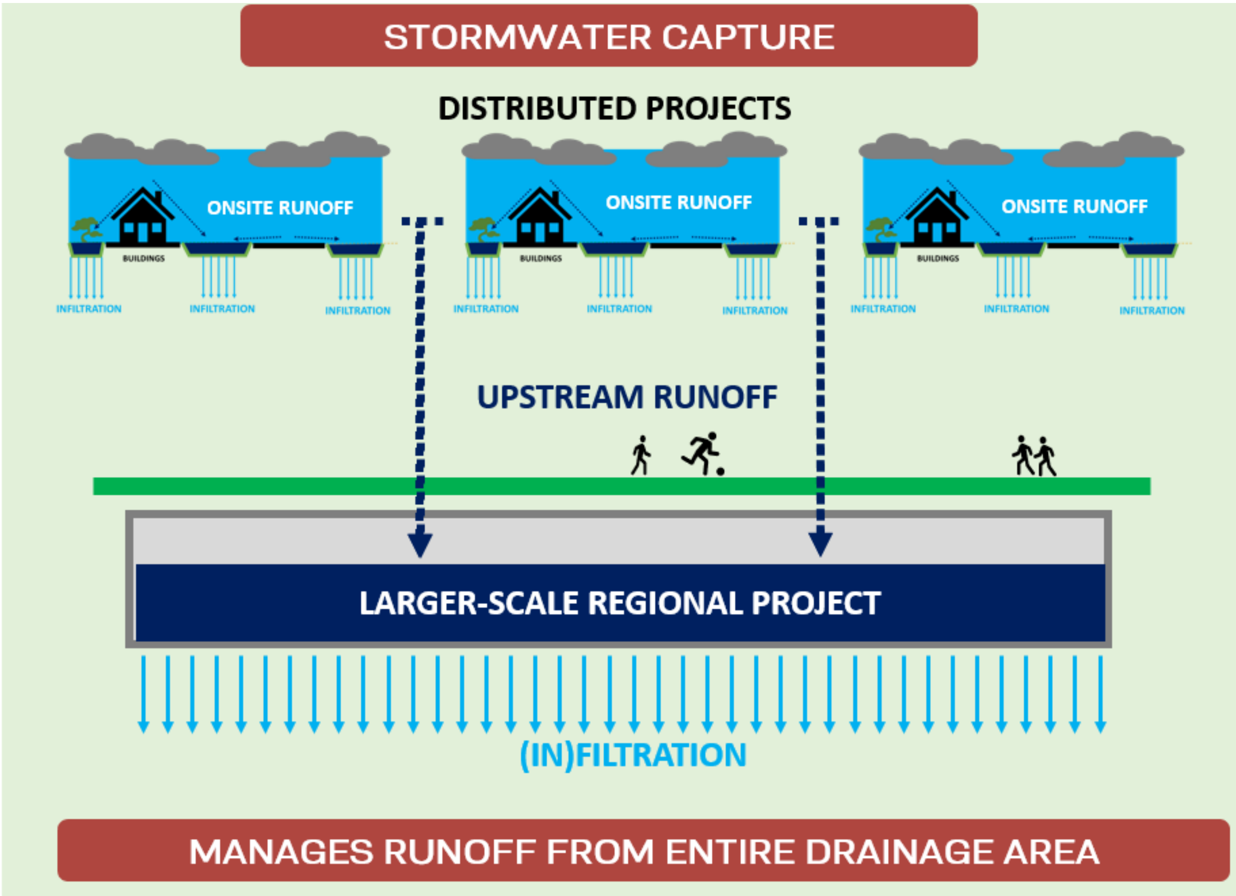

Figure 1-3. Schematic of stormwater capture projects.

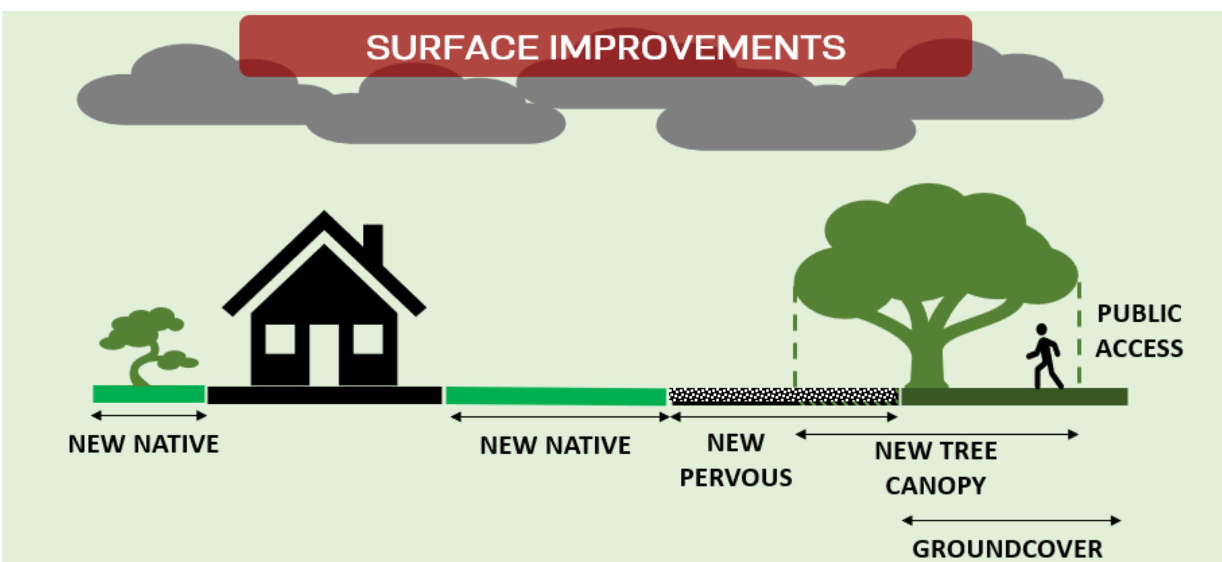

Figure 1-4. Schematic of surface improvement opportunities.

While surface improvements only capture rainwater that falls directly on them, stormwater capture projects are designed to intercept and manage runoff from a contributing drainage area larger than just the footprint of the project (whether that be onsite or offsite). As such, the Working Group chose the following types of stormwater capture projects, categorized into either Nature-Based Solutions, Nature-Mimicking Solutions, or multi-benefit Gray Infrastructure. The building blocks for modeling Nature-Based Solutions, Nature-Mimicking Solutions, and multi-benefit Gray Infrastructure projects are discussed further in **Section 2**, and the Working Group definitions are displayed below, as well as the representative BMP type chosen to model each category of project types.[1]

Stormwater Capture Opportunities

Nature-Based Solutions: Vegetated control measures usually designed to manage onsite surface runoff prior to entering a storm drain, such as rain gardens, bio(in)filtration, tree wells, parkway basins, cisterns that irrigate/overflow to vegetation. Control measures, such as constructed wetlands, are examples of Nature-Based Solutions that can manage runoff from an offsite tributary area. **[Representative BMP Type for Modeling: Rain Gardens]**

Nature-Mimicking Solutions: Unvegetated projects that capture runoff and infiltrate into existing soils, such as infiltration basins/spreading grounds, infiltration galleries, infiltration trenches, and permeable pavement. Bioreactors or low flow diversions that only divert to the sewer network should not be included unless there are associated planted materials. These projects can either manage onsite or offsite runoff. **[Representative BMP Type for Modeling: Infiltration Galleries]**

Gray: Unvegetated projects that capture and store runoff before discharging to the sewer for reclamation *or* filter and discharge back to an open channel. **[Representative BMP Type for Modeling: Storage-to-Sewer or -Filtration]**

Often, Nature-Based Solutions projects are above-ground and are constrained to any area within a parcel outside of an active recreational area. However, Nature-Mimicking and multi-benefit Gray Infrastructure Projects can be built within an active recreational area (i.e., underground). Further, the Technical Team evaluated and modeled hybrid scenarios, such as Nature-Mimicking or multi-benefit Gray Infrastructure Projects that may incorporate natural elements in inactive recreational areas.

The Working Group defines surface improvement opportunities as new tree canopy, groundcover, native vegetation, or permeable pavement.[2] These types of projects could be paired with any of the stormwater capture projects to amplify overall benefits relative to the Working Group's metrics.

Surface Improvement Opportunities

New Trees/Tree Canopy: Native tree canopy added to parcels and road rights-of-way where space is currently available to plant.

New Pervious: Conversion of impervious surfaces to permeable pavement or gravel to maintain current use while allowing rainfall infiltration.

New Groundcover: Conversion of bare ground to native groundcover

Native Conversion: Conversion of existing groundcover to native groundcover

Park Access: Provision of public access to new park or green space previously not accessible.

In screening hypothetical project opportunities, the Technical Team made the following assumptions regarding available footprint:

[1] Note the Working Group's definitions vary from current SCWP Ordinance definitions.
[2] It is acknowledged that permeable pavement can also be designed to manage onsite runoff; however, for the purposes of advancing the "change in area of all pervious land uses" metric, it was assumed that conversion of impermeable area, such as pavement, to permeable pavement would warrant an advancement in this metric.

- **Nature-Based Solutions projects:** Considered for every parcel and road right-of-way opportunity within Alhambra Wash based on available footprint. The available footprint was delineated based on LARIAC Land Cover 2016 data in which it was assumed that rain gardens could be implemented on the following land cover types—grasses/shrubs, tall shrubs, and bare soil—and be at least 10 feet from an existing building. In addition, active recreation areas were not considered for placement of rain gardens. The size of the rain gardens was capped by either the required footprint based on the 85th percentile, 24-hour storm or available site footprint. For this analysis, rain garden boundaries were not spatially defined, rather rain garden area was based on LARIAC Classification sums within each parcel as shown in **Figure 1-5**. For future analyses, it is recommended that rain garden boundaries be spatially defined using LARIAC classification data paired with parcel boundaries and building footprints. To provide a more feasible dataset of rain garden opportunities, flow accumulation raster datasets should be used to rank or screen for viability.

Figure 1-5. Rain gardens developed using the LARIAC Landcover Classification dataset.

- **Regional projects:** Screened watershed for opportunities on public and private land to implement larger stormwater capture projects (either subsurface infiltration galleries or storage-to-sewer or -filter). These larger opportunities were selected based on the following characteristics: available land space based on LARIAC Land Cover 2016 data, ability to capture at least 100 acres of impervious drainage, and proximity to a nearby storm drain to take offsite drainage from. For subsurface infiltration galleries, site topsoil infiltration rates were estimated using the Los Angeles County Soils Type Feature Layer.[3] Examples of regional projects identified, and data used to identify said projects can be seen in **Figure 1-6** and **Figure 1-7.** All 44 potential regional projects identified in the Pilot Watershed symbolized by the land ownership type below.

[3] LA County GIS Portal. Soils Type shapefile. https://egis-lacounty.hub.arcgis.com/datasets/soil-types-feature-layer/explore

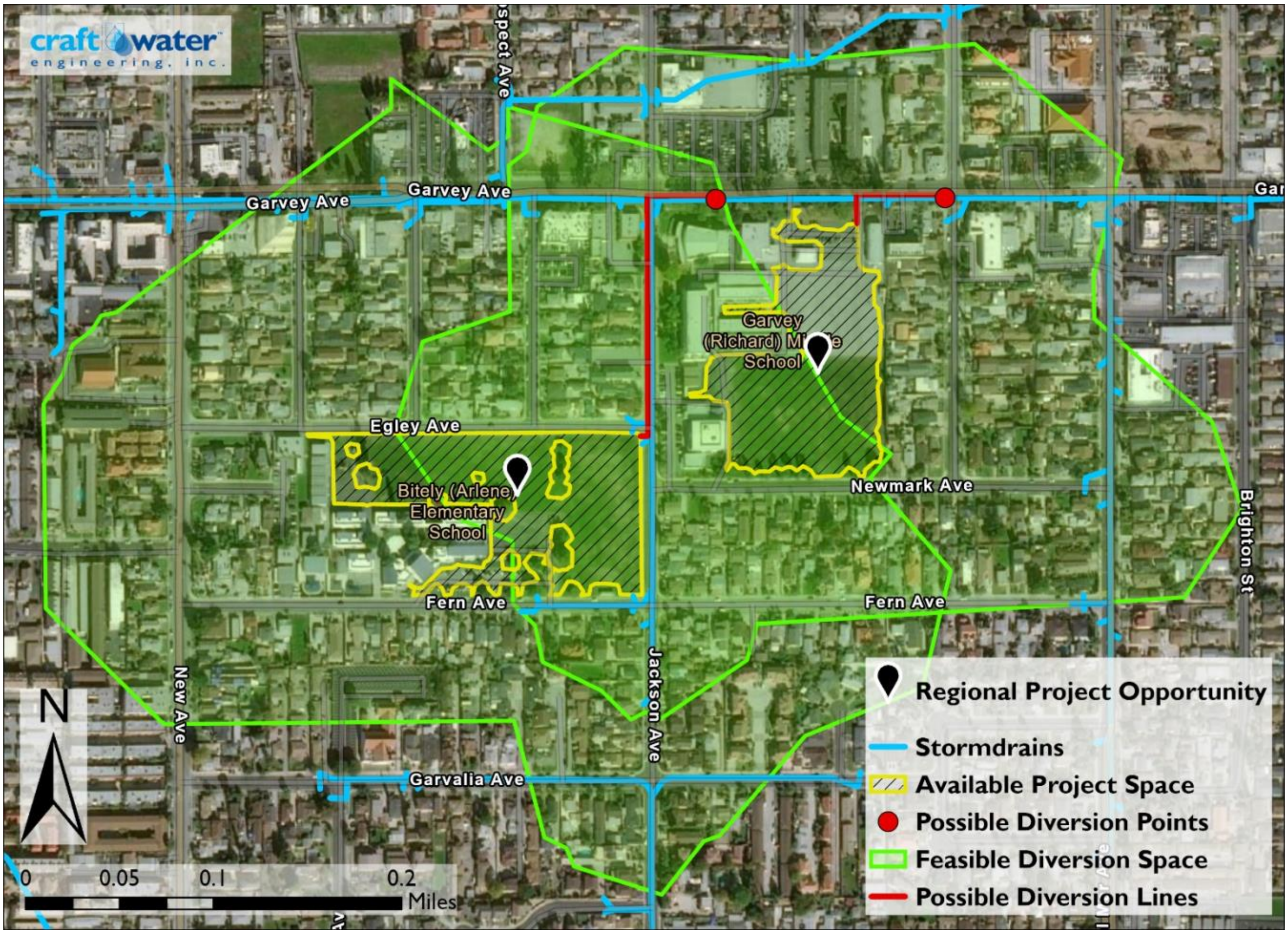

Figure 1-6. Two examples of regional projects identified in the Pilot Watershed.

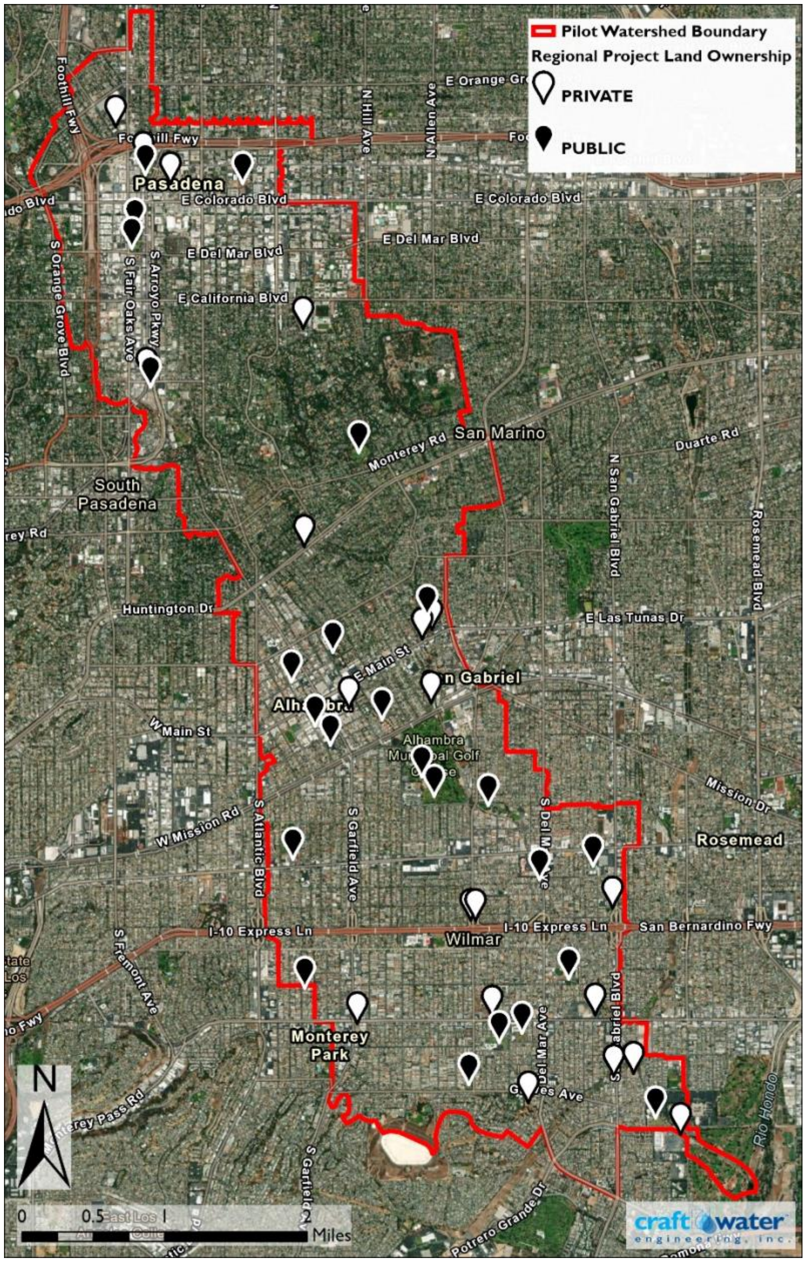

Figure 1-7. All 44 potential regional projects identified in the Pilot Watershed symbolized by the land ownership type.

In screening hypothetical surface improvement opportunities, the Technical Team made the following assumptions. Detailed methodologies can be found in Section 2.3:

- **New trees/tree canopy:** One-half canopy width setback from building or existing tree and one canopy width away from the next new tree (in which the canopy width is dependent on the type of tree planted). Opportunities were only considered on "grasses/shrubs," "tall shrubs," and "bare soil areas" from the LARIAC Land Cover 2016 data classification. Canopy growth curves by tree category and size at planting are detailed in **Section 2.3.2.**
- **New pervious:** New permeable pavement was placed on any area classified as "other paved" (e.g., parking lots, driveways, sidewalks, etc.) from the LARIAC Land Cover 2016 data classification.
- **New groundcover:** New groundcover was placed on any area classified as "bare soil" according to the LARIAC Land Cover 2016 data classification.

- **Native conversion:** Opportunities for native conversion were placed on existing "grasses/shrubs" and "tall shrubs" classified areas from the LARIAC Land Cover 2016 data. Existing native vegetation area was then subtracted from the above sum.
- **Park access:** Public parcels not currently considered accessible recreation parks per L.A. County's Park Needs Assessment (which includes non-park public parcels and non-recreation parks). All areas will be counted toward the new park/green space metric except for a 10-foot buffer from buildings. Private parcels will not be considered.

Where opportunities for trees, groundcover, and native vegetation coincided with Nature-Based Solution opportunities (e.g. rain gardens) based on available BMP footprint, the costs for the coinciding trees, groundcover, and native vegetation were absorbed into the cost of the rain gardens for benefit accounting purposes.

The cost assumptions for the stormwater capture and surface improvement opportunities can be found in **Table 1-4**.

Table 1-4. Cost assumptions for hypothetical project opportunities.

Project Type	Capital Cost	O&M Cost	Data Sources
NBS (Distributed) – *Residential*	$2.1M/acre footprint	1% of capital cost per year = $21,000/acre/year	Low Impact Development Stormwater Control Cost Estimation Analysis for EPA's National Stormwater Calculator
NBS (Distributed) – *Non-Residential Private Parcels*	$1.5M/acre footprint	1.5% of capital cost per year = $22,500/acre/year	City of San Diego Operational Cost Database, American Society of Civil Engineers (ASCE) Environmental and Water Resources Institute (EWRI) Survey of BMP Operations and Maintenance (O&M) Costs, Craftwater Compilation of Southern California Regional Stormwater Project Cost Data
NBS (Distributed) – *Non-Residential Public Parcels and Road Right-of-Way*	$2.1M/acre footprint	$43,000/acre/year	City of San Diego Operational Cost Database, ASCE EWRI Survey of BMP O&M Costs, Craftwater Compilation of Southern California Regional Stormwater Project Cost Data
Nature-Mimicking	Varies by site (function of area, depth, diversion rate)	$68,800/acre/year	Craftwater Compilation of Southern California Regional Stormwater Project Cost Data
Gray	Varies by site (function of area, depth, diversion rate)	$68,800/acre/year + $3,900/year for filter less than or equal to 2.88 cubic feet per second (cfs) or $7,800/year for filter greater than 2.88 cfs	Craftwater Compilation of Southern California Regional Stormwater Project Cost Data
New Trees/Tree Canopy	$150/tree (15-gallon)	$250/tree/year	Kuehler et al., Theodore Payne Foundation for Wild Flowers & Native Plants, Cal Poly San Luis Obispo, Craftwater, TreePeople
New Pervious	$35.43/square feet	$0.50/square feet/year	City of San Diego Operational Cost Database
New Groundcover	$2.05/square feet	$2.71/square feet/year	Craftwater, Homeadvisor, Schill Grounds Management
Native Vegetation	$2.05/square feet	$2.71/square feet/year	Craftwater, Homeadvisor, Schill Grounds Management
Park Access	$4M for parks less than an acre $2M/acre for parks greater than an acre	$5,900/acre/year	Los Angeles Neighborhood Land Trust

Section 4 will describe in detail how metrics will be reported for each investment/implementation scenario and compared against different investment/implementation scenarios for the overall pilot watershed.

2 Methodology for Evaluating Working Group Initial Metrics

This section describes how each metric was defined, what datasets were used to characterize existing conditions, at what spatial scales they were modeled, and how hypothetical projects were simulated throughout the Alhambra Wash pilot watershed to model each metric.

2.1 Water Quality

The Alhambra Wash pilot watershed falls within the Upper Los Angeles River (ULAR) Watershed Management Area (WMA) which is managed by the ULAR Watershed Management Group (Group) (**Figure 2-1**). The ULAR Group is composed of 19 permittees, including 17 cities, the Los Angeles County Flood Control District, and unincorporated areas of L.A. County located in the upstream areas of the Los Angeles River Watershed. The Group was formed to work collaboratively on stormwater management in the region and ensure that the Los Angeles National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit, Order No. R4-2012-0175, along with other regulatory stormwater requirements, are met. Per the Permit requirements, the Group completed an Enhanced Watershed Management Program (EWMP), approved by the Los Angeles Regional Water Quality Control Board (Regional Board) in April 2016, and recently revised the EWMP for submittal to the Regional Board in June 2021. The EWMP identified control measures and the financial strategy required to achieve compliance targets based on applicable Total Maximum Daily Loads (TMDLs) in the ULAR region. With the commencement of the SCWP in Fiscal Year 2019-2020, and with Water Quality being one of the SCWP's fourteen Goals, MS4 permittees are interested in leveraging funding from the Program to help meet their compliance requirements. Prior to the SCWP, most MS4 permittees did not have a dedicated source of funding solely for stormwater management, unlike drinking water or wastewater utilities that rely on ratepayers. The ULAR WMA spans both the SCWP-defined Upper Los Angeles River and Rio Hondo (RH) Watershed Areas managed by the ULAR and RH Watershed Area Steering Committees (WASCs).

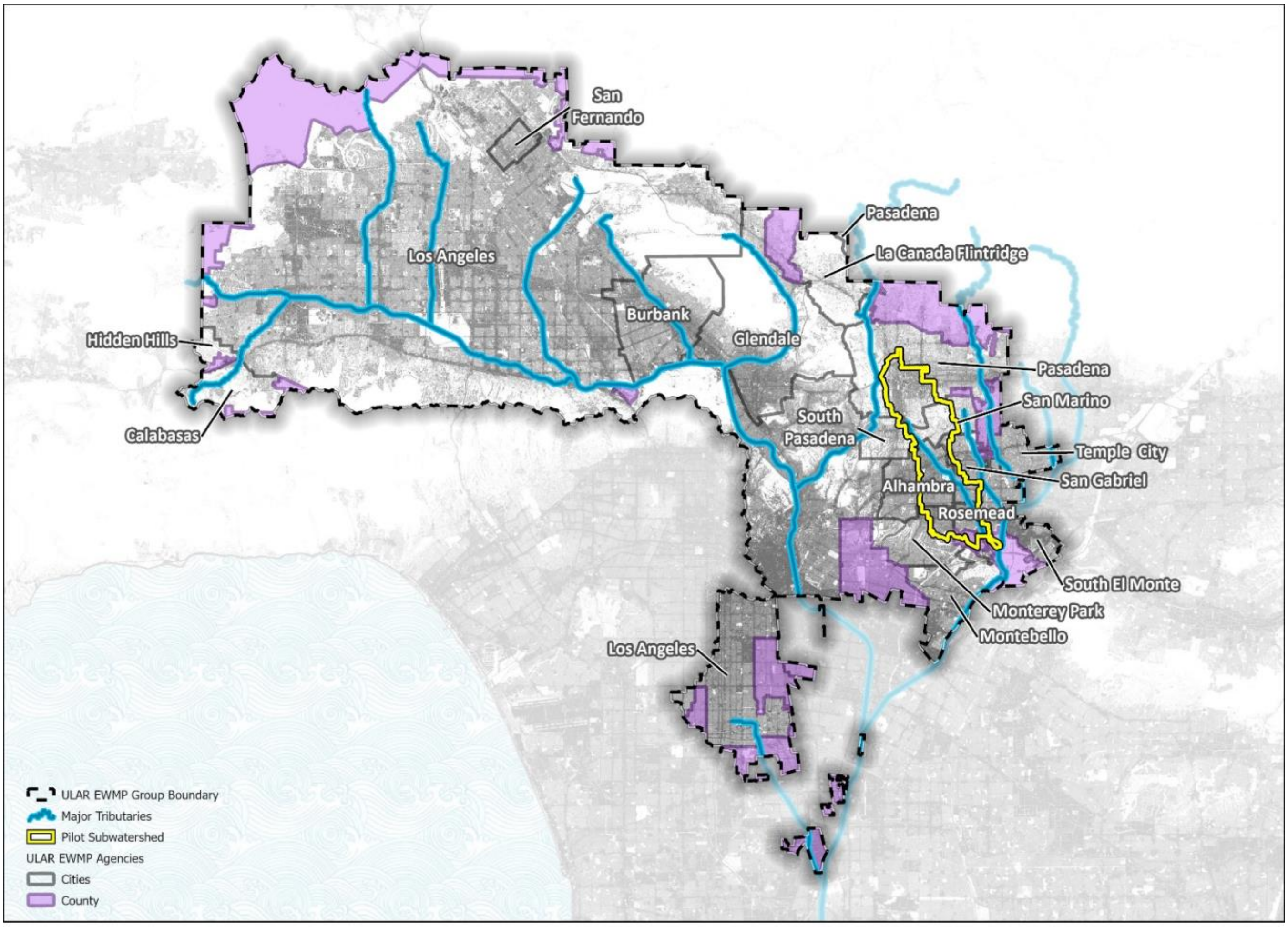

Figure 2-1. Location of the Alhambra Wash pilot watershed within the ULAR WMA.

Figure 2-2 illustrates the hydrology of the Alhambra Wash pilot watershed. Stormwater and urban runoff within the Alhambra Wash pilot watershed flows from the Alhambra Wash to the Rio Hondo above Whittier Narrows Dam to the Whittier Narrows Flood Control Basin. Of note, approximately 90 percent of incoming flows to the Whittier Narrows Flood Control Basin are retained, according to regional watershed modeling. The Whittier Narrows Dam, constructed and operated by the U.S. Army Corps of Engineers, controls downstream releases to the Rio Hondo based on operating rules (**Figure 2-3**). Downstream from the dam, the Rio Hondo combines with the Los Angeles River, which ultimately discharges to the Pacific Ocean at San Pedro Bay. Of note, the modeling results are not impacted by what occurs at the downstream Whittier Narrows dam; rather, the questions regarding Water Supply Benefits, water rights, etc. associated with being upstream of a large spreading grounds are more philosophical in nature and may be explored more in detail with the MMS.

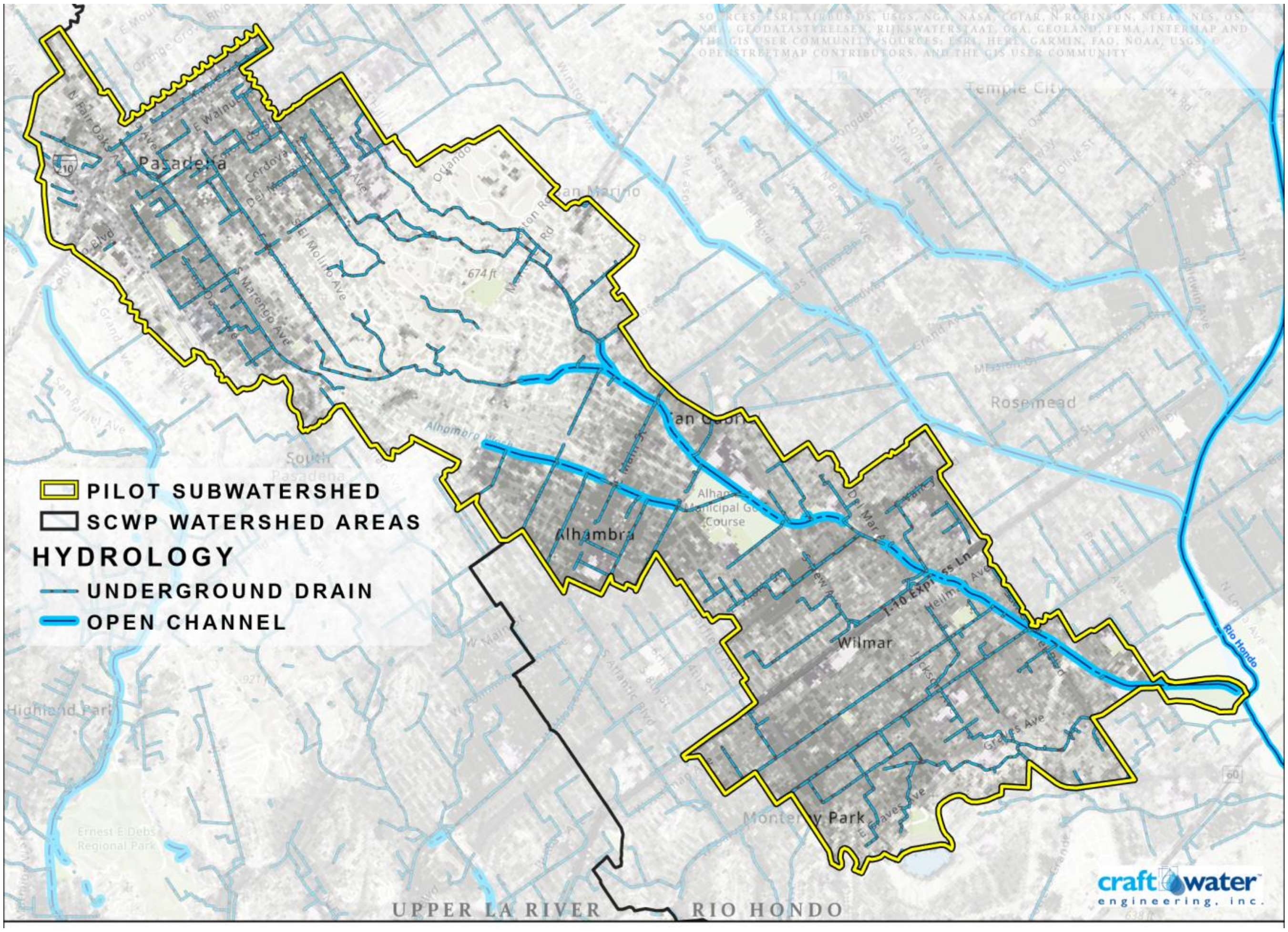

Figure 2-2. Hydrology of the Alhambra Wash pilot watershed.

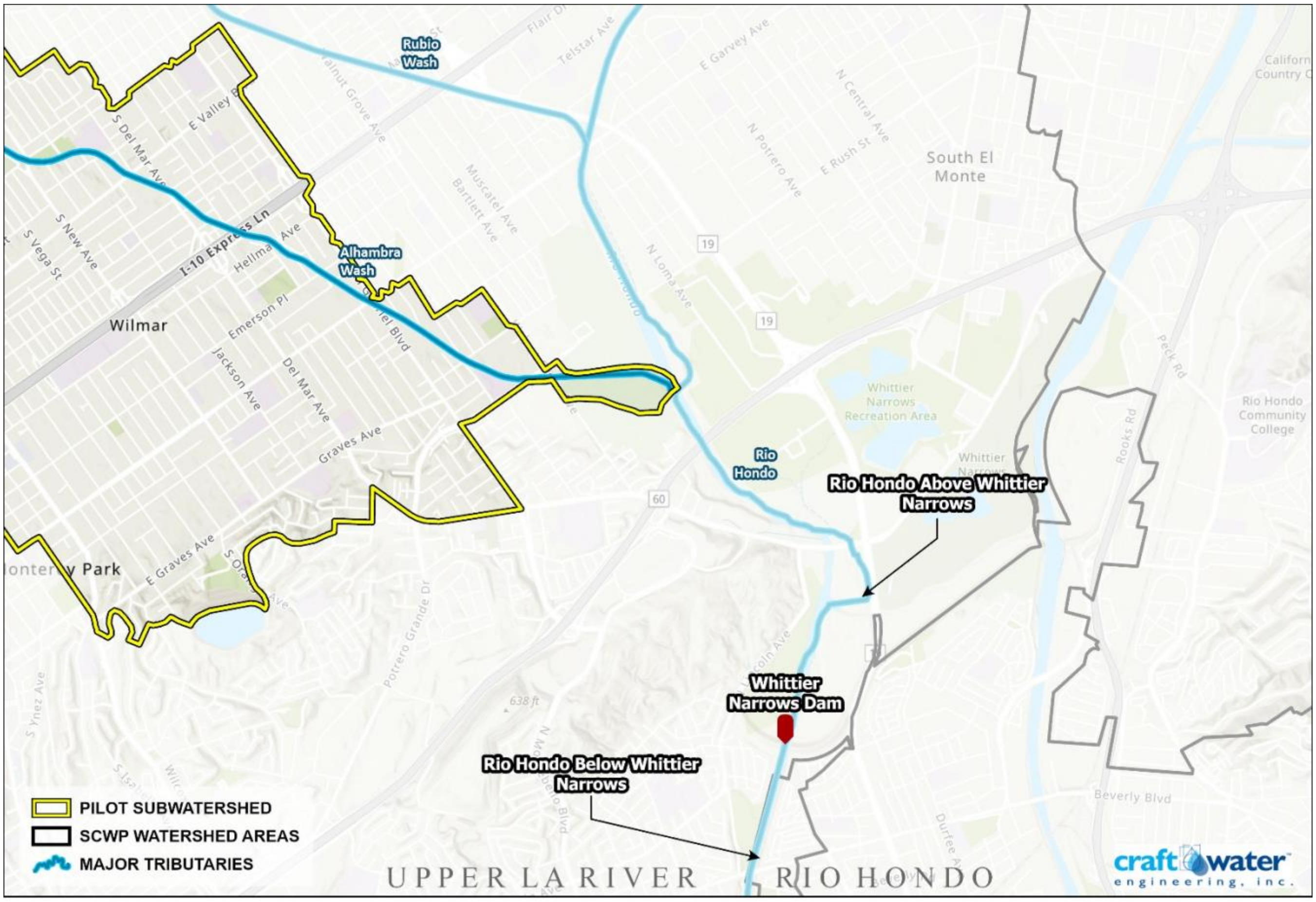

Figure 2-3. Location of the Alhambra Wash relative to the Whittier Narrows Dam.

Beneficial uses form the cornerstone of water quality protection under the Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties.[4] Once beneficial uses are designated, appropriate water quality objectives can be established and programs that maintain or enhance water quality can be implemented to ensure the protection or restoration of beneficial uses. Chapter 2 of the Basin Plan discusses beneficial use definitions in further detail.

Table 2-1. Beneficial uses for waterbodies pertinent to the Alhambra Wash pilot watershed.

Waterbody	Existing	Potential	Intermittent
Alhambra Wash	RARE	MUN, WARM, WILD, REC1*	GWR, REC2
Rio Hondo above Whittier Narrows Dam	RARE, REC2	MUN, WARM	GWR, WILD, REC1*
Whittier Narrows Flood Control Basin	GWR, WARM, WILD, REC1, REC2	MUN, RARE	--

*Access to concrete channels prohibited by Flood Control District
Acronyms: GWR = Ground Water Recharge, MUN = Municipal and Domestic Supply, RARE = Rare, Threatened, or Endangered Species, REC1 = Water Contact Recreation, REC2 = Non-contact Water Recreation, WARM = Warm Freshwater Habitat, WILD = Wildlife Habitat

While the only existing beneficial use at Alhambra Wash is RARE (meaning that the Alhambra Wash supports habitats necessary for the survival and successful maintenance of plant or animal species established under state or federal law as

[4] Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties. https://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/basin_plan_documentation.html

rare, threatened, or endangered), existing beneficial uses of waterbodies downstream of Alhambra Wash are also characterized as being used for water contact recreation, limited contact recreation, and groundwater recharge (**Table 2-1**).

Based on historical data from the Upper Los Angeles River watershed from the last 30 years, water quality impairments have been identified for different tributaries and reaches of the Los Angeles River—as well as the lakes in the ULAR WMA—for bacteria, conventional pollutants, legacy pesticides/toxics, metals, and nutrients. Based on the identified water quality impairments, TMDLs are developed for specific constituents in various water bodies to protect the established beneficial uses. These TMDLs and their associated numeric targets and milestone deadlines are the primary drivers to inform the selection and prioritization of control measures for pollutant load reduction. The TMDLs and applicable water bodies in the ULAR WMA (also called Category 1 Water Body-Pollutant Combinations) are displayed in **Table 2-2**.

Table 2-2. Category 1 Water Quality Priorities for the ULAR Watershed Management Area.

<table>
<tr><th colspan="2">TMDLs</th><th>Constituents</th></tr>
<tr><td colspan="2">Los Angeles River and Tributaries Metals TMDL*</td><td>Copper, Lead, Zinc, Cadmium</td></tr>
<tr><td colspan="2">Los Angeles River Bacteria TMDL*</td><td>E. coli</td></tr>
<tr><td colspan="2">Los Angeles River Nitrogen Compounds and Related Effects TMDL*</td><td>Ammonia-N, Nitrate-N, Nitrite-N, Nitrate-N + Nitrite-N</td></tr>
<tr><td colspan="2">Los Angeles River Watershed Trash TMDL*</td><td>Trash</td></tr>
<tr><td colspan="2">Legg Lake Trash TMDL</td><td>Trash</td></tr>
<tr><td rowspan="5">Los Angeles Area Lakes TMDLs</td><td>Legg Lake System Nutrients TMDL</td><td>Total-P, Total-N</td></tr>
<tr><td>Lake Calabasas Nutrient TMDL</td><td>Total-P, Total-N</td></tr>
<tr><td>Echo Park Lake Trash TMDL</td><td>Trash</td></tr>
<tr><td>Echo Park Lake Nutrient TMDL</td><td>Total-P, Total-N</td></tr>
<tr><td>Echo Park Lake Polychlorinated Biphenyl, Chlordane, and Dieldrin TMDLs</td><td>Sediment: PCBs, Chlordane, Dieldrin</td></tr>
<tr><td colspan="2">Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters Toxic Pollutants TMDL*</td><td>Sediment: DDTs, PCBs, Copper, Lead, Zinc, PAHs</td></tr>
</table>

*As a tributary to the Los Angeles River and Greater Los Angeles and Long Beach Harbors, the TMDLs designated with an asterisk are currently considered applicable to the Alhambra Wash

The ULAR Enhanced Watershed Management Program (EWMP) was developed by the ULAR Group to prescribe control measures for managing the TMDLs listed above. In the EWMP, zinc is one of the "limiting pollutants" under wet weather conditions along with *E. coli* during both dry and wet weather conditions. Limiting pollutants are those that require the most control measures to address (i.e., control measures that address the limiting pollutants are expected to also address all other pollutants of concern). Bacteria in the ULAR WMA is currently being addressed through non-structural source investigation and abatement strategies under one of the SCWP's Scientific Studies: *Adaptation to the Load Reduction Strategy*. Therefore, zinc is currently considered the limiting pollutant driving watershed-wide structural control measure requirements, in relation to the Total Long-Term Pollutant Load Captured and Frequency Exceeding Numeric Water Quality Objectives metrics. There is confidence that projects optimized to capture zinc should be able to also capture non-modeled constituents that have similar fate and transport mechanisms to zinc.

Overall, it is critical that Water Quality metrics are developed at scales that are both environmentally meaningfully and practically measurable. This means that metrics defined for individual projects must directly translate to progress toward attaining beneficial uses in downstream receiving waters.

2.1.1 Total Long-Term Pollutant Load Captured

Definition

The Working Group defined the metric as follows: *"The quality of pollutants captured and prevented from entering the storm drainage system and/or receiving waters; will include pollutants associated with listed impairments."* This metric is meaningful on a project scale to measure how site-specific improvements are reducing the discharge of pollutants to water bodies.

Data Sources and Methodology

Based on the original Watershed Management Modeling System (WMMS) 1.0 model, the Alhambra Wash pilot watershed is 51.3 percent impervious and 48.7 percent pervious.[5] The predominant impervious land uses throughout the Alhambra Wash pilot watershed are single family residential (26.4%), multi-family residential (24.1%), commercial (14.1%), institutional (7.8%), industrial (2.3%), highways (4.2%), and secondary roads (21.0%). This land use distribution is representative of the County's impervious land use distribution as displayed in **Figure 2-4**.

[5] Los Angeles County Public Works and Los Angeles County Flood Control District. Watershed Management Modeling System. https://www.waterboards.ca.gov/losangeles/water_issues/programs/stormwater/municipal/watershed_management/tac/doc/wmms_tac_presentation.pdf

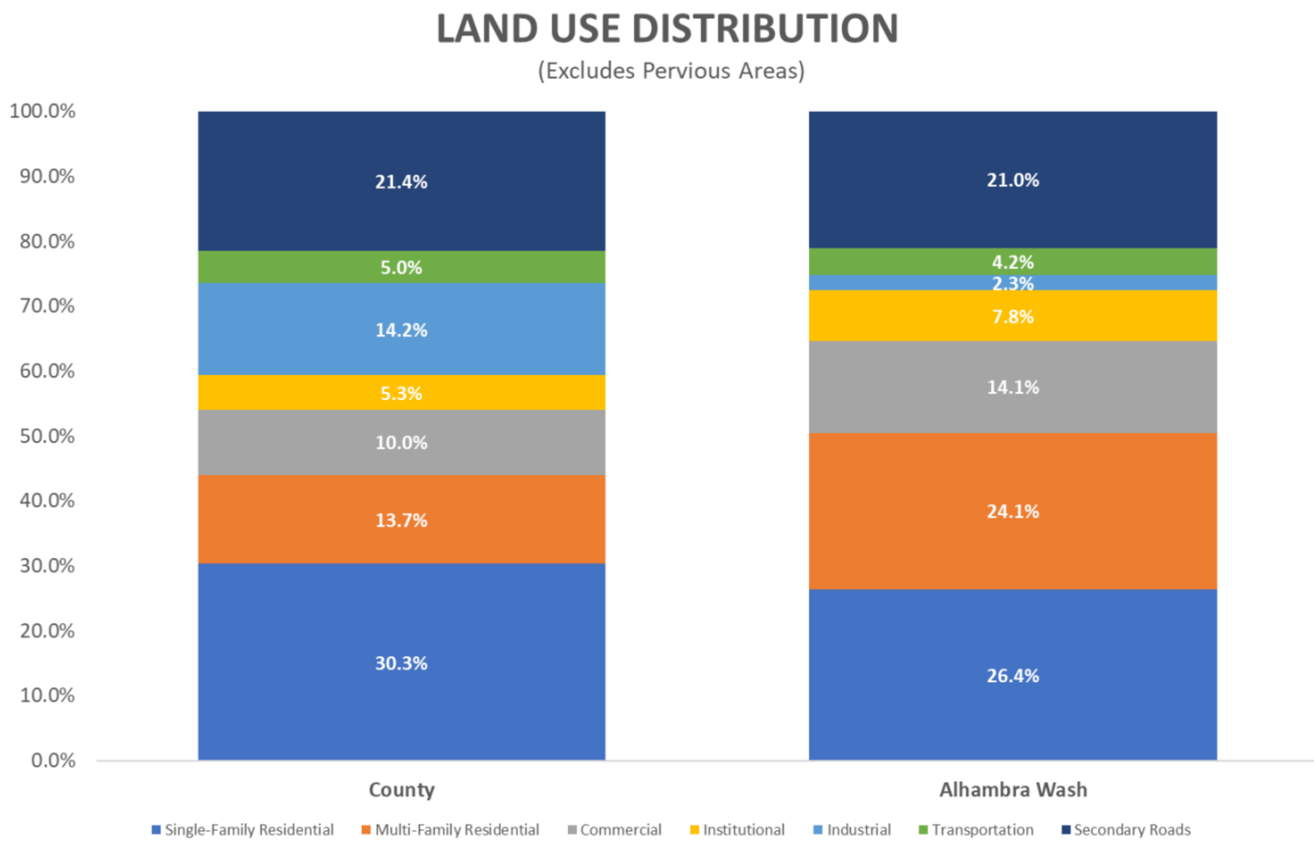

Figure 2-4. Land use distribution of Alhambra Wash and the County.

The Loading Simulation Program C++ (LSPC) model utilized to develop the Rio Hondo/San Gabriel River (RHSGR) Water Quality Group's revised Watershed Management Program (rWMP) was used to model the baseline pollutant loading from projects' contributing drainage areas over a 10-year period (Water Years 2002 to 2011). This model was locally calibrated to the data within the RHSGR Water Quality Group's boundaries (upstream of the Alhambra Wash pilot watershed) as well as monitoring data collected in the Los Angeles River at the Wardlow Road gauging station (downstream from the Alhambra Wash pilot watershed).

Regional projects' contributing drainage areas were delineated using geospatial data associated with the LSPC subwatersheds and verified/corrected using further geospatial analysis when full subwatersheds did not coincide with project locations and where subsurface storm drains overlapped. Digital stormwater pipe inventories and high-resolution Light Detection and Ranging (LiDAR) elevation data was used to accomplish subwatershed splitting.

Hydrologic response units (HRUs) form the basis of modeling baseline pollutant loading; HRUs represent unique combinations of land use, soil hydrologic group, and slope that produce similar runoff and water quality response. A shapefile of HRUs, obtained from the WMMS 1.0 model, were clipped to regional projects' contributing drainage areas and used to model runoff and water quality baseline timeseries. For distributed projects, the impervious acreage of each site was used for the drainage area, since onsite projects are required to only capture the 85th percentile, 24 hour storm event volume from the impervious portion of their sites. Water quality parameters that can be modeled within WMMS 1.0 include sediment, nutrients (total nitrogen and total phosphorus), heavy metals (total copper, total lead, and total zinc), and fecal coliform. To note, the RHSGR calibrated model was set up to simulate the source, transport, and fate of sediment, copper, lead, and zinc. Pollutant loads were simulated with associated sediment loading (where metals are connected with the processes of sediment buildup, wash-off, and transport via rainfall events or irrigation runoff).

Once the baseline runoff and pollutant loading hourly time series were generated for distributed and regional projects, project performance was evaluated relative to a project's baseline runoff and pollutant loading. A custom BMP modeling Python script was used to improve upon certain modeling limitations in the EPA's System for Urban Stormwater Treatment and Analysis Integration (SUSTAIN). This custom model is grounded in the physical BMP representations used in SUSTAIN, and it provides built-in optimization algorithms to more systematically automate the process of evaluating countless different project configurations to select a cost-effective solution related to project goals. It is important to note that a project's performance is subjected to what can be diverted into the BMP; a project may not be able to divert all the baseline runoff and pollutant loading due to inflow, storage, and outflow capacities at each hourly timestep. The baseline loading that is not able to be diverted into the BMP will instead be bypassed downstream.

Table 2-3 displays the BMP modeling parameters for each representative BMP type and category as agreed upon by the Working Group. The representative BMP type for each BMP category (Nature-Based Solutions, Nature-Mimicking Solutions, or Gray) exemplify the highest-performing type of BMP within the BMP category in terms of Water Quality and Water Supply benefits. It is important to note that maximum available BMP footprints for each type of BMP category were delineated based on protecting the existing uses at the site, such as baseball fields or parking lots. For example, it would not be feasible to implement a constructed wetlands on a recreational field currently used for baseball or soccer; therefore, possible incorporation of Nature-Based Solutions would take the form of vegetated bioswales in unoccupied areas at the site.

In terms of BMP performance, infiltration-based BMPs are assumed to remove 100 percent of the runoff and pollutant loading that can be diverted into the BMP. Effluent Concentration Limits (ECLs) based on industry standard filtration devices were used to model the BMP performance of filtration based BMPs.

Table 2-3. BMP modeling parameters for each representative BMP type and category.

BMP Category	Representative BMP Type	Modeling Parameters
Nature-Based Solutions project	Rain garden	85th percentile, 24-hour event volume (ac-ft)
		Infiltration rate (in/hr)
		Maximum available footprint (ac)
		Media volume depth (ft)
		Number of diversions
		Ponding depth (ft)
Nature-Mimicking Solutions project	Subsurface infiltration gallery	Diversion invert elevation below ground surface (ft)
		Diversion rate (cfs)
		Diversion type (gravity or pumping)
		Infiltration rate (in/hr)
		Inline or offline diversion (diversion length in ft, if applicable)
		Maximum available footprint (ac)
		Number of diversions
		Ponding depth (ft)
Multi-benefit Gray Infrastructure Project	Storage-to-sewer and/or -filtration	Diversion invert elevation below ground surface (ft)
		Diversion rate (cfs)
		Diversion type (gravity or pumping)
		Filtration unit rate (cfs)
		Inline or offline diversion (diversion length in ft, if applicable)
		Maximum available footprint (ac)
		Number of diversions
		Ponding depth (ft)

Projects that interact in series, or "nesting," are taken into consideration to accurately assess both Water Quality and Water Supply benefits associated with different scenarios and timelines when projects upstream or downstream of other projects are turned "on" or "off." The modeling evaluates how upstream projects built after a downstream project would potentially "reduce" the Water Quality and/or Water Supply benefits of the downstream project (i.e., because the upstream project is capturing water and pollutants that would have otherwise been treated downstream). Because of the "reduction" of Water

Quality and/or Water Supply benefits, the downstream project would not necessarily reap the same Water Quality and Water Supply benefits that it would have received if no upstream project was built. The Technical Team is able to temporally model the phased implementation of projects to quantify the changes in Water Quality and Water Supply benefits as nesting of watershed projects occur.

2.1.2 Volumetric Capture Proxies

Consistent with the 2012 Municipal Separate Storm Sewer Systems (MS4) Permit and the current Safe Clean Water Program scoring criteria, the volumetric capture of the 24-hour 85th percentile design storm was modeled for each project. The Enhanced Watershed Management Programs (EWMPs) and Watershed Management Programs (WMPs) utilize 24-hour volumetric capture targets to assess compliance and progress with Total Maximum Daily Load (TMDL) deadlines.

Definition

The Working Group defined the metric as follows: *"The volume of water captured over a specific time period as a surrogate for pollutant capture; often expressed as a 24-hour volume managed/treated."* The Working Group agreed that this metric may not be as meaningful as others for measuring improvement toward beneficial use attainment; however, the Working Group is interested in seeing how results of this analysis correlate with pollutant load, especially because jurisdictions have the option to use design storm runoff volume retention as an alternative compliance pathway.[6]

Data Sources and Methodology

Geospatial isohyetal data from the Los Angeles County GIS portal was used to select the 85th percentile rainfall (in inches) for modeling the 24-hour, 85th percentile design storm. The 85th percentile rainfall corresponding to the centroid of a projects' drainage area was used. This number was then multiplied by the incremental unit hyetograph per the Los Angeles County Department of Public Works Hydrology Manual to obtain the appropriate 85th percentile design storm for modeling. The unit hyetograph provides the temporal distribution of one inch of rainfall occurring over a 24-hour period. Each project's drainage area will be subjected to the 85th percentile rainfall timeseries to estimate the 24-hour event volume from the 85th percentile storm. A project's volumetric capture of the 85th percentile storm is dependent on the timeseries of its inflow, storage, and outflow capacities over a 24-hour period.

The volumetric capture can be compared with 24-hour volumes assigned to each jurisdiction within the Alhambra Wash per the 2016 ULAR EWMP (accepted by the Los Angeles Regional Water Quality Control Board) to assess how project implementation contributes to jurisdictional 24-hour volumetric capture targets, which is 355 acre-feet for the Alhambra Wash.

2.1.3 Frequency Exceeding Numeric Water Quality Objectives

Definition

The Working Group defined the metric as follows: *"Monitoring or modeling how often pollutant concentrations in a storm drain or receiving water body exceed the numeric objectives specified in the Basin Plan, Total Maximum Daily Loads (TMDLs), California Toxic Rules (CTR), Municipal Action Levels (MALs), etc. for listed impairments. Also includes frequency of unpermitted non-stormwater (dry weather flow) discharge."* This metric is most meaningful when considering water quality improvements at a regional scale (i.e., the quality of water discharging from a storm drain outfall or in a downstream receiving water).

[6] Section X.B.2.b.iii. of the Regional Phase I MS4 Permit (Order No. R4-2021-0105) states: "A Permittee shall be deemed in compliance with final WQBELs and receiving water limitations…if it has retained all conditionally exempt, non-essential non-stormwater…and all stormwater runoff up to and including the volume equivalent to the applicable receiving water for that waterbody provided the Permittee is implementing all actions and schedules in an approved Watershed Management Program."

Data Sources and Methodology

This analysis assessed the frequency that runoff concentrations exceed numeric water quality objectives for zinc because zinc is one of the limiting pollutants under the ULAR EWMP. Long-term timeseries of modeled daily zinc loadings from project drainage areas were compared against long-term timeseries of modeled daily zinc targets for wet weather days because the majority of pollutant load reductions are required during wet weather to meet applicable standards. For this analysis, wet weather days are defined as any day with rainfall greater than 0.1 inch and the subsequent three days; however, this definition can also vary based on the critical conditions specified in the TMDLs. As rainfall varies spatially and temporally, the most downstream location of the Alhambra Wash was designated as the compliance location for flagging wet weather days for the purposes of this analysis. It is important to use the most downstream compliance target to accurately assess progress with water quality improvements due to projects implemented within the tributary area of the receiving water body to ultimately protect the beneficial use of the applicable receiving water body.

Numeric water quality targets for the Metals TMDL are based on the numeric water quality criteria established by the California Toxics Rule (CTR) to protect beneficial use of the receiving water body. The acute and chronic CTR equations determine concentrations that cannot be exceeded to protect aquatic life health. Specifically in this analysis, the acute CTR criteria is used to determine metal TMDL loading capacities and waste load allocations, as acute criteria are protective of aquatic life conditions during wet weather. CTR equations are dependent on the 50th percentile hardness values as well as conversion factors to convert from dissolved to total recoverable metals (total recoverable metals is what is able to be modeled in LSPC; however, the dissolved criteria is the appropriate criteria to protect aquatic life). Hardness values and conversion factors were updated based on more recent monitoring data (1996-2017) from Mass Emission Station S10 (Los Angeles River at Wardlow). Based on the updates, the revised zinc numeric water quality target utilized for this analysis is 173 µg/L (was previously 159 µg/L under Resolution No. R15-004). Wet days in which exceedances of the 173 µg/L numeric target were observed were flagged and are referred to as “wet exceedance days.”

Recognizing that this metric is more appropriate at the MS4 outfall scale rather than the project scale, the Technical Team devised the following metric that could be modeled and measured at the project scale: Wet Day Long-Term Pollutant Load Captured. The definition of this metric is similar to the “Total Long-Term Pollutant Load Captured” except that it only considers reductions that occur on “wet exceedance days” in order to avoid “taking credit” on the days where pollutant load reduction may not be as meaningful (i.e. on days in which water quality standards are already met).

2.1.4 Attainment of Biological Objectives

Definition

The Working Group defined the metric as follows: *“Biological indices used to describe the health of streams based on their benthic macroinvertebrates; typically based on observation of ecosystem structure and function, and measurement of the observed taxa in a receiving water compared to expected taxa (e.g., California Stream Condition Index).”* The Working Group agreed that Biological Objectives measured at a watershed scale are one example of a metric that is closely related to beneficial use attainment in the receiving waters.

Data Sources and Methodology

Although Attainment of Biological Objectives is not written into the Basin Plan or TMDLs within Los Angeles County, the Working Group agreed that it would be beneficial to assess this metric at the watershed/regional scale, similarly to the San Diego Regional Water Quality Control Board. While chemistry-based approaches have been successful in certain instances for certain beneficial uses, they are essentially numerical proxies for protection and restoration of aquatic life beneficial uses. Use of biological objectives in addition to existing chemical, physical, or toxicological water quality objectives represents a more holistic approach to evaluating water quality by providing a metric to assess the relationship between chemical, physical, and biological conditions.

The California Stream Condition Index (CSCI) scores map was used to assess the current stream health of Alhambra Wash. Alhambra Wash has a CSCI score of 0.39, indicating that it is very likely altered (**Figure 2-5** and **Figure 2-6**).[7] The CSCI technical memorandum details the following about the tool:[8]

"The California Stream Condition Index (CSCI) is a new statewide tool that translates complex data about individual benthic macroinvertebrates (BMIs) living in a stream into an overall measure of stream health. The CSCI represents the latest generation of biological indicators for assessing stream health in California. The CSCI combines two separate types of indices, each of which provides unique information about the biological condition at a stream: a multi-metric index (MMI) that measures ecological structure and function, and an observed-to-expected (O/E) index that measures taxonomic completeness. Unlike previous MMI or O/E indices that were applicable only on a regional basis or under-represented large portions of the state, the CSCI was built with a statewide dataset that represents the broad range of environmental conditions across California."

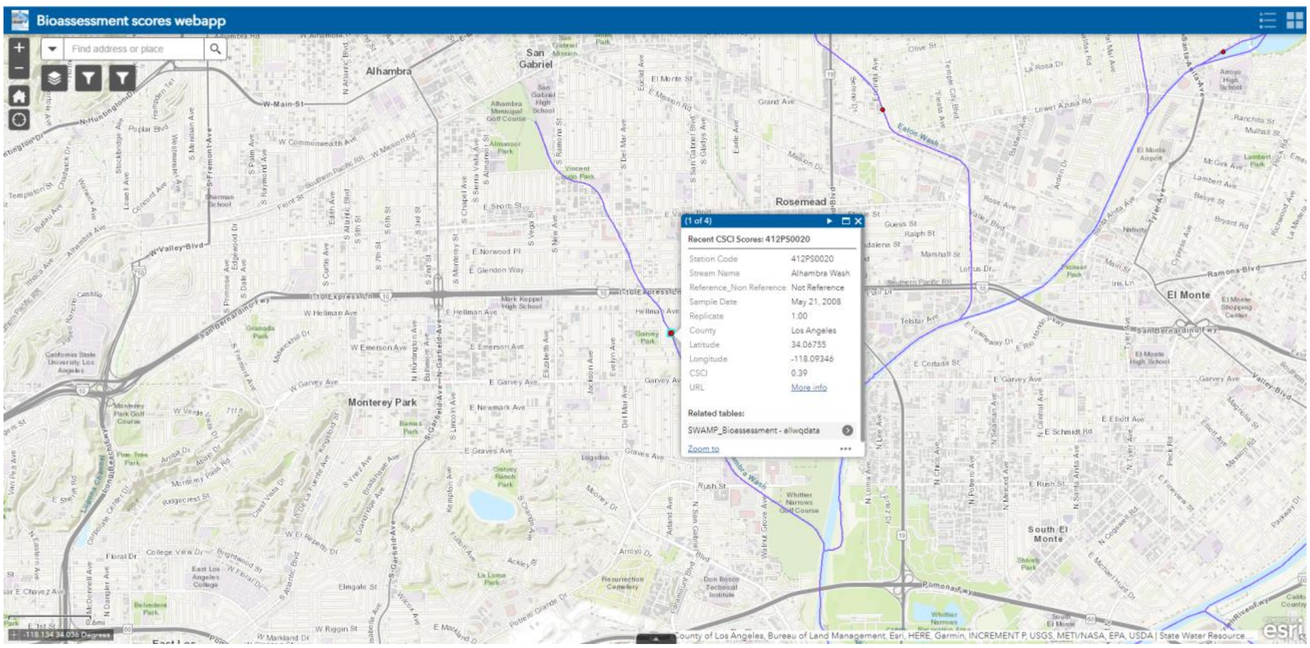

Figure 2-5. CSCI Score for the Alhambra Wash.

[7] California Stream Condition Index (CSCI) Scores Map. https://waterboards.maps.arcgis.com/apps/webappviewer/index.html?id=ea4edd2400b845959a791666ee0a8c09

[8] The California Stream Condition Index (CSCI): A New Statewide Biological Scoring Tool for Assessing the Health of Freshwater Streams. https://www.waterboards.ca.gov/water_issues/programs/swamp/bioassessment/docs/csci_tech_memo.pdf

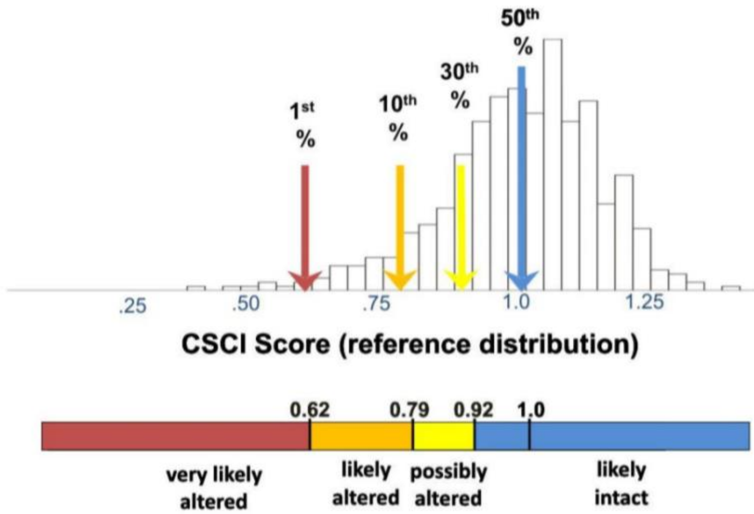

Figure 2-6. Distribution of CSCI Scores at Reference Sites with Thresholds and Condition Categories (Source: CSCI).

In addition, SCCWRP (Southern California Coastal Water Research Project) developed a web-based interactive mapping program (the Stream Classification and Priority Explorer (SCAPE) web app) to help watershed stream managers visualize where they are more likely or less likely to find success in improving stream condition. The web app maps data generated by a new computer modeling tool that predicts the degree to which stream biointegrity scores are likely to be limited, or constrained by urban and agricultural development. For the Alhambra Wash, the 95th percentile potential CSCI score is 0.72; therefore, Alhambra Wash is classified as likely constrained.

There may not be sufficient information to characterize how changes to the landscape due to different structural solutions will increase the CSCI score due to the lack of a readily available automated tool needed to calculate the score (under development by the State Water Board). Therefore, it is not be possible to characterize direct changes to the baseline CSCI score for the Alhambra Wash at this time given the lack of high-resolution data at the project scale. It is recommended that this metric be retained for measuring the success of the overall SCWP program once more funded projects are in the ground.

2.1.5 Recreational Facility Closures

Definition

The Working Group defined the metric as follows: *"The number of days per year when surface waters designated in the Basin Plan with recreational beneficial uses are closed to recreation due to water quality impairments."* This metric is most directly tied to public health goals. With beaches being a significant tourist attraction in California as well as an integral part of California's culture and economy, ocean waters adjacent to beaches must be safe for swimming and other recreational use. When certain bacteria are present in sufficient concentrations, they pose a health hazard for swimming. Inland water bodies can also pose pathogen risks to those who come in contact during fishing, hiking, boating, or other recreation.

Data Sources and Methodology

Specific to the Alhambra Wash, the nearest recreational facility is Legg Lake, located at the Whittier Narrows Flood Control Basin, approximately 1.25 miles from the mouth of where the Alhambra Wash outlets into the soft-bottomed portion of the Rio Hondo River. Legg Lake is a recreational facility where the public can enjoy kayaking and fishing. According to the ULAR CIMP, Legg Lake receives drainage directly from the Rio Hondo MS4 outfall located in a parkway adjacent to Lerma Road near the intersection with Fawcett Avenue, to which unincorporated County land and South El Monte contribute. Based on satellite imagery, it is unclear whether any flows from the Rio Hondo are diverted into Legg Lake via underground conveyance structures. It was concluded that there is insufficient data to perform a causal analysis of whether bacteria exceedances in the Alhambra Wash contribute to any recreational closures at Legg Lake without further site investigation and hydrodynamic modeling. Instead, dry weather monitoring data from 38 MS4 outfalls within the Alhambra Wash was used as a proxy to calculate the frequency of bacteria exceedances above the applicable water quality objective (320 MPN/100 mL for single samples according to the State Water Resources Control Board Bacteria Provisions published in February 2019).

Based on limited recreational facilities within the Alhambra Wash and uncertainty of whether tributaries to the Rio Hondo and the Rio Hondo itself drain to Legg Lake, this metric may not be appropriate for this pilot watershed. Additionally, while the Rio Hondo upstream from Whittier Narrows, and the Whittier Narrows Dam Flood Control Basin itself, are designated for contact and non-contact water recreation, flows contributing to these receiving waters from the Alhambra Wash are commingled with significant upstream contributions; this confounds the ability to model facility closures without also modeling the entirety of the Rio Hondo watershed. The ULAR Group is moving toward non-structural control strategies to address bacteria exceedances, rather than structural controls, whereas this analysis is focused on a variety of Nature-Based Solutions, Nature-Mimicking Solutions, and multi-benefit Gray structural controls. This metric is most meaningful when evaluating a full watershed in the context of receiving waters that support recreational use; it is therefore recommended that this metric be retained for potential use in other watersheds, such as coastal watersheds, which can be more affected by recreational closures due to poor water quality.

2.2 Water Supply

The Working Group came to a consensus on several metrics related to the Water Supply Goal, which, in several instances, diverge from interpretations of those metrics by some SCWP oversight committee members.

The Alhambra Wash is located upstream of the Whittier Narrows Flood Control Basin, a large-scale spreading grounds facility. Approximately 90 percent of runoff entering Whittier Narrows is retained there (based on long-term averages), although it is uncertain how much water at Whittier Narrows is evaporated that could have otherwise been infiltrated upstream. There is also uncertainty whether Whittier Narrows is recharging usable aquifers downstream compared to what could potentially be infiltrated upstream via other projects. Working Group members generally favored crediting Water Supply Benefits to projects upstream of spreading grounds which differs from opinions expressed by various SCWP committee members. While Whittier Narrows is outside of the Pilot Watershed Area, the Technical Team can inform recommendations by modeling the long-term evapotranspiration expected from the flood control basin, and recommends monitoring evaporation at Whittier Narrows to inform decisions on how credit may be attributed to upstream projects.

Working Group members agreed that Water Supply Benefits should be attributed to projects that infiltrate to shallow groundwater aquifers, which also differs from some SCWP committee members' opinions that only water reaching a deep aquifer managed for drinking water should count as a Water Supply Benefit. One Working Group member had noted that some industries use shallow wells for process water, and that any potable water not used for process water, irrigation, etc., should count as a Water Supply Benefit. Water infiltrated to shallow aquifers may also contribute to downstream stream interflow, which provides an environmental water supply to support ecosystems.

Finally, while the Scoring Committee has thus far given Water Supply Benefit points to any project that claims to be diverting to a future water reclamation facility, Working Group members clarified that Water Supply Benefits should be attributed to reuse programs only if dedicated funding plans and resources are already in place, such as Operation NEXT at Hyperion Water Reclamation (owned by L.A. Sanitation) located in Playa Del Rey and the Joint Water Pollution Control Plant (owned by Los Angeles County Sanitation Districts) located in Carson.

The Technical Team recommends that the Magnitude of Water Use Offset and Relative Water Demand Augmented or Offset be consolidated into a single metric because they are reporting the same thing (the first metric reports in absolute quantities while the latter metric reports in percentages).

2.2.1 Magnitude of New Water Captured

Definition

The Working Group defined the metric as follows: *"Acre-feet of new urban runoff and/or stormwater captured to replenish or augment local supply, or to sustain or improve environmental baseflows, on an average annual basis; includes all water infiltrated below the root zone (i.e., deep percolation) and all water delivered to a sewer tributary to an existing or planned reclamation/reuse facility."* This definition deviates from the current SCWP scoring criteria in that it credits environmental flows, which could turn any filtration BMP into a Water Supply Benefit ***if*** it is confirmed by biologists that the downstream receiving water body requires water to sustain its ecosystems. It is important to note that baseline environmental water demand may be currently unknown for most receiving waters and ecosystems and will thus require environmental studies.

Data Sources and Methodology

Using the runoff timeseries described in Section 2.1.1, the Magnitude of New Water Captured is calculated by subtracting the flows bypassing a project from the flows diverted into a project, where the inflow, storage, and outflow of the project govern the water that can be captured. The Technical Team ensured that there was no "double counting" of water due to nested projects.

2.2.2 Magnitude of Water Use Offset

Definition

The Working Group defined the metric as follows: *"Potable or non-potable water use offset by capturing and using local stormwater or urban runoff, including for irrigation of vegetation in both manmade and natural systems."*

Data Sources and Methodology

While there are different endpoints for onsite use of captured stormwater, such as for irrigation, groundwater recharge, toilet flushing, or laundry, among others, irrigation remains one of the most popular endpoints for captured stormwater in many of the SCWP projects submitted thus far. At the project site, irrigation demand for vegetated surfaces could be partially offset by dry weather flows; however, this is site-dependent and requires more detailed feasibility analysis than in the scope of this Pilot Analysis. Dry weather flows are typically tapped as a resource for irrigation reuse because the volume is more manageable, reliable, and appropriate for use as an irrigation water source. Irrigation does not typically occur during wet weather events, and the large runoff volumes collected during these events would not likely be used on-site within recommended storage volume drawdown time periods (96 hours). There is typically adequate available storage in the BMP during dry conditions to capture all dry weather flows and either filter them for irrigation use or allow them to discharge normally. Using the runoff timeseries described in Section 2.1.1, dry weather flows were screened using an R script based on whether there was no rain in the preceding 24 hours and whether flows were smaller than two cubic feet per second.

Without water metering data from the agencies that manage the parcels, monthly demand estimates for irrigated areas of project sites can be calculated using the Simplified Landscape Irrigation Demand Estimate (SLIDE) rule which uses the same years of evapotranspiration data from the California Irrigation Management Information System (CIMIS) as the water years used for the hydrologic and water quality modeling. Using data from the Los Angeles Region Imagery Acquisition Consortium (LARIAC) Land Cover 2016 dataset,[9] the area of tree canopy and grasses/shrubs were calculated based on the methodology described in Sections 2.3.2 and 2.3.3. The landscape water demand is displayed below:

$$Landscape\ Water\ Demand\ (gal.) = ET_o \times PF \times LA \times 0.623$$

Where:

- ET_o is inches of historical average or real-time reference evapotranspiration data in inches for the period of interest;
- PF is the plant factor (0.5 for tree canopy and 0.8 for grasses/shrubs);
- LA is the landscape area, in square feet; and
- 0.623 is the factor to convert inches of water to gallons.

If the dry weather flow supply for a given month exceeded irrigation demand for a corresponding month, then the irrigation demand for the month was utilized and vice versa. The bigger of the two numbers for each given month were used and summed for the twelve months to obtain the average annual Magnitude of Water Use Offset at the project site scale.

However, recognizing that this metric is site-dependent, given that the use of captured stormwater onsite varies by agency or client, and there could be different endpoints for captured stormwater other than irrigation, the Technical Team did not model this metric for every project. However, the Working Group still recommends that this metric be included in *Feasibility Guidelines* applications so that project proponents can demonstrate how they are reducing demand for imported water through onsite use of captured stormwater.

[9] LARIAC Land Cover 2016 Dataset: https://lariac-lacounty.hub.arcgis.com/

2.2.3 Relative Water Demand Augmented or Offset

Definition

The Working Group defined the metric as follows: *"Percentage of local water demand augmented/offset based on the sum of the two metrics above; baseline local water demand estimated using residential per-capita potable water use."*

Data Sources and Methodology

The Working Group recognized that this metric may not be meaningful at the project scale because one individual stormwater project is likely not to significantly reduce water demand region wide; rather, the sum of projects is likely to meaningfully contribute to an offset in residential water demand and thus, the Working Group agreed that it is useful to estimate the water demand augmented or offset at a Program scale. The paragraphs below detail a potential methodology for modeling and measuring this metric.

On the watershed scale, estimated local water demand for the Alhambra Wash can be based on the reported demand estimate from each contributing jurisdiction's Urban Water Management Plan (UWMP). The Alhambra Wash boasts eight jurisdictions, including Alhambra, Monterey Park, Pasadena, Rosemead, San Gabriel, San Marino, and South Pasadena, as well as unincorporated County land. Where contributing jurisdictions did not have an associated accessible UWMP (i.e., Rosemead, San Marino, and unincorporated County land), the water demand was extrapolated based on the percentage of the jurisdiction within the Alhambra Wash drainage area.

For neighborhood-level local water demand estimates, water demand can be calculated by multiplying the total population within a selected area with the residential water use per capita. The PE Civil Reference Manual states a residential water use per capita between 75-130 gallons per capita per day.[10]

The number(s) obtained from the Magnitude of Water Use Offset metric could be divided by the neighborhood-level local water demand estimates or the watershed-level local water demand estimates to obtain the percentage of Relative Water Demand Augmented or Offset at the neighborhood-scale and watershed-scale, respectively.

[10] Lindeburg, Michael. PE Civil Reference Manual, Sixteenth Edition.

2.3 Community Investment Benefits (CIB)

The following subsections describe the CIB metrics that have been agreed upon by the Working Group.

Due to the large number of CIB metrics, the Technical Team recommends consolidating the reporting of CIB metrics so that only those that most meaningfully measure the intended community benefits are kept as discussed in the development of the watershed signatures in Section 4.

2.3.1 Access to Green Space/Recreation

Definition

The Working Group defined the People Within Walking Distance to Park/Green Space metric as follows: *"Total population within the "walkshed" of vegetated spaces of any size designated for passive or active recreation."* Specifically, the Working Group defined the sizes of the walksheds to be the following:

- 6,000 square feet to 3 acres (Pocket to Small Park): one-quarter mile walkshed
- 3 acres to 10 acres (Medium Park): one-half mile walkshed
- 10 acres and above (Large Park): two mile walkshed (or by biking or driving)

The Working Group defined the New Green Space per Person with Access metric as follows: *"Provision of public access to new park or green space previously not accessible (this includes public parcels not currently considered accessible recreation parks per Park Needs Assessments, which includes non-park public parcels and non-recreation parks). This definition does not consider private parcels."*

Data Sources and Methodology

Existing green spaces were characterized based on the Countywide Parks and Open Space shapefile accessed from the L.A. County GIS portal.[11] This dataset was used for developing the Park Needs Assessment and categorized parks into four distinct categories: local parks, regional recreation parks, regional open space, and natural areas. A shapefile of park access points developed for the Park Needs Assessment was requested from John Diaz, GIS Analyst at L.A. County's Parks and Recreation Department to develop an accurate representation of service areas around each park. These park access points were developed for every local park, regional recreational, and regional open space. For parks larger than one acre, multiple access points were placed in order to accurately tie park access to the walkable street network.

Population data from the 2014 Los Angeles County Age/Race/Gender Population Estimates from the U.S. Census Bureau was utilized to quantify the number of people who have access to these parks. These population estimates, which are provided on a census tract level, originated with the 2014 American Community Survey Population Estimates from the U.S. Bureau and are adjusted annually by both the County and the California State Department of Finance to improve accuracy. To improve the accuracy of the spatial analyses completed for the Parks Needs Assessment, a probable distribution of population within each census tract was developed. This was accomplished by dividing the entire County into one-acre hexagons. Population was distributed among the grid cells within each census tract based on the underlying Los Angeles County Assessor's parcel land use type. This population analysis was done as part of the Park Needs Assessment, and the cleaned GIS shapefile was also requested from John Diaz, GIS Analyst at L.A. County's Parks & Recreation Department to use for analysis.

Finally, the ArcGIS online street network dataset was used to generate walking distance service areas ("walksheds") toward each park using ArcGIS's Network Analyst extension around all existing parks within the Pilot Watershed.[12] Streets that were deemed safe for pedestrians to travel on were selected to develop the walksheds; for example, the walkable street

[11] LA County GIS Portal. Countywide Parks and Open Space shapefile. https://egis-lacounty.hub.arcgis.com/datasets/lacounty::countywide-parks-and-open-space-public-hosted/about
[12] ArcGIS. Network Analyst Extension. https://pro.arcgis.com/en/pro-app/latest/help/analysis/networks/what-is-network-analyst-.htm

network does not include unsafe walking paths, such as highways. An example of one such walkshed can be seen in **Figure 2-7**.

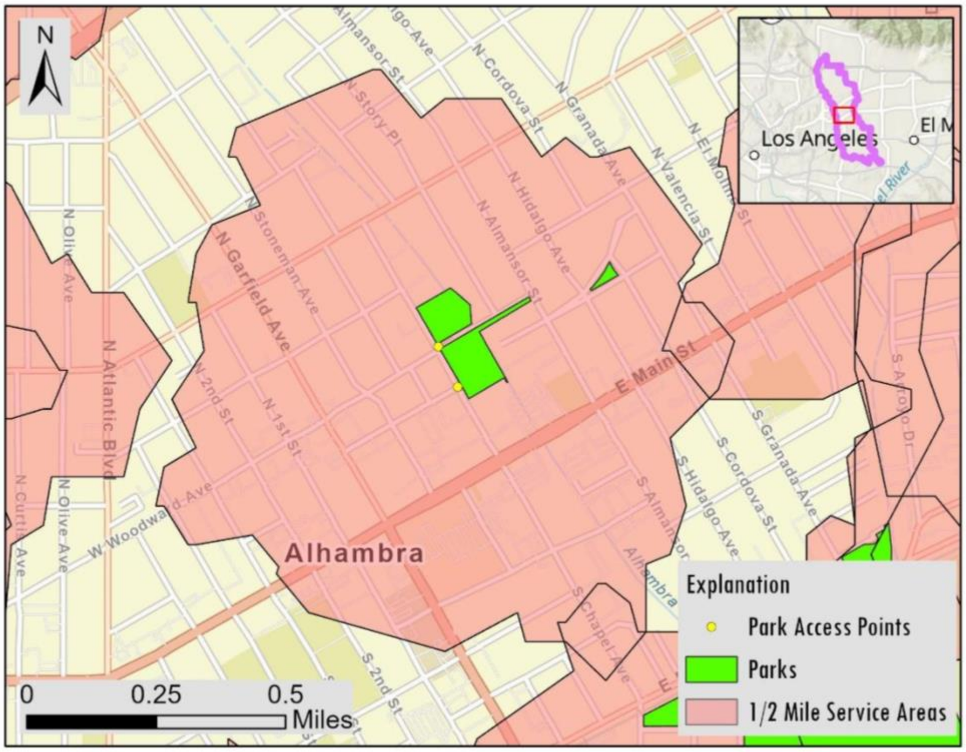

Figure 2-7. Example 1/2 Mile Walking Distance Service Areas Generated via ArcGIS's Network Analyst Extension.

People Within Walking Distance to Park/Green Space

In order to calculate the People Within Walking Distance to Park/Green Space, the population hexagons were first converted to a raster with the Feature to Raster tool, using the total population attribute as the raster value.[13] The resolution of the raster was set to 3’, meaning each cell had a width and height of 3’. The resulting population hexagon raster was then divided by the average number of raster cells within each hexagon using the Raster Calculator tool so that the cells within each hexagon would sum up to the total population specified by the original population shapefile.[14] **Figure 2-8** displays the transition from population hexagons to raster.

[13] ArcGIS. Feature to Raster Tool. https://pro.arcgis.com/en/pro-app/2.8/tool-reference/conversion/feature-to-raster.htm
[14] ArcGIS. Raster Calculator Tool. https://pro.arcgis.com/en/pro-app/2.8/tool-reference/spatial-analyst/raster-calculator.htm

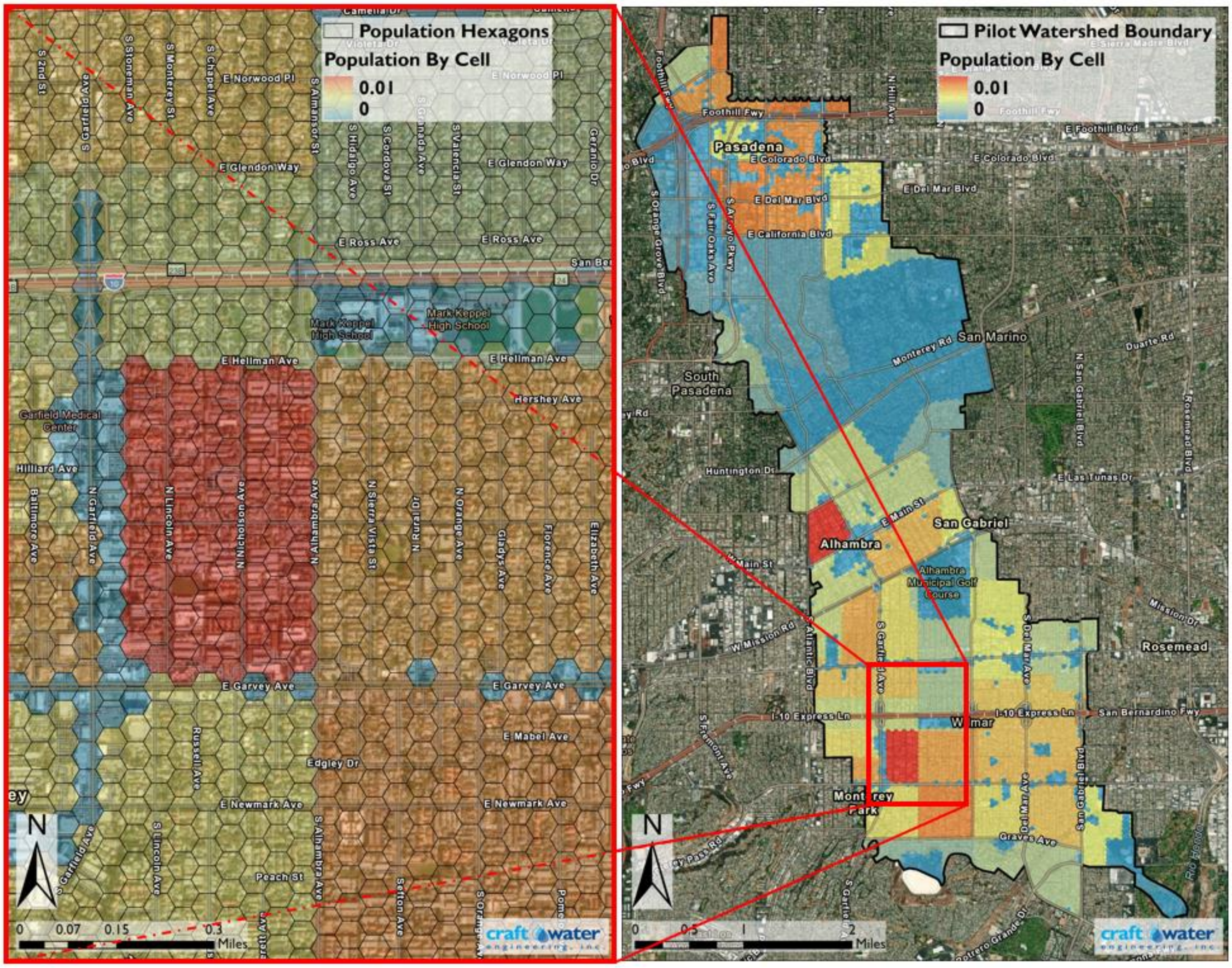

Figure 2-8. Population hexagon shapefile converted to a raster.

Converting the population polygon shapefile to a raster was a necessary step in the analysis since it allows the summation of population using a variety of different shapes as boundaries. This is an important factor as walksheds do not have hexagonal boundaries. This methodology is based on the assumption that population is distributed evenly across each of the 1-acre hexagons.

Next, all walksheds were dissolved into a single polygon feature using the Dissolve tool.[15] Green space walksheds were dissolved to avoid double-counting population that reside in multiple park walksheds (see walkshed overlap in **Figure 2-9**). The dissolved walksheds were used in conjunction with the population hexagon raster estimate the number of People Within Walking Distance to Park/Green Space by utilizing the Zonal Statistics as Table tool.[16]

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[15] ArcGIS. Dissolve Tool. https://pro.arcgis.com/en/pro-app/2.8/tool-reference/data-management/dissolve.htm

[16] ArcGIS. Zonal Statistics as Table Tool. https://pro.arcgis.com/en/pro-app/2.8/tool-reference/spatial-analyst/zonal-statistics-as-table.htm

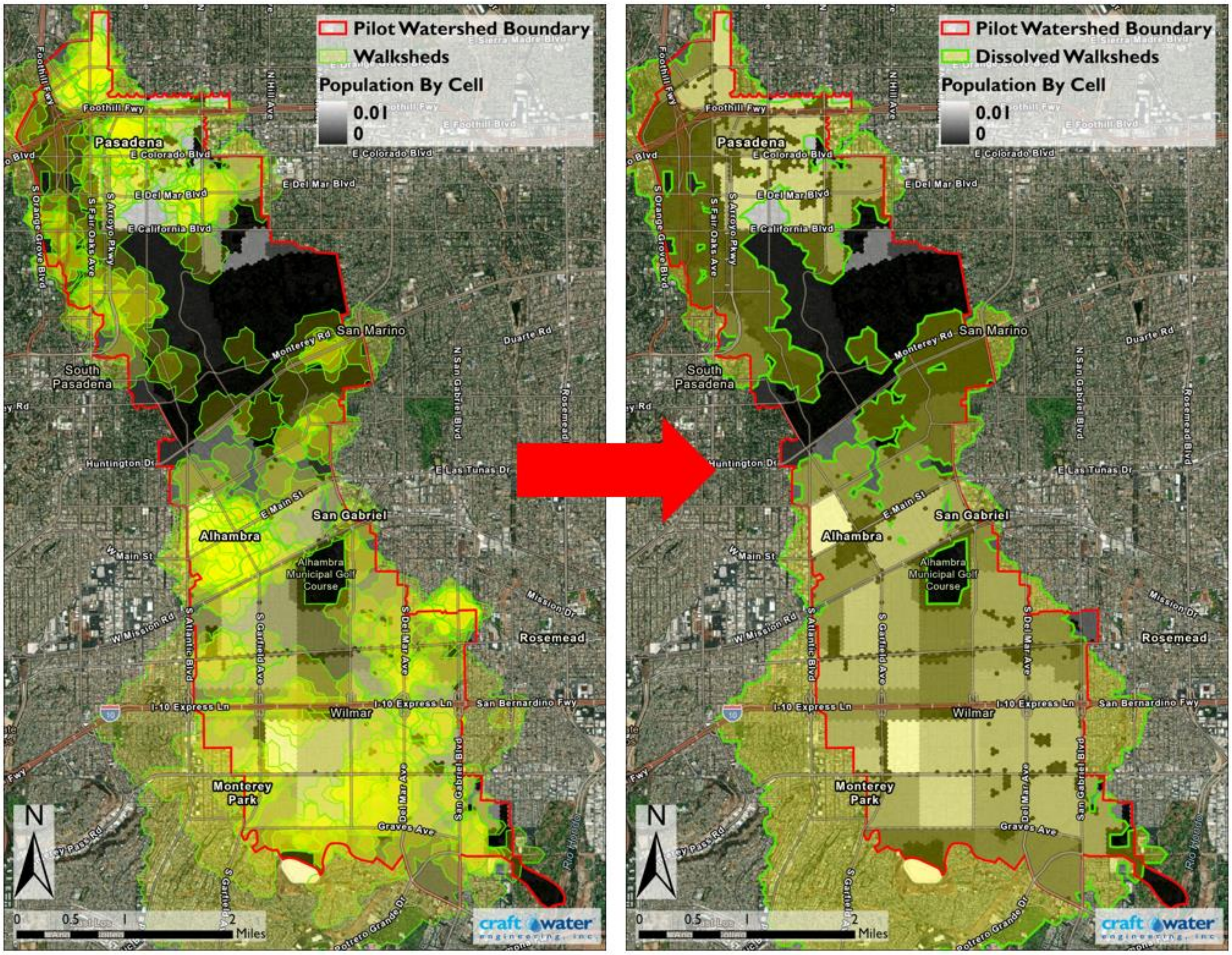


Figure 2-9. Before and after dissolving walkshed polygons to avoid double counting population

New Green Space Added Per Person with Access

New green space areas were developed by pulling all government parcels within the Pilot Watershed that were not existing parks from the LA County Parcel Shapefile.[17] 10' buffers around building footprints were erased from the possible new green space parcel polygons using the erase tool.[18] Access points were digitized for each parcel polygon using Google Earth; these access points were subsequently used to develop new green space walksheds. Possible new green space polygons before and after erasing building buffers along with corresponding access points are shown in **Figure 2-10**.

[17] LA County Parcel Shapefile. https://hub.arcgis.com/datasets/lahub::la-county-parcels/explore?location=33.807914%2C-118.298821%2C8.94

[18] ArcGIS. Erase tool. https://pro.arcgis.com/en/pro-app/2.8/tool-reference/analysis/erase.htm

Figure 2-10. Building footprint buffers erased from possible new green space parcel polygons with corresponding access points used to develop walksheds.

The new green space walksheds were dissolved with the existing green space walksheds, then the total population was summed within all walkshed boundaries. New Green Space Added Per Person with Access was then calculated using the following equation:

$$New\ Green\ Space\ Added\ Per\ Person\ with\ Access = \frac{New\ Green\ Space\ Area + Original\ Green\ Space\ Area}{Total\ Population\ Within\ New\ and\ Original\ Walksheds}$$

2.3.2 Tree Canopy

Definition

The Working Group defined the metric as follows: *"Total change in tree canopy coverage."*

Data Sources and Methodology

Existing tree canopy coverage was estimated from the Los Angeles Region Imagery Acquisition Consortium (LARIAC) Land Cover 2016 dataset. These land cover datasets are set to be released approximately once every three years. The land cover dataset is a classification raster that defines areas such as tree canopy, grass/shrubs, bare soil, buildings, roads, etc.

Percent tree canopy cover was calculated in ArcGIS Pro using the Tabulate Area tool (Table **2-4**).[19] This tool allows the user to extract information from a raster or polygon dataset within the boundaries of another dataset (such as a watershed boundary or service area).

The results for the Alhambra Wash pilot watershed are shown below.

Table 2-4. Example Land Cover Results for the Alhambra Wash Watershed

Class Name	Area (acres)	% Coverage
Tree Canopy	2,262.3	23%
Grass/Shrubs	1,721.7	17%
Bare Soil	263.9	3%
Water	11.7	0%
Buildings	2,383.6	24%
Roads/Railroads	1,328.7	13%
Other Paved	2,014.2	20%
Tall Shrubs	0.2	0%

The percent existing tree canopy cover can be found by dividing the existing tree canopy area by the total area of the area of interest. It is worth noting that the total area from the output table will not always be exactly the same as the region of interest polygon due to the resolution of the raster from which information is being extracted.

To determine potential new canopy coverage, 15 climate resilient tree species suggested by TreePeople were placed throughout the Pilot Watershed area. The names and size characteristics of the trees used in this analysis are shown in Table **2-5** below.

[19] ArcGIS. Tabulate Area Tool. https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-analyst/tabulate-area.htm

Table 2-5. Name and size characteristics of the 15 tree species used to estimate new potential canopy.

Common Name	Scientific Name	Maximum Height	Canopy Width	Planting Area
White Bottlebrush	Callistemon salignus	25 feet	10-15 feet	5' to 10'
Soapbark Tree	Quillaja saponaria	45 feet	15-25 feet	5' to 10'
Coast Banksia	Banksia integrifolia	60 feet	15-30 feet	Greater than 10'
Peppermint Tree	Agonis flexuosa	35 feet	15-30 feet	5' to 10'
Tecate Cypress	Hesperocyparis forbesii	25 feet	20 feet	5' to 10'
Flaxleaf Paperbark	Melaleuca linariifolia	30 feet	20-25 feet	5' to 10'
Catalina Cherry	Prunus ilicifolia subsp. lyonii	35 feet	20-30 feet	5' to 10'
African Sumac	Searsia lancea	30 feet	20-35 feet	5' to 10'
Honey Mesquite	Prosopis glandulosa	35 feet	25-35 feet	5' to 10'
Maverick Honey Mesquite	Prosopis glandulosa 'Maverick'	35 feet	25-35 feet	5' to 10'
Island Oak	Quercus tomentella	50 feet	25-40 feet	Greater than 10'
Chitalpa	Chitalpa tashkentensis	35 feet	30 feet	5' to 10'
Indian Rosewood	Dalbergia sissoo	60 feet	30-40 feet	Greater than 10'
Texas Ebony	Ebenopsis ebano	40 feet	30-40 feet	5' to 10'
Rose Gum/Sydney Red Gum	Angophora costata	65 feet	30-50 feet	Greater than 10'

The first step in the new canopy analysis was to spatially define areas where new trees could be planted. This task was accomplished by using the LARIAC Classification raster to find areas where grass or bare soil were located. An example of the available planting area is shown in **Figure 2-11** below.

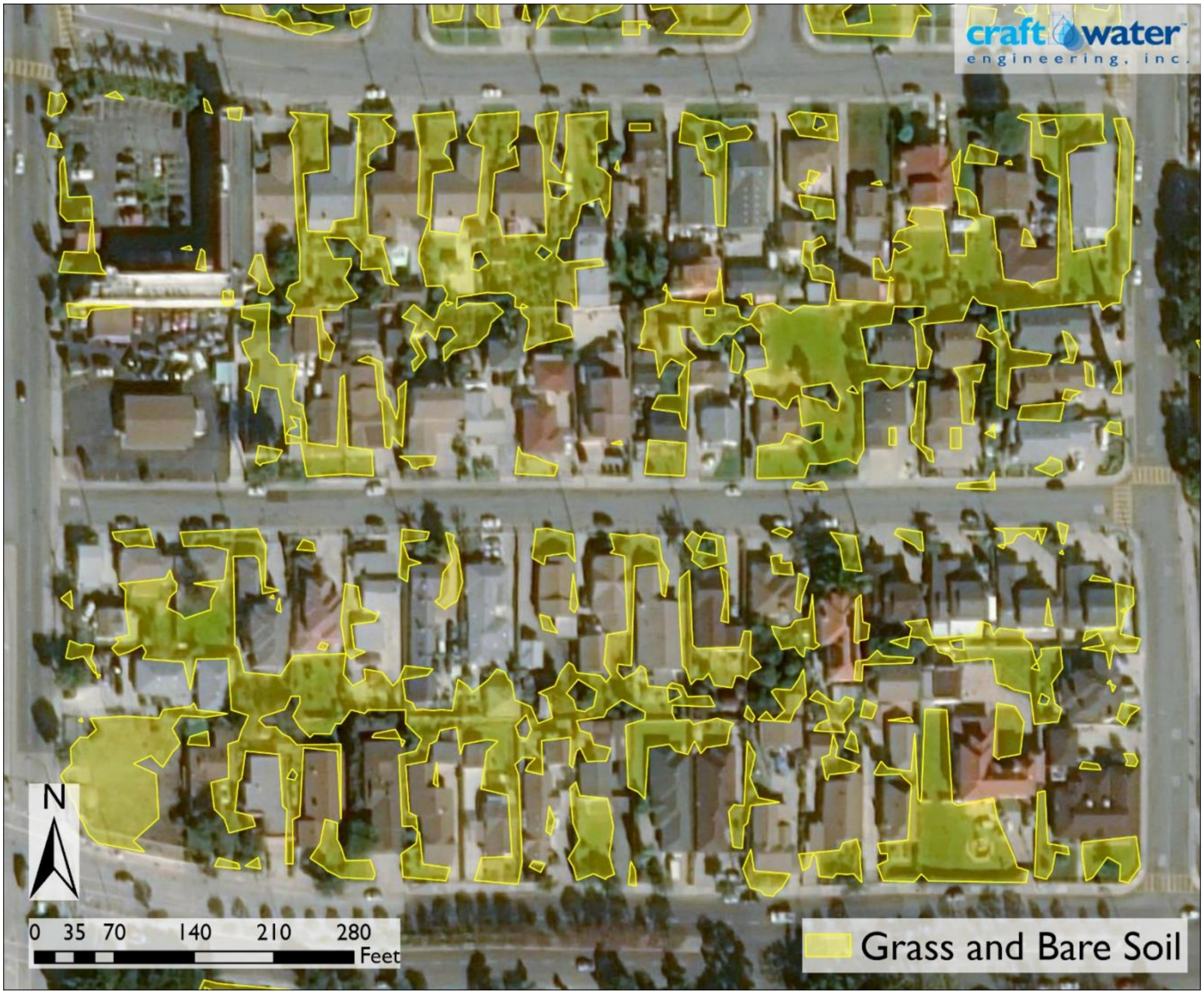


Figure 2-11. Grass and Bare soil extracted from the LARIAC Classification raster.

The yellow polygons in **Figure 2-11** symbolize areas where trees could be planted. However, Table **2-5** indicates that the trees used in this analysis have two different planting area requirements: 5' to 10' and 10'+. To accurately represent the planting area spatially, negative buffers were used to further specify areas where trees could be planted. Specifically, a -2.5' and a -5.0' buffer was performed on the yellow polygons to obtain viable planting areas for the 5' to 10' and 10'+ planting areas respectively. The resulting possible planting areas are shown in **Figure 2-12** below.

Figure 2-12. 10'+ (pink) and 5'-10' (blue) available planting areas, compared with the grass and bare soil areas symbolized in yellow.

Performing the negative buffer on the grass and bare soil polygons ensures that there will be enough room around the base of every new tree according to the requirements specified by TreePeople in Table **2-5**. The viable planting areas shown above were further refined by incorporating buffers around existing canopy and buildings to ensure that no new canopy would touch a building or an existing tree's canopy. Once new tree area polygons had been developed and refined, trees were placed using the Create Random Points tool.[20] The largest size trees (50' diameter canopy) were placed first, then the next largest trees (40' diameter canopy) were placed second, etc. After each size of tree was placed in the viable planting areas, the new canopy polygon was used as an eraser on the planting polygons to prevent smaller trees from being planted under the larger trees.

The results of this analysis can be seen in **Figure 2-13**.

[20] ArcGIS. Create Random Points Tool. https://pro.arcgis.com/en/pro-app/2.8/tool-reference/data-management/create-random-points.htm

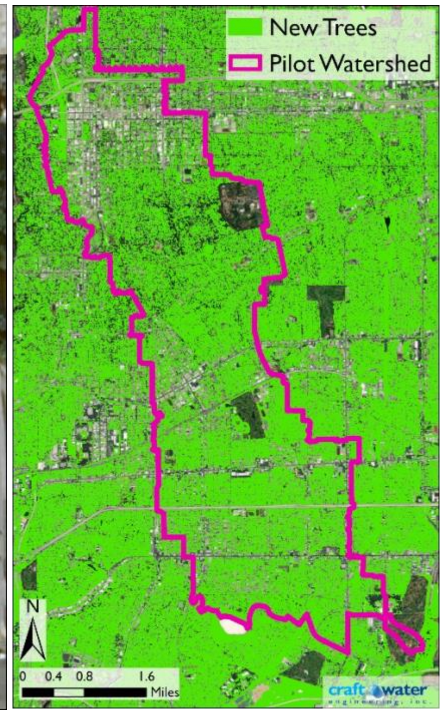


Figure 2-13. Potential new trees placed across the Pilot Watershed Area

This methodology produces new tree polygons that are optimally placed to maximize new canopy without negatively affecting existing canopy or buildings.

To estimate how the needle for the Change in Tree Canopy Coverage metric could be moved due to the planting of trees via Nature-Based Solutions or surface improvements, a temporal analysis was performed by investigating growth characteristics of common native trees. Resources from the Theodore Payne Foundation for Wild Flowers and Native Plants were used to identify trees that would likely be planted and thrive in the project areas.[21] Growth metrics such as maximum height, maximum canopy width, and growth rate were subsequently researched using resources from the Urban Forest Ecosystems Institute.[22] Finally, common sizes of trees that can be purchased from a nursery were investigated.[23] It is important to note that this analysis did not account for the decay rate of trees.

For each tree, the height at planting was assigned based upon the common tree sizes available from an orchard. Tree height following planting was calculated by multiplying the average growth rate by the number of years passed. Once the tree had reached the maximum height, the maximum height was assigned, and no further calculation was performed.

To estimate the increase in Tree Canopy over time, the ratio of maximum tree height to maximum canopy width was calculated for each type of tree. Each height value previously calculated was then multiplied by this ratio to determine the canopy width at each time increment. The assumption used in these calculations is that the ratio of maximum canopy width to maximum height is always equal to the ratio of current canopy width to current tree height as described by the equation below:

[21] Theodore Payne Foundation for Wild Flowers & Native Pants. Native Trees for Urban Gardens. https://theodorepayne.org/wp-content/uploads/2013/11/NATIVE-TREES_FINAL.pdf
[22] California Polytechnic State University San Luis Obispo Urban Forest Ecosystems Institute. A Tree Selection Guide. https://selectree.calpoly.edu/
[23] O'Connell Landscape. A Guide to Container Sizes – Tree Sizes for Instant Impact. http://oclandscape.com/ocblog/a-guide-to-container-sizes-tree-sizes-for-instant-impact/

$$\frac{(Tree\ Canopy\ Width)_{max}}{(Tree\ Height)_{max}} = \frac{(Tree\ Canopy\ Width)_i}{(Tree\ Height)_i}$$

Where i is time.

In an effort to analyze general trends, all trees studied were separated into three general classes depending upon their height: tall (75’+), medium (40’-75’), and short (0’-40’). The average change in canopy area with time was graphed for each of the three classes in **Figure 2-14**.

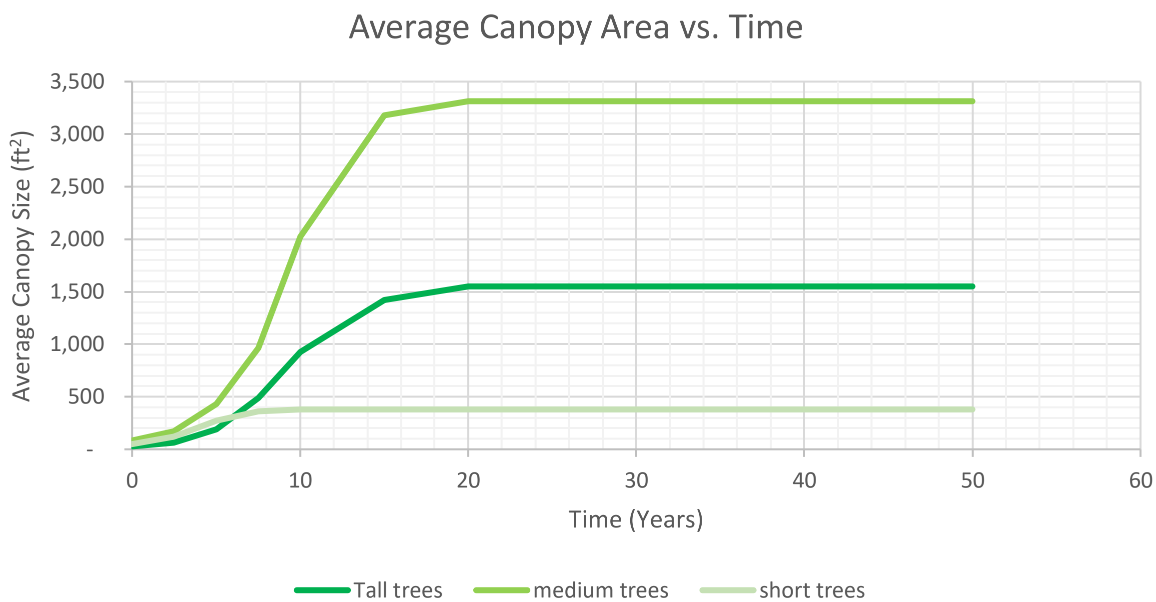


Figure 2-14. Average Canopy Area Over Time for Tall, Medium, and Short Trees.

The initial tree height (based upon common nursery sizes) was then varied to visualize how average canopy area would increase accordingly for tall, medium, and short trees as shown in **Figure 2-15**, **Figure 2-16**, and **Figure 2-17**, respectively. It is important to note that the canopy area of trees within the three classes (tall, medium, and short) varies considerably. It is therefore recommended that the actual tree type should be used to obtain more accurate estimates of canopy growth.

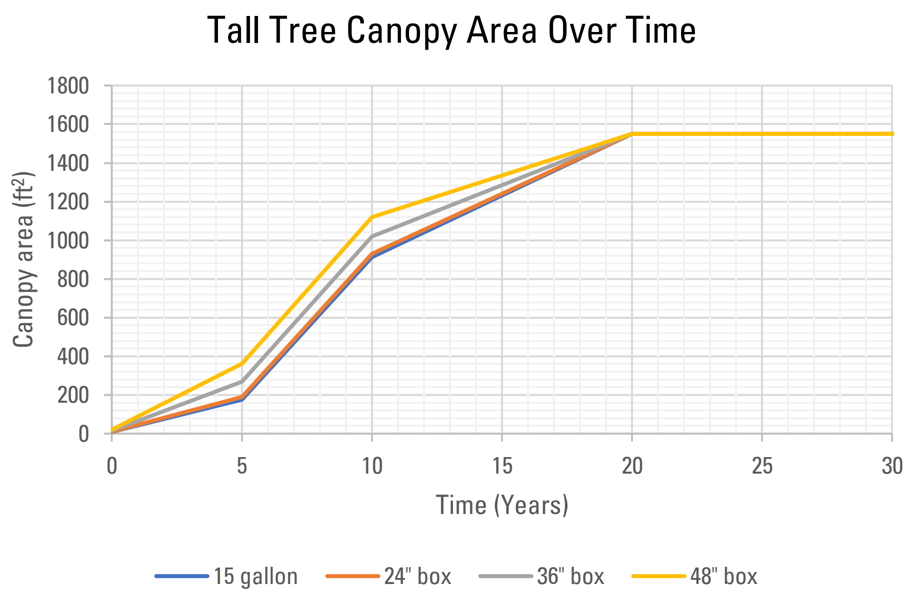


Figure 2-15. Tall Tree Canopy area over time for various nursery sizes.

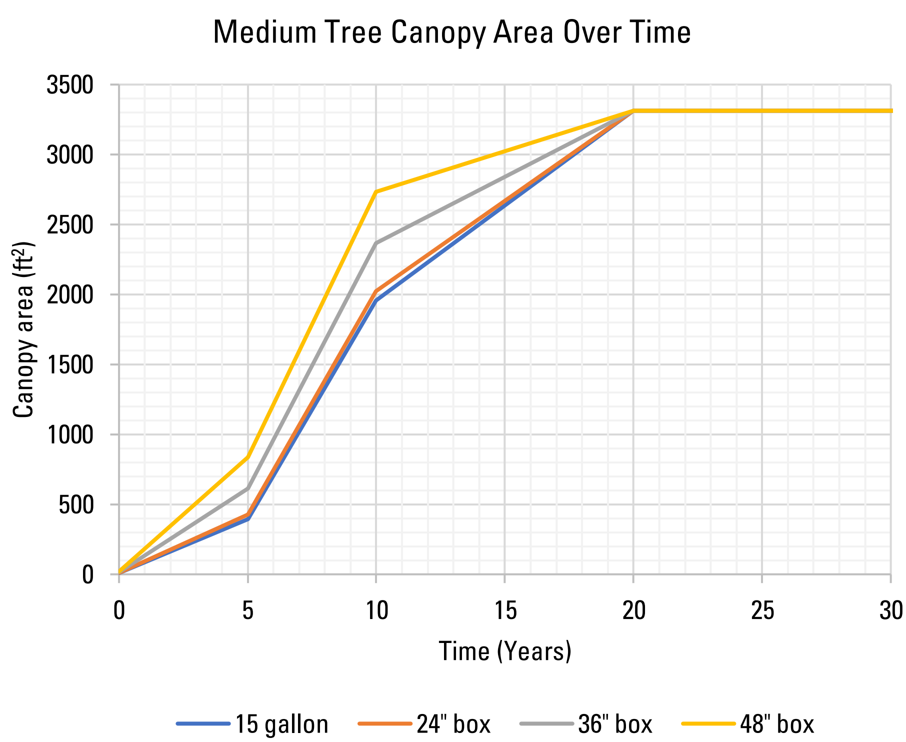


Figure 2-16. Medium Tree Canopy area over time for various nursery sizes.

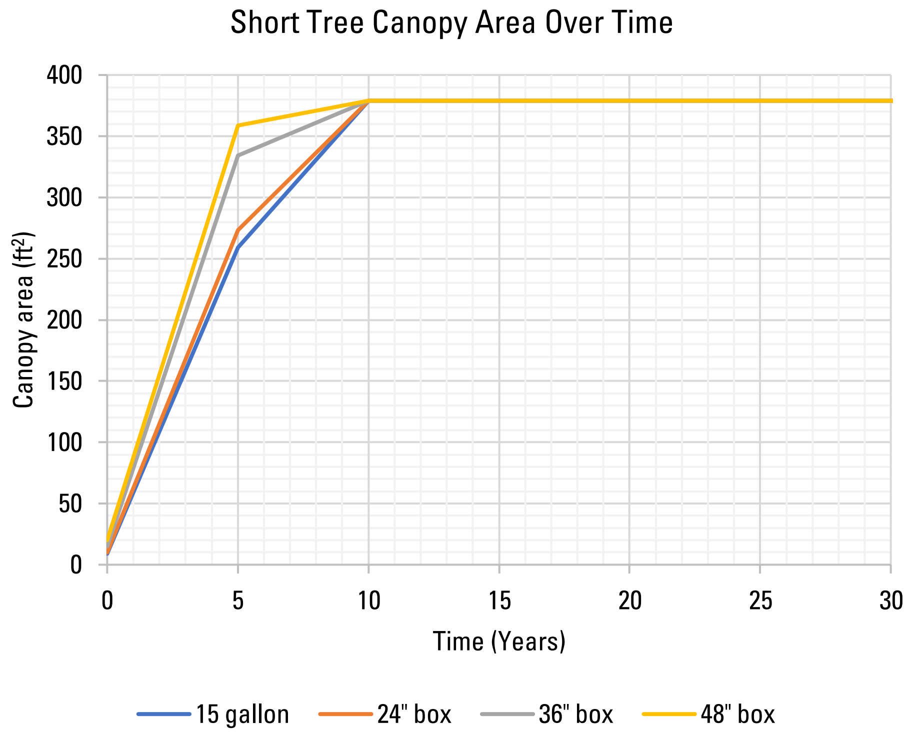


Figure 2-17. Short Tree Canopy area over time for various nursery sizes.

2.3.3 Pervious Land Cover

Definition

The Working Group defined the Change in Area of All Pervious Land Uses metric as follows: *"Conversion of impervious surfaces (e.g. pavement, rooftops) to pervious surfaces (e.g. bare, gravel, vegetated, or permeable pavement)."* The Working Group defined the Change in Area with Groundcover metric as follows: *"Conversion of unvegetated impervious or pervious surfaces to pervious surface with vegetated groundcover (e.g. grass, forbs, shrubs)."*

Data Sources and Methodology

Change in Area of All Pervious Land Uses

The LARIAC 2016 Land Cover dataset was used to estimate existing pervious cover by splitting the classification categories output from the Tabulate Area tool (described in Section 2.3.2) into two groups shown in Table **2-6** and **Figure 2-18**:

Table 2-6. Categorization of pervious versus. impervious land cover types.

Pervious	Impervious
Tree Canopy	Water
Grass / Shrubs	Buildings
Bare Soil	Roads / Railroads
Tall Shrubs	Other Paved

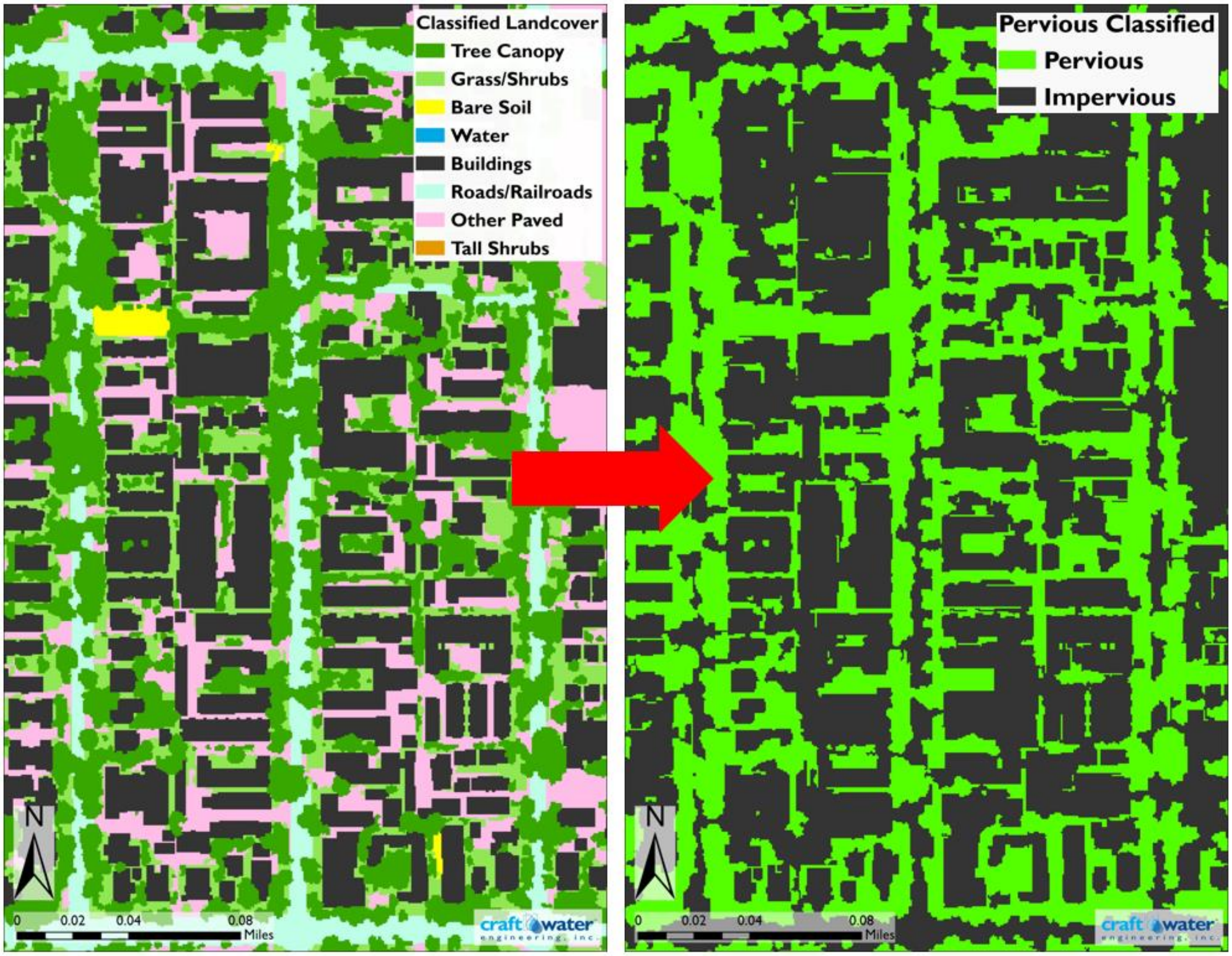


Figure 2-18. Grouping LARIAC classified classes into “Pervious” and “Impervious”

The existing pervious area was calculated by summing the areas found in the “pervious” column category.

As the LARIAC Land Cover dataset is based upon aerial observations, the type of surface underneath the tree is unknown. These categories are based upon the assumption that the tree canopy is considered to be a “pervious” surface, which may or may not be true depending upon the ground beneath the tree.

The potential pervious area was calculated by adding all the areas found in the “pervious” column, plus the “Other Paved” area. The addition of the “Other Paved” assumes that all parking lots, driveways, sidewalks, etc. could potentially be converted to pervious surfaces. The Change in Area of All Pervious Land Uses is therefore equal to the area classified as “Other Paved”.

Change in Area with Groundcover

The existing groundcover metric was estimated similarly to the Change in Tree Canopy Coverage metric using the LARIAC 2016 Land Cover dataset and methodology described in Section 2.3.2 in by the using the following equation:

$$Existing\ Groundcover = Grass/Shrub\ Area + Tall\ Shrub\ Area$$

Potential new groundcover was calculated by modifying the above equation to include bare soil in the numerator of the fraction:

$$Potential\ New\ Groundcover = Grass/Shrub\ Area + Tall\ Shrub\ Area + Bare\ Soil$$

The Change in Area with Groundcover is therefore equal to the area classified as “Bare Soil”.

2.3.4 Native Vegetation

Definition

The Working Group defined the metric as follows: “*Conversion of unvegetated impervious or pervious surfaces to pervious surface with native vegetation, in which native vegetation is defined as an assemblage of plants in a specific place or region that has adapted to environmental and biological conditions*.”

Data Sources and Methodology

Existing Native Vegetation cover was quantified using the data developed by the United States Department of Agriculture.[24] The tabulate area tool described in Section 2.3.2 was used to extract the area distribution of each type of vegetation within the area of interest. The “Class Field” selected was the “REGIONAL_DOMINANCE_TYPE” field that describes “a recurring plant community defined by the dominance of one or more species.” The resulting table from the Alhambra Wash polygon is shown below in Table **2-7**. Any vegetation described as urban, non-native, barren, or nursery (shown in red) was removed. Subsequently, the remaining areas were summed to obtain the total area of Native Vegetation.

[24] United States Department of Agriculture. Existing Vegetation Mid Region 5 South Coast shapefile. https://data.fs.usda.gov/geodata/edw/edw_resources/meta/S_USA.EVMid_R05_SouCoast.xml

Table 2-7. Example Output from the Existing Vegetation: Region 5 – South Coast shapefile recommended by The Nature Conservancy; classes shown in red are considered non-native.

Name	Area (acres)	Percent
Annual Grasses and Forbs	52.03	0.52%
Barren	1.33	0.01%
California Sagebrush	24.99	0.25%
Coast Live Oak	16.24	0.16%
Eucalyptus	0.72	0.01%
Non-Native/Ornamental Conifer/Hardwood	565.80	5.67%
Non-Native/Ornamental Grass	226.48	2.27%
Non-Native/Ornamental Hardwood	62.41	0.62%
Nurseries	29.32	0.29%
Urban or Industrial Impoundment	3.65	0.04%
Urban/Developed (General)	8,999.91	90.12%
Willow	3.35	0.03%
Grand Total	9,986.23	100.00%

Change in Area of Native Vegetation was estimated with the LARIAC Landcover dataset and the existing native vegetation dataset by using the following equation:

$$
\begin{aligned}
&Change\ in\ Area\ of\ Native\ Vegetation \\
&\quad = Grass/Shrubs^* + Tall\ Shrubs^* + Tree\ Canopy^* + Bare\ Soil^* - Existing\ Native\ Vegetation
\end{aligned}
$$

Where all areas marked * are from the LARIAC Landcover dataset.

This equation implies that all vegetation that are not currently classified as “Native” by the USDA along with any area classified as “bare soil” could potentially be converted to new native vegetation.

2.3.5 Flood Management

Definition

The Working Group defined the metric as follows: *“Reduction in the flow rates discharged from a watershed under specific storm conditions; high peak flow rates during storms can overwhelm the drainage system and cause localized or regional flooding.”*

Data Sources and Methodology

While the Working Group agreed that a benefit of stormwater capture projects is alleviating localized, urban flooding, the Working Group acknowledged that there is a lack of data for modeling localized, urban flooding. The Working Group recommends that the District create best practices for municipalities for localized flooding data collection and relevant attributes needed to inform a future urban flooding model specific to the County. Flood Factor, a free online tool created by the nonprofit First Street Foundation, can be one of the tools to guide this research area.[25]

[25] Flood Factor. https://floodfactor.com/

2.3.6 Local Economy

Definition

The Working Group defined the metric as follows: *"Jobs, new and green (e.g., number per square mile, differentiating between capital/construction and operations/maintenance."*

Data Sources and Methodology

Based on data from the City of San Diego Operational Cost Database, the Technical Team used the outputs detailed in Table **2-8** to calculate the number of full-time equivalents (FTEs) arising from different implementation/investment scenarios.

Table 2-8. Estimated jobs assumptions for hypothetical project opportunities.

Project Type	Planning & Design Jobs	Capital Jobs	O&M Jobs
NBS (Distributed) – *Residential*	0.15 FTEs/acre footprint	0.12 FTEs/acre footprint	0* FTEs/acre footprint (no new O&M jobs – included with property owner's routine yard care)
NBS (Distributed) – *Non-Residential Private Parcels*	1.11 FTEs/acre footprint	1.52 FTEs/acre footprint	0.30 FTEs/acre footprint
NBS (Distributed) – *Non-Residential Public Parcels and Road Right-of-Way*	1.55 FTEs/acre footprint	2.13 FTEs/acre footprint	0.57 FTEs/acre footprint
Nature-Mimicking	5.38 FTEs/acre footprint	11.09 FTEs/acre footprint	0.92 FTEs/acre footprint
Gray	5.38 FTEs/acre footprint	11.09 FTEs/acre footprint	0.92 FTEs/acre footprint
New Trees/Tree Canopy	0.001525 FTE/tree	0.0003 FTE/tree	0.00075 FTE/tree
New Pervious	Included w/ construction jobs	3 FTEs/acre footprint	0.81 FTEs/acre footprint
New Groundcover	N/A	N/A	N/A
Native Vegetation	N/A	N/A	N/A
Park Access	Included w/ construction jobs	Labor = 33 percent of construction cost	Needs input from municipal partners

*For the purposes of this analysis, it was assumed that distributed NBS on residential property would generate 0 FTE; however, the Working Group sees value and potential for jobs in O&M for this category. See Recommendation #20.

2.4 DAC Benefits

As previously discussed, some of the Working Group's questions related to Disadvantaged Community (DAC) Benefits were deemed infeasible to be directly or indirectly quantified; rather, the Working Group agreed that the modeling would be able to inform their recommendations once the data was analyzed from the modeling. These questions were characterized as either definitions-based, process-based, or outcomes-based. For example, the modeling would be able to determine the beneficiaries attributed to a project, but it would be unable to quantify who should determine needs and benefits; instead, this would be considered a process-based question. Unlike the directly or indirectly quantifiable proposed metrics, these questions were instead tracked by the Technical Team for discussions regarding programmatic recommendations.

The Ordinance defines a DAC Benefit as the following (§16.03.I): "*A Water Quality Benefit, Water Supply Benefit, and/or Community Investment Benefit located in a DAC or providing benefits directly to a DAC population.*" The definition of a DAC according to §16.03.H is: "*A Census Block Group that has an annual median household income of less than eighty percent (80%) of the Statewide annual median household income (as defined in Water Code section 79505.5).*"

There has been considerable debate among many on benefit accounting related to DAC beneficiaries in the context of the SCWP. Through a review of comment letters submitted to the SCWP's Regional Oversight Committee, the Technical Team noted the following opposing viewpoints regarding DAC Benefits between municipal agencies and non-governmental organizations (NGOs).

Table 2-9. Comment matrix displaying key comments on several topics related to DAC Benefits.

Category of Comment	NGO Viewpoint	Municipal Agency Viewpoint
Whether or not located inside a DAC	Inside DAC	Inside or outside of DAC Also, some watersheds may not have DACs (e.g. North Santa Monica Bay), so the North Santa Monica Bay WASC has the viewpoint that projects outside of a DAC should count.
Scale of the DAC Benefits (regional vs. community vs. project-specific)	Community/project-specific	Regional benefits should count (i.e. water quality and water supply).
Lack of a framework for quantifying impact of DAC Benefit	Wants clearer measurement of benefits and outcomes	N/A (may limit flexibility)
"Providing benefits directly to a DAC" from Section 16.03.I - blurry definition of what a benefit is and what equity means	Want more clear definitions/shared understanding of definitions among all parties	Educational programs outside of a DAC counts as providing benefits to a DAC

To address the comments presented in **Table 2-9**, the Technical Team performed a robust analysis to guide the Working Group's philosophical discussions on this nuanced topic. First, the Working Group agreed that different benefits accrue to beneficiaries at different spatial scales. For example, with regard to Water quality and Water supply, respectively, treating stormwater upstream or at its source will improve downstream receiving Water Quality conditions (i.e. beaches, etc.) for everyone to enjoy, and water saved by using local water supply will reduce reliance on imported water from the State Water Project or the Colorado River in the future. Therefore, Water Quality and Water Supply benefits accrue on a regional scale, whether it be by Watershed Area, groundwater recharge basin areas, drinking water/sewershed service areas, or other regional context; however, Community Investment Benefits are realized locally by people in the community, and therefore have smaller service areas. According to the Working Group's recommended metrics, Community Investment Benefits primarily accrue through planting new trees and vegetation and providing new park space to serve the local population, and the Working Group agreed that each of these improvements influences the surrounding population at different scales. The Working Group agreed on the following scales of influence, or "service areas," for parks, trees, and vegetation:

- Parks: Service area should be between one-quarter mile to two miles in radius (using the walkable road network) depending on park size
  - 6,000 square feet to 3 acres (pocket or small park) = one-quarter mile service area

  - 3 to 10 acres (medium park) = one-half mile service area
  - 10+ acres (large park) = two mile service area
- Trees/Vegetation: Service area should be 100 feet radius, regardless of the road network

The population newly served by various projects can then be objectively estimated by intersecting these service areas with census data (disaggregated to the parcel-scale). Although this method provides greater clarity on who may benefit from new projects compared to the current "all-or-nothing" approach, the Technical Team acknowledges that the method is only as accurate as the available data and does not capture the full extent of unquantifiable benefits from new projects. Because the method uses residential census data, it only estimates benefits to people where they *live,* but not also to where people *work.* Note that the Working Group also agreed that newly created jobs and reduced flooding provide Community Investments Benefits, but more information is needed to estimate the service areas and population served by these types of improvements.

The Pilot Analysis and Working Group discussion concluded that—consistent with the definition of "DAC Benefit" in the SCWP Ordinance—all three major types of SCWP Program Goals (Water Quality Benefits, Water Supply Benefits, and Community Investment Benefits) should each constitute a DAC Benefit. However, benefits should accrue to people living in DACs based on the relevant scale and access regardless of whether the project is located within the Census-block-limits of the DAC. For example, if a vacant lot located just outside of a DAC were retrofitted with new park amenities, trees, and stormwater capture features, these benefits would accrue to the people living in the adjacent DACs within the service area who now have access to these benefits. This concept is demonstrated in the Alhambra Wash in F**igure 2-19**, where a new green space or an upgraded existing green space that is outside the boundary of a DAC could hypothetically benefit approximately 3,800 people living in the adjacent DAC within the one-half mile service area.

On the contrary, locating projects within DAC boundaries does not necessarily equate to adequate accrual of benefits to DAC beneficiaries if not thoughtfully planned (for example, a Gray infrastructure project located within a DAC will provide Water Quality and Water Supply Benefits to those within *and* outside of the DAC, and alone will not meaningfully contribute to Community Investment Benefits).

F**igure 2-19**. Using the one-half mile service area (green), a hypothetical new park opportunity located outside of a DAC could serve approximately 3,800 people living in the adjacent DAC (DAC block groups outlined in purple).

The Technical Team also performed a sensitivity analysis to assess how a park project's location impacts the number of potential beneficiaries based on the service areas (**Figure 2-20**). The team found that locating park projects solely in DACs benefits a higher percentage of DAC beneficiaries relative to the total population; however, the total number of beneficiaries is less than if park projects were built both inside and outside of a DAC boundary. It is acknowledged that this recommendation is site-specific; the results in the Alhambra Wash are impacted by the size and location of potential park spaces. In the Alhambra Wash, there are larger parcels that could be converted into green space outside of DACs whereas potential parcels that could be converted within DACs are generally smaller in size, thus, the service areas are smaller and less DAC population is benefitted. This Pilot Analysis demonstrated that measuring DAC Benefits based on population served could potentially "unlock," and enable project proponents to leverage, underutilized opportunities adjacent to DACs by more objectively estimating *who* would directly benefit from the new projects (whereas under current Program guidance, it is uncertain whether such projects definitively provide DAC Benefits).

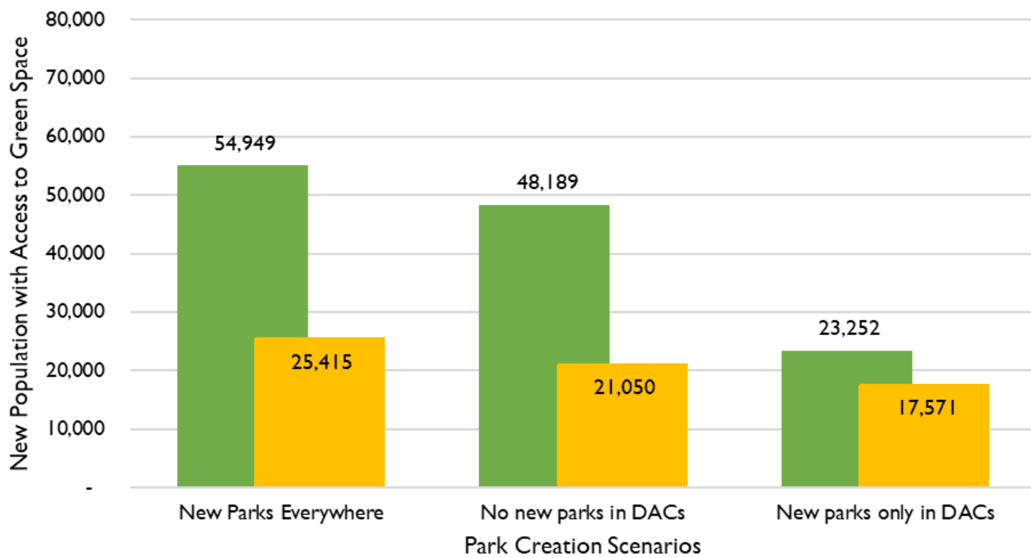


Figure 2-20. Total population served (green) and DAC population served (orange) by hypothetical new parks implemented throughout the Alhambra Wash pilot watershed; building parks everywhere benefited the most people (both in and out of DACs) because more opportunities with large service areas were available.

Regarding site-level improvements, such as trees and vegetation, it is more advantageous to locate trees and vegetation within DACs. This is because the service areas of trees and vegetation are smaller, thus, the benefits are realized locally.

Section 18.04.J of the SCWP Ordinance states that the Program shall "*provide DAC Benefits, including Regional Program infrastructure investments, that are not less than one hundred ten percent (110%) of the ratio of the DAC population to the total population in each Watershed Area.*" However, this prescription implies that benefits are proportional to investments, which is not always the case. Under the current approach, the 110 percent DAC Benefit minimum allocation is calculated by project funding amounts requested from the SCWP for each stormwater investment plan (SIP) proportional to the DAC population ratio of each Watershed Area. During the WASC prioritization process, WASCs determine on a binary basis whether a project—and all its associated funding—is providing a DAC Benefit based on responses received in the *Feasibility Study* application. This approach does not consider how benefits accrue to people living in DACs, nor the magnitude of the benefits accrued to DACs. The Working Group tested various new methods of calculating the 110 percent allocation and concluded that the 110 percent minimum target should be based on benefits per capita, rather than investment. See Attachment B for calculations on how the 110 percent minimum target could be calculated based on benefits per capita.

2.5 Other Prioritized Goals

The remaining prioritized goals were be assessed in the following manner:

- **Green jobs and career pathways:** This metric will be built ground-up with granular data to analyze full-time equivalent (FTE) jobs where FTE = 2080 work hours per year as detailed in **Section 2.3.6.**

- **Other funding:** Addressed with WHAM (Measures W, H, A, and M) analysis. The WHAM analysis flagged potential WHAM project locations in the pilot area that could be enhanced with Measure W funding ("new" geographies unlocked by WHAM) (detailed in Section 4.
- **Spectrum of project sizes:** Addressed by comparing magnitude of benefits across different types of BMP solutions (Nature-Based, Nature-Mimicking, multi-benefit Gray).
- **Proportional municipal benefits:** Assessed by tallying metrics across relevant jurisdictional scales.
- **Operations and maintenance:** This is considered a programmatic criterion to ensure long-term project performance and upkeep. Costs/benefits of O&M was analyzed in the Pilot Analysis.

3 Monetizing Benefits

In total, the Working Group chose 16 separate metrics to evaluate the SCWP across various scales. While these metrics meaningfully convey the specific, multi-benefit outcomes desired from the Program, it can be challenging to holistically compare alternatives and generate recommendations without translating results into one common set of units. The ARLA Technical Team has therefore normalized all metrics to "dollars" by monetizing the cumulative benefits.

Earth Economics, a 501(c)(3) non-profit organization headquartered in Tacoma, Washington, United States, is an organization that uses natural capital valuation to help decision makers and local stakeholders understand the use of natural capital assets. Based on the final list of metrics that were selected by the Working Group, and other considerations such as availability of local data, Earth Economics proposed a framework that includes a method for valuing each metric. Earth Economics developed an Excel valuation tool that includes valuation modules for benefits associated with each metric, including specific economic methods and custom local data inputs (i.e., demographic, biophysical, etc.).

The results of each metric/benefit is expressed as the value of each benefit per year ($ per year), or net present value of benefits over the lifetime of the project/program ($). The valuation of each metric is presented in **Table 3-1**. For details on how the valuation of each metric was derived, refer to Appendix E: ARLA'S SCWP Benefit-Cost Analysis Tool.

Table 3-1. Summary of Benefit Category Inputs for the Tool (2020 USD).

Benefit Specific	Method	Input	Physical Unit	Low	High	Caveat
Aesthetic value	Benefit transfer	New Trees Added	Tree	$101	$120	Based on assumptions of the i-Tree tool and McPherson et al (2016).
Aesthetic value	Meta-Analysis	New Green Space Added	Acre	$3,225	$3,225	Meta-analysis. Ecosystem services are not perfectly transferable across sites.
Removal of air pollutants (Air Quality)	Avoided cost	New Groundcover	Acre	$46	$46	Based on a national-level study.
Removal of air pollutants (Air Quality)	Avoided cost	New Trees Added	Tree	$9	$9	
Carbon sequestration (Climate Stability)	Avoided cost	New Groundcover	Acre	$57	$96	Carbon sequestration rates can be strongly influenced by management practices.
Carbon sequestration (Climate Stability)	Avoided cost	New Trees Added	Tree	$18	$18	Baseline sequestration rates are based on street trees in Modesto, CA, as reported by McPherson and Simpson (2002).
Existence value	Meta-Analysis	New Canopy	Acre	$2,557	$2,557	Meta-analysis. Ecosystem services are not perfectly transferable across sites.
Existence value	Meta-Analysis	New Green Space Added	Acre	$3,377	$3,377	Meta-analysis. Ecosystem services are not perfectly transferable across sites.
New total Full Time Equivalent (FTE) planning and construction jobs added	Input-output analysis	Projected planning and construction budget	Jobs/$1 million	12.6	16.6	Static I-O analysis of economic impacts of water use efficiency projects using the 2009 social accounting matrix for L.A. County. Numbers for stormwater and recycled water projects were selected. Assumes construction finishes in one year.
New total Full Time Equivalent (FTE) O&M jobs added	Input-output analysis	Projected annual O&M budget	Jobs/$1 million	10	13.9	Static I-O analysis of economic impacts of water use efficiency projects using the 2009 social accounting matrix for L.A. County. Numbers for stormwater and recycled water projects were selected. Assumes construction finishes in one year.
Economic contribution of spending in planning and construction	Input-output analysis	Projected planning and construction budget	Economic contribution per $1 million spending in stormwater and recycled water projects	$1,910,962	$2,094,898	Static I-O analysis of economic impacts of water use efficiency projects using the 2009 social accounting matrix for L.A. County. Numbers for stormwater and recycled water projects were selected. Assumes construction finishes in one year.
Economic contribution of spending in O&M	Input-output analysis	Projected annual O&M budget	Economic contribution per $1 million spending in stormwater and recycled water projects	$1,864,379	$2,002,640	Static I-O analysis of economic impacts of water use efficiency projects using the 2009 social accounting matrix for L.A. County. Numbers for stormwater and recycled water projects were selected. Assumes construction finishes in one year.
Physical activity (public health)	Avoided cost	New Green Space Added	Acre	$9,719	$15,878	Visitor data from a study of neighborhood parks in the City of Los Angeles. L.A. County Department of Parks and Recreation does not have its own estimates.
Physical activity (productivity)	Avoided cost	New Green Space Added	Acre	$7,137	$11,659	Visitor data from a study of neighborhood parks in the City of Los Angeles. L.A. County Department of Parks and Recreation does not have its own estimates.
Recreation (Consumer surplus)	Consumer surplus	New Green Space Added	Acre	$43,699	$71,389	Visitor data from a study of neighborhood parks in the City of Los Angeles. L.A. County Department of Parks and Recreation does not have its own estimates.

Benefit Specific	Method	Input	Physical Unit	Low	High	Caveat
Mitigation of Urban Heat Island (UHI) effect on health (Public health)	Avoided cost	New Canopy	Acre	$128	$815	Based on national and regional impacts. Does not account for local temperatures.
Water Quality	Alternative Cost	Pounds of zinc removed per year	Pounds	$3,173	$3,173	Least-cost alternative developed by Craftwater Engineering models. Includes all combinations of structural solutions, but does not consider the impact of non-structural stormwater management approaches.
Groundwater recharge (Water Supply)	Alternative cost	New Water Captured Annually	Acre-foot	$634	$966	Assumes that all "new water captured" will recharge an aquifer that is used for water supply in L.A. County.
Stormwater reclamation (Water Supply)	Alternative cost	New Water Captured Annually	Acre-foot	$755	$755	

4 Development of Watershed Signatures

A total of 28,000 hypothetical project opportunities were identified in the pilot watershed and iteratively modeled across a range of combinations (e.g., 100 percent NBS, 100 percent Gray, 100 percent Nature-Mimicking, and various blended scenarios) using custom-built watershed models described in **Section 2**. Modeling was conducted for a 50-year period to simulate long-term Program implementation scenarios. This first-of-its-kind analysis enabled the Working Group to quantitatively evaluate how different investment decisions advance the Working Group's metrics, and subsequently the Goals of the SCWP.

Considering the Pilot Analysis modeled numerous combinations of project types using multiple metrics across three primary SCWP Goals (Water Quality, Water Supply, and Community Investment Benefits), the Working Group needed a clear and logical tool to visualize patterns and distill data-driven recommendations. A new type of chart was therefore conceptualized to plot the unique "signature" of the watershed under the spectrum of project implementation scenarios (**Figure 4-1**). The intent of the watershed signature chart is to compare the magnitude of Water Quality, Water Supply, and Community Investment Benefits that may arise from investing a set amount of funds in various portfolios of project types. For this analysis, it was assumed that $125 million could be available to the Alhambra Wash (treating the pilot watershed as a hypothetical proxy for a full Watershed Area) over a 50-year period, not including funds that could be leveraged from the County's other measures, such as Measures H, A, and M. Projects were incorporated into the $125 million 50-year budget based on pollutant removal cost-effectiveness, as all Measure W projects are required to have a Water Quality treatment component. Once the portfolio of projects under different feasible project implementation scenarios were determined, the total amount of benefits were estimated using the metrics agreed upon by the Working Group.

The watershed signature was created by selecting the most representative metric of the Water Quality, Water Supply, and Community Investment Benefit Goals, which were Wet Day Long-Term Pollutant Load Captured, Magnitude of New Water Captured, and Change in Monetized CIB, respectively. Because there were numerous CIB metrics, the Working Group agreed that a single metric of CIB would be beneficial to use, thus, the Technical Team used the outputs from Earth Economics' SCWP Benefit-Cost Analysis Tool (Appendix E) to compute the Change in Monetized CIB for each scenario. It is important to note that the monetization of CIB is dependent on the dollar values assigned to each benefit specified in **Table 3-1**, and that Change in Tree Canopy Coverage (or Change in Number of Trees) as well as New Green Space Added are the inputs that will most likely drive higher monetization of the Change in Monetization of CIB metric. The results from each metric were normalized against the respective best-performing metric within each project implementation scenario from the "base assumptions" so that the cumulative benefits from each implementation scenario could be "stacked" for comparison. Each goal was considered equally important for this analysis. When the total benefits are stacked (depicted on the vertical axis) for each implementation scenario (shown along the horizontal axis), the watershed signature is drawn. The watershed signature can be used to inform investment decisions by suggesting which scenarios maximize benefits and meet local needs in that particular watershed.

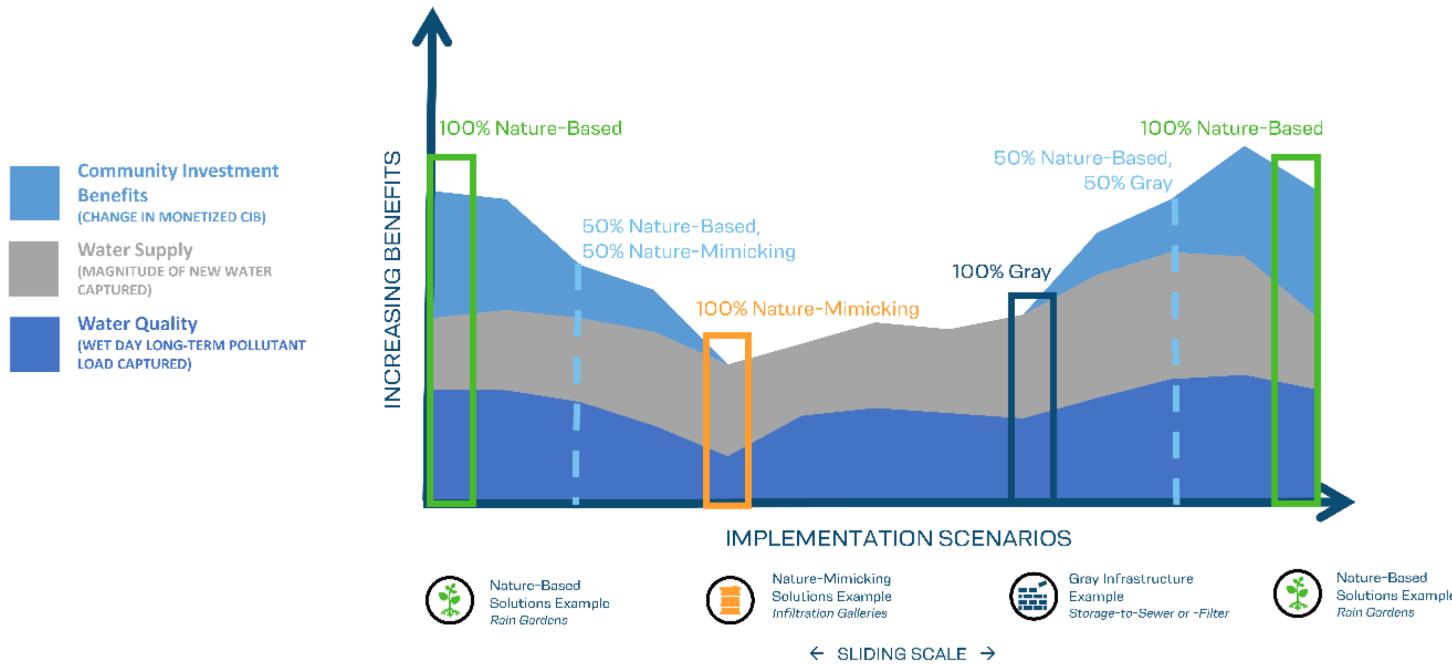


Figure 4-1. Example of watershed signature output for Alhambra Wash.

Each watershed throughout L.A. County will produce its own unique signature, as the types and sizes of hypothetical project opportunities in a watershed are governed by a watershed's unique attributes, including different land use types, land ownership (public and private), population, infrastructure network configuration, and hydrogeological conditions. Within the Alhambra Wash, the Working Group found that investing SCWP funds in a blend of distributed rain gardens (Nature-Based Solutions) and regional storage-to-sewer or -filter projects (Gray Infrastructure) yielded the most overall benefits; whereas, solely spending on regional infiltration galleries (Nature-Mimicking Solutions) or storage-to-sewer or -filter projects (Gray Infrastructure) yielded the least overall benefits (not including surface improvements, which can yield additional Community Investment Benefits). The watershed signature helped elucidate that Nature-Mimicking projects may not be as efficient as storage-to-sewer or -filter projects (Gray Infrastructure) in the Alhambra Wash due to relatively low infiltration rates.

To ensure that the assumptions behind the development of the watershed signature were robust and that resulting recommendations would be backed by adequate data, the Working Group conducted a sensitivity analysis, which is a data-driven investigation of the extent to which certain variables in model assumptions impact the outcomes. Conducting a sensitivity analysis provides an in-depth review of all the variables, and ensures that the predicted outcomes and recommendations are robust, reliable, and certain under an array of potential conditions. Key variables that were analyzed include:

- Capital and operations and maintenance costs (O&M) for distributed projects: Costs for distributed regional projects were doubled and the projects included for each scenario were re-prioritized based on pollutant removal cost-effectiveness. The overall benefits from the blended scenarios decreased due to less rain gardens providing Water Quality, Water Supply, and Community Investment Benefits.

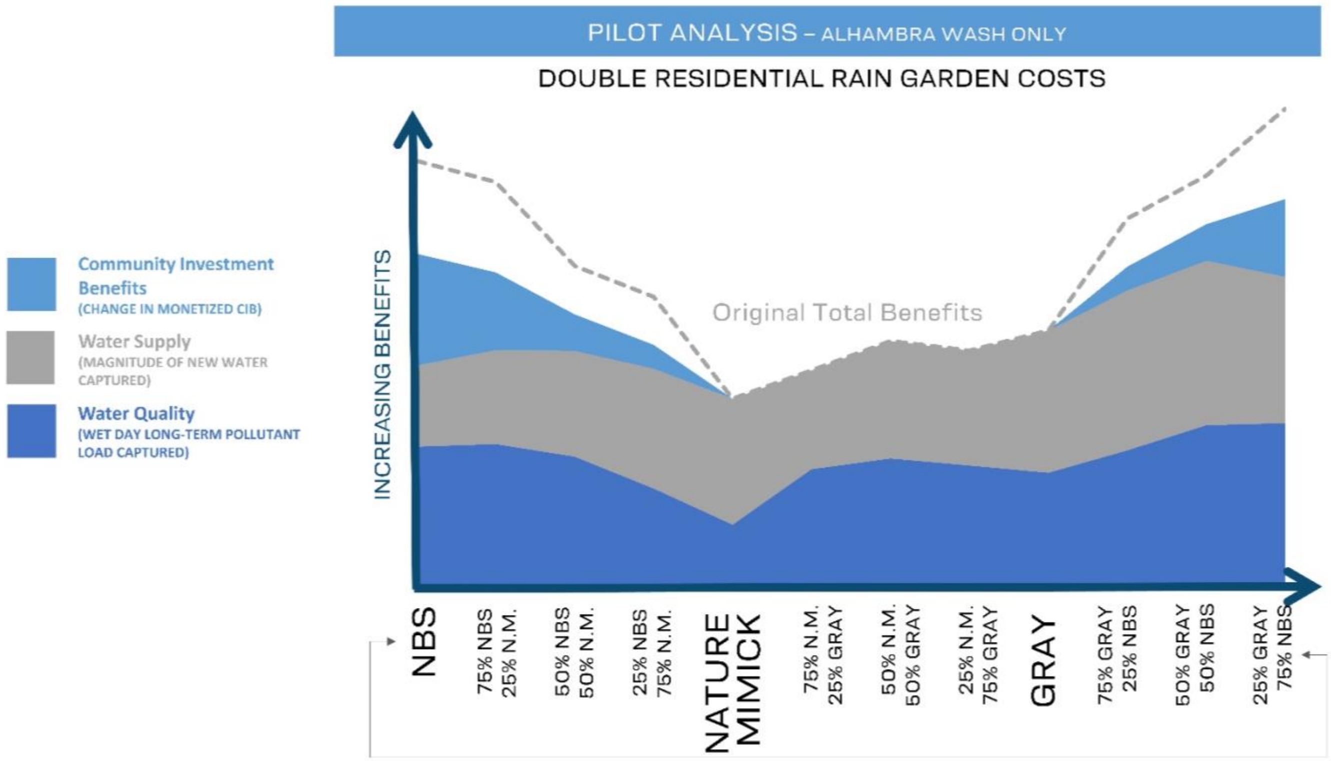


Figure 4-2. Updated watershed signature with doubling residential rain garden costs.

- Private property implementation rates: **Figure 4-1** assumes that 20 percent of all private property in Alhambra Wash over 50 years will have rain gardens implemented. The purpose of varying the private property implementation rates was to account for the fact that not every private property owner that has a feasible opportunity to implement a rain garden on their property will agree due to various reasons. To make up for the difference in “missed” rain garden opportunities on viable parcels, rain gardens on right-of-way parkways were incorporated into the scenarios. **Figure 4-3** and **Figure 4-4** illustrate the updated watershed signature for the 50 percent and 25 percent adoption rates of rain gardens, respectively, or 10 percent and 5 percent of all private property in Alhambra Wash over 50 years. The figures illustrate that private property make up a good portion of the opportunity for increased Water Quality, Water Supply, and Community Investment Benefits, thus, the Working Group came to a consensus on a recommendation to the District regarding creating a private property incentive program.

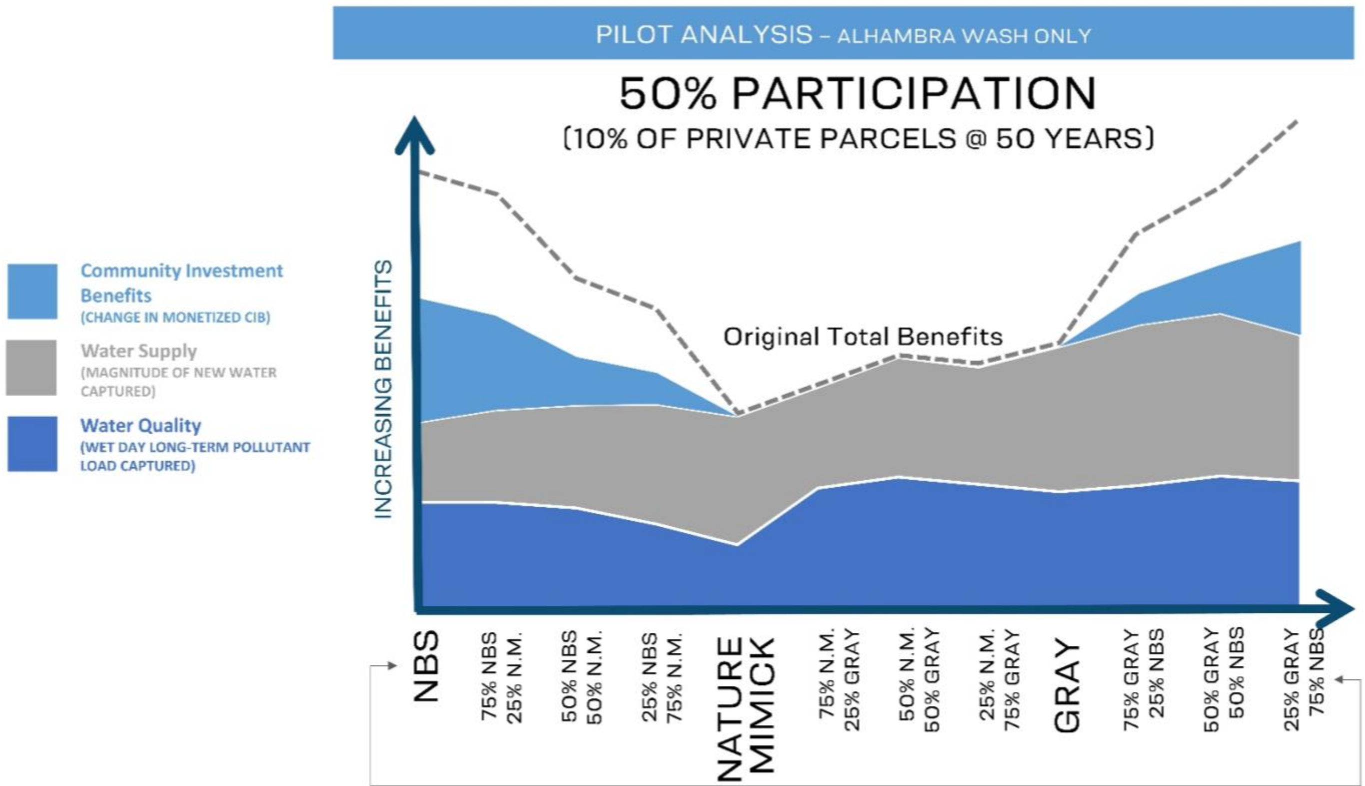


Figure 4-3. Updated watershed signature with 50 percent private parcel participation (10 percent of private parcels in Alhambra Wash over 50 years).

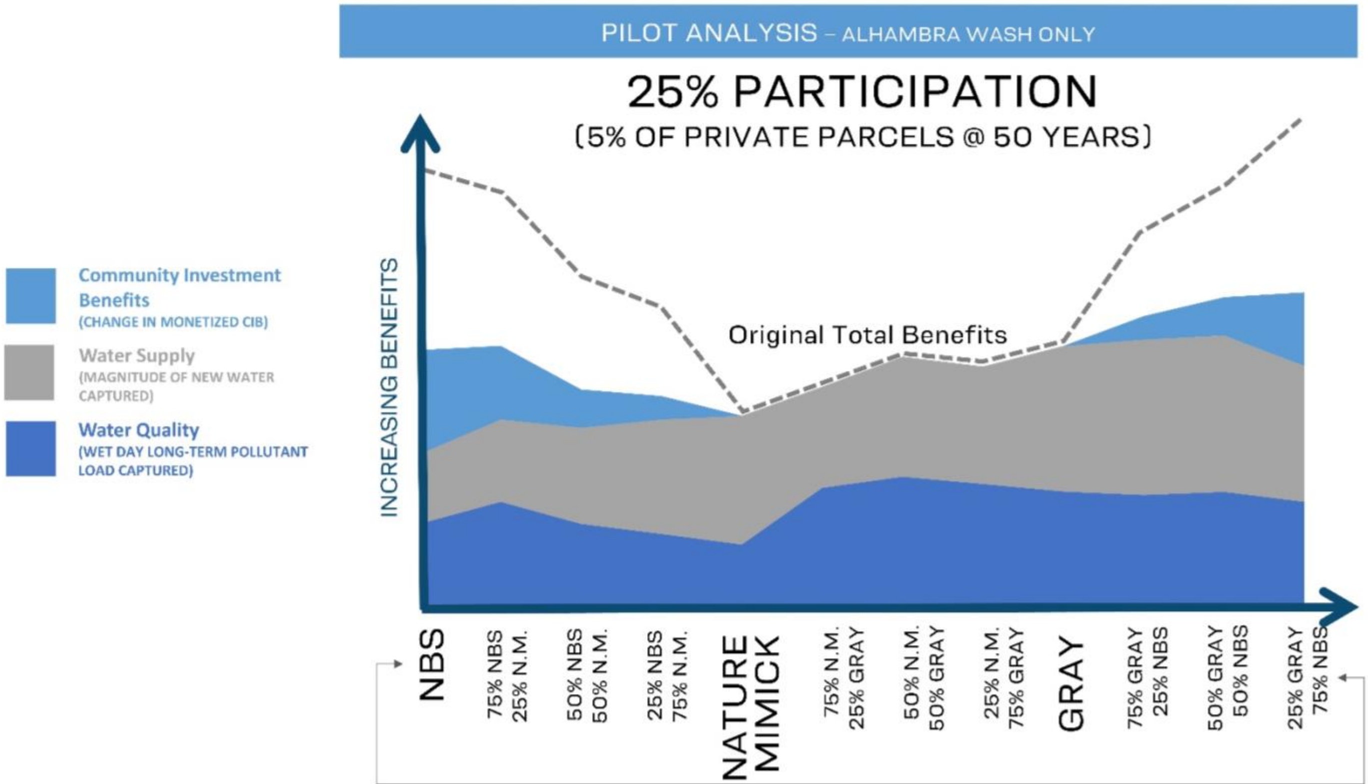


Figure 4-4. Updated watershed signature with 25 percent private parcel participation (5 percent of private parcels in Alhambra Wash over 50 years).

- Variability of infiltration rates into native soil/high-throughput engineered filter media: Various assumed infiltration rates were tested for Nature-Mimicking infiltration gallery projects, from one-half the assumed infiltration to double the assumed infiltration rate (**Figure 4-5**). **Figure 4-5** illustrates how the Water Supply Benefits greatly increases for the 100 percent Nature-Mimicking scenario compared to the base scenario, thus bringing the total benefit of the 100 percent Nature-Mimicking Solutions scenario to nearly the same total benefit of the 100 percent Gray Infrastructure scenario. This example demonstrates how the watershed signature can change its shape depending on watershed-specific factors such as hydrogeological conditions. It is important to acknowledge that the infiltration rates in Alhambra Wash are relatively low based on GIS data, ranging from 0.2 inches per hour to 1 inch per hour. The Working Group also wanted to test how the shape of the watershed signature would change due to incorporating high-throughput engineered filter media (e.g. 5 inches per hour) for non-residential rain gardens as well as doubling the infiltration rate of infiltration galleries (**Figure 4-6**). Note that the costs of non-residential rain gardens were adjusted in this scenario to account for the design of underdrains due to the use of high-throughput filter media. The higher total benefits compared to the base scenario indicate that investing in high-throughput engineered filter media for non-residential rain gardens would be a worthwhile investment and technology to look into.

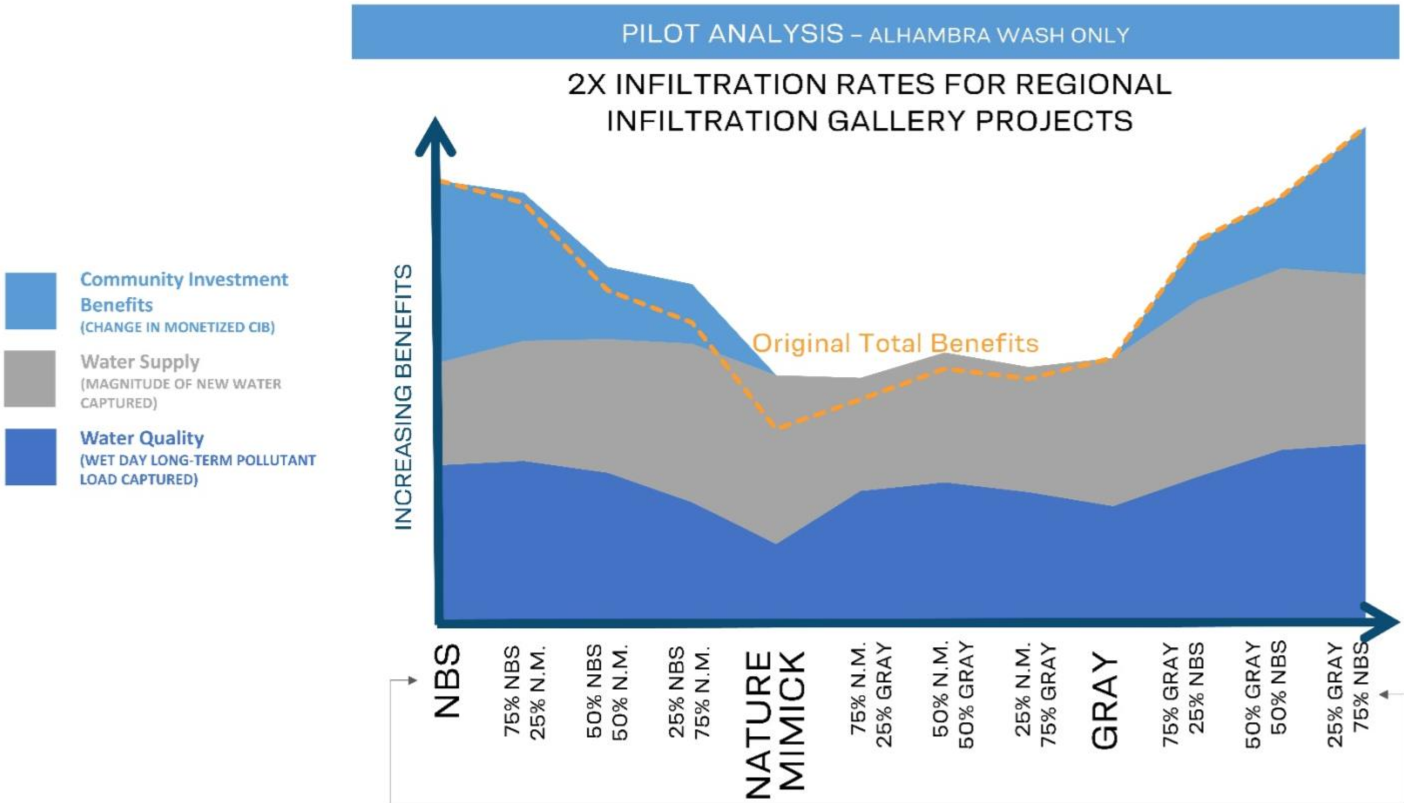


Figure 4-5. Updated watershed signature for double the infiltration rate of Nature-Mimicking infiltration gallery projects.

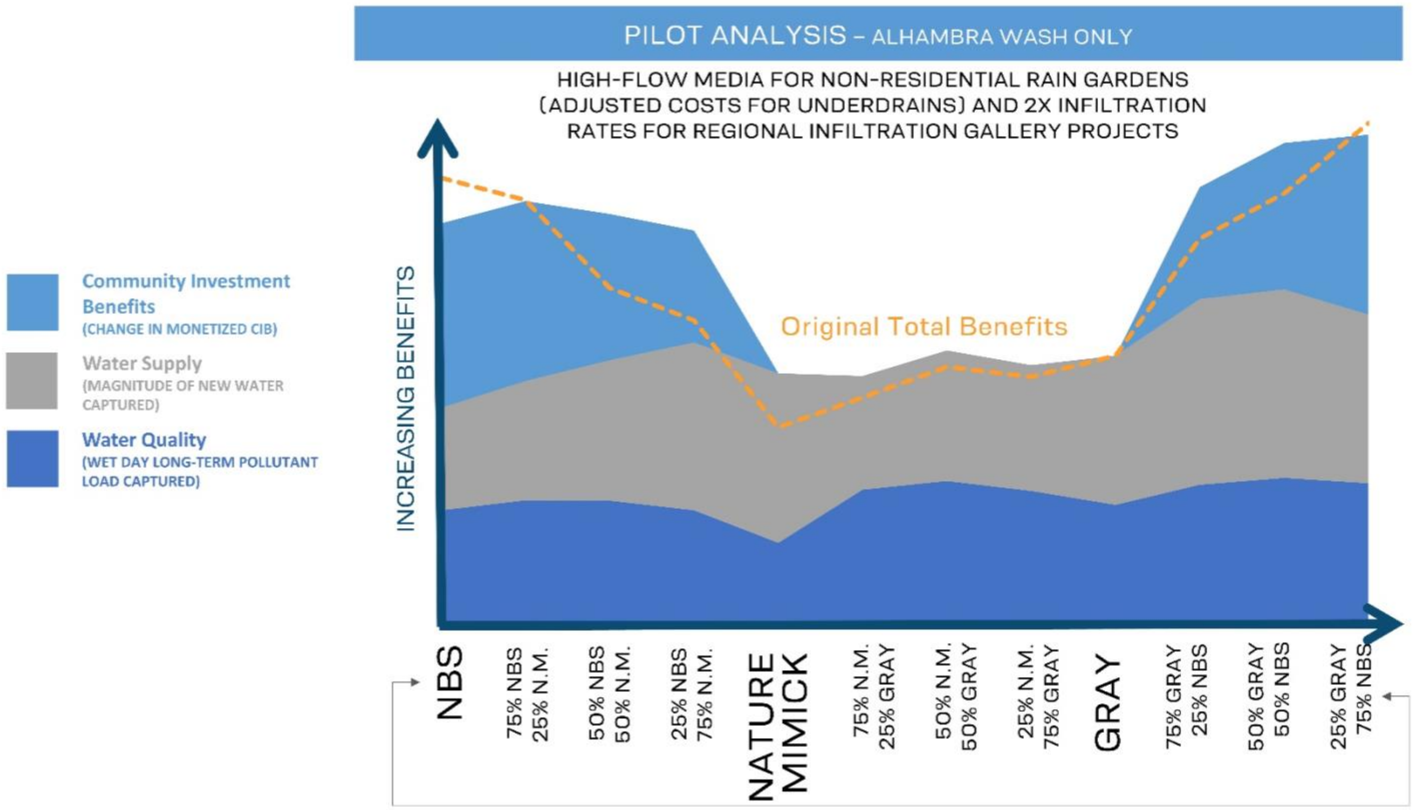


Figure 4-6. Updated watershed signature for double the infiltration rate of Nature-Mimicking infiltration gallery projects and high throughput engineered filter media for non-residential Nature-Based Solutions.

- Leveraged funding through WHAM: The Technical Team screened the watershed for land opportunities that could be leveraged for Measure A, M, and W municipal funding. Based on cursory research, the Technical Team concluded that synergies with Measure H outcome lie primarily with jobs/workforce development, not land opportunities. Therefore, project synergies will require more site-specific information (e.g. where new housing is proposed to be built, ensure stormwater capture is fully explored). With respect to Measure A, geographies that can be unlocked for funding include existing park spaces and new park spaces due to significant alignment in Measure A and W goals. There is also goal overlap between Measure M and W; thus, opportunities that can be leveraged for funding include Metro-owned parcels for green street/alley conversion and any corridor with needed street improvements, pothole repairs, signals, etc. **Figure 4-7** illustrates how overall Water Quality, Water Supply, and Community Investment Benefits can be significantly boosted by leveraging WHAM funding.

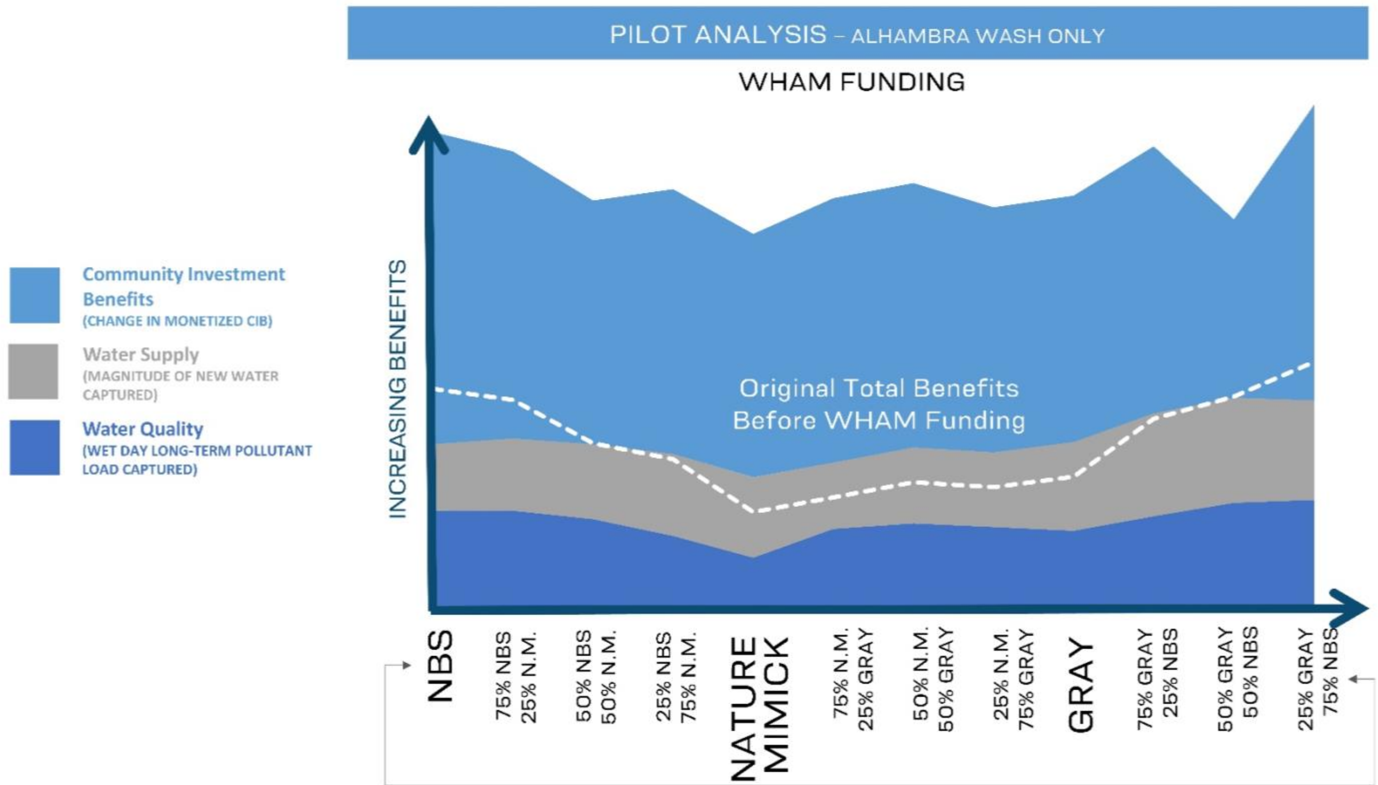


Figure 4-7. Updated watershed signature accounting for leveraged WHAM funding over 50 years (an additional $120 million with $40 million from Measure A, $30 million from Measure M, and $50 million from Measure W's Municipal Program).

While these sensitivity analyses produced changes to the shape of the watershed signature, it remained clear that in order to maximize benefits within the Alhambra Wash, it is crucial to invest in a combination of Nature-Based and regional infrastructure, rather than solely regional infrastructure.

5 Next Steps

Dr. Elizabeth Fassman-Beck of the Southern California Coastal Water Research Project (SCCWRP) provided third-party review of the technical assumptions underlying this document and stated the following: “The assumptions and model structure adopted by the Project seem technically reasonable and appropriately configured. A significant effort is apparent in balancing detail with available information and project resources.” Dr. Fassman-Beck suggested that the following topics could warrant additional discussion on uncertainty/model sensitivity to improve future iterations of the model results:

- Scenarios, which have not been calibrated or verified with real project-monitoring data;
- Assumed infiltration rate(s) for modeling of rain gardens and infiltration galleries (*partially addressed in Section 4*);
- Role of trees in the context of overall model results since few commonly used models for stormwater planning or BMP design incorporate robustly developed routines to model the influence of trees. It would be instructive to compare model predictions against an alternative model such as iTree, which has been developed specifically by tree experts; and,
- Aquifer recharge via stormwater. The use of stormwater to recharge aquifers is of growing interest and concern in southern California. The project’s Water Supply benefit calculations assume that the volume of captured and infiltrated runoff equals the volume of aquifer recharge. There is little, if any, existing evidence in the literature to demonstrate the equivalence of capture and recharge, or vice versa. In the case of deep aquifers, such as underlying many areas of Los Angeles, it is worthwhile to question whether all water infiltrated becomes water supply, unless perhaps water for evapotranspiration is considered a benefit. While the project’s assumptions align with typical best practice, a statement or explanation to the lack of data supporting or refuting the assumption is warranted.

These suggestions will be carefully considered in future iterations of similar studies (e.g. the Metrics and Monitoring Study) to ensure adaptive management of the SCWP based on the latest watershed science and data.

ATTACHMENT A: DETAILED ALTERNATIVE SCORING CRITERIA EXAMPLES

The purpose of this section is to provide a step-by-step example of how alternative scoring frameworks were tested for three sites and different project types for each site (Figure A-1). Table A-1 displays key performance metrics for selected sites and project types.

Figure A-1. Three sites and different project types for which alternative scoring frameworks were tested.

Table A-1. Key performance metrics for selected sites and project types.

Site	Cost	Wet Day Long-Term Pollutant Load Captured (pounds per year) (WQ)	Magnitude of New Water Captured (ac-ft per year) (WS)	New Trees Planted (# trees) (CIB)	WQ/$ in millions	WS/$ in millions	CIB/$ in millions
Park & Ride (Gray)*	$2,760,000	15.40	607.49	0	5.6	220.7	0
Well Lot (Gray)*	$3,500,000	11.61	20.08**	0	3.3	5.8	0
Well Lot (NBS)	$51,000	0.19	0.33	9	3.7	6.5	176.5
School (NBS)	$470,000	1.89	3.42	89	4.1	7.4	189.4

*The Gray Infrastructure projects were not modeled to capture the 85th percentile, 24-hour storm; thus, under the current scoring criteria, they would automatically be reclassified as a dry weather project and both under 40 points for capturing 100 percent of dry weather runoff and managing over 200 acres of dry weather runoff.

**When only considering the Well Lot (Gray) project in isolation, it is modeled to capture 347 ac-ft per year of water. However, when considered in a nest with other regional projects in the pilot watershed, it captures 20 ac-ft per year of water.

Table A-2 displays the current (third column) versus proposed (fifth column) scoring criteria thresholds in Alternative Example #1 for each scoring category section (first column). The maximum scores indicated in the second column are the current maximum number of points designated to each category. For Alternative Scoring Example #1, the following revisions are applied.

1. The scoring criteria are synchronized with the Working Group's recommended metrics so that projects can be assessed using clearly defined, locally-relevant metrics.
    a. For Water Quality, Water Supply, and Community Investment Benefits, the metrics used to normalize based on cost-effectiveness are proposed to be Wet Day Long-Term Pollutant Load Captured, Magnitude of New Water Captured, and monetized Community Investment Benefits, respectively.
    b. To better account for the value of leveraged funding, any funding match is subtracted from the project costs. Using this approach, the 10 points from the "Leverage Funds and Community Support" category now addresses justified community engagement, per Recommendation #8. For the purposes of these examples, it was assumed that no funds were leveraged and no community engagement has been completed.
2. Scoring criteria are normalized to total project costs so that every project is compared on the basis of costs and benefits, rather than just total benefits.
    a. Evaluating project priority on the basis of cost-effectiveness enables all projects to be compared equitably to ensure the best use of SCWP funds; additionally, awarding points proportional to cost-effectiveness provides a logical and structured approach to value project benefits, as compared to relying on scoring benchmarks that might favor larger or smaller projects.
    b. To assign points to normalized metrics, hypothetical scoring distributions were established based on benchmarking the range of potential projects modeled for the Pilot Analysis, but this could also be done using projects submitted to the SCWP during each funding cycle (similar to "grading on a curve"); for example, the projects that provide the best Water Quality Benefits per dollar (80th percentile performance or higher) would receive the maximum points, whereas projects that provide average (50th percentile) Water Quality Benefits per dollar would receive half points. The fourth column of Table A-2 displays the hypothetical scoring distributions for the Water Quality, Water Supply, and Community Investment Benefit categories. The subdivision of points is based on the 20^{th} percentile, 40^{th} percentile, 60^{th} percentile, and 80^{th} percentile value of the cost-effectiveness metrics.

Table A-2. Current vs. proposed scoring criteria thresholds for Alternative Scoring Example #1. The maximum scores indicated in the second column are the current maximum number of points designated to each category.

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Water Quality Wet + Dry Weather Part 1	20	Cost Effectiveness = (24-hour BMP Capacity) / (Construction Cost in $ Millions) • <0.4 = 0 points • 0.4-0.6 = 7 points • 0.6-0.8 = 11 points • 0.8-1.0 = 14 points • >1.0 = 20 points	50	Wet Weather Impairment Reduction Efficiency = Wet Day Pollutant Load Reduced (annual average pounds reduced)/$ in millions • <1.5 pounds per $ = 10 points • <2.0 pounds per $ = 20 points • <2.5 pounds per $ = 30 points • <3.7 pounds per $ = 40 points • >3.7 pounds per $ = 50 points
Water Quality Wet + Dry Weather Part 2	30	Primary Pollutant Reduction: • > 50% = 15 points • > 80% = 20 points Secondary Pollutant Reduction: • > 50% = 5 points • > 80% = 10 points		
Water Supply Part 1	13	• >$2500/ac-ft = 0 points • $2000-2500/ac-ft = 3 points • $1500-2000/ac-ft = 6 points • $1000-1500/ac-ft = 10 points • <$1000/ac-ft = 13 points	25	New Water Capture Efficiency = New Water Captured (annual average acre-feet captured)/$ in millions • <5.4 ac-ft per $ = 5 points • <7.0 ac-ft per $ = 10 points • <9.0 ac-ft per $ = 15 points • <11.4 ac-ft per $ = 20 points • >11.4 ac-ft per $ = 25 points
Water Supply Part 2	12	• <25 ac-ft/year = 0 points • 25-100 ac-ft/year= 2 points • 100-200 ac-ft/year = 5 points • 200-300 ac-ft/year = 10 points • >300 ac-ft/year = 12 points		
Community Investment	10	• One Benefit = 2 points • Three Benefits = 5 points • Six Benefits = 10 points	10	*New Trees Planted per Dollar Spent = New Trees (# trees)/$ in millions • <89.1 trees per $ = 4 points • <94.2 trees per $ = 6 points • <187.2 trees per $ = 8 points • >187.2 trees per $ = 10 points

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Nature Based Solutions	15	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or useable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points	15	Better define NBS vs. Nature-Mimicking
Leveraging Funding Part 1	6	• >25% Funding Matched = 3 points • >50% Funding Matched = 6 points	0	Leveraged funding deducted from costs for the Water Quality, Water Supply, and Community Investment Benefit scoring section
Leveraging Funding Part 2	4	The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs	10	Better define engagement/robust scoring according to Recommendation #8

*For the purposes of this scoring example, new trees planted per dollar (in millions) spent was used. However, it is recommended that a monetized CIB metric be used to consolidate the numerous types of CIB that a project may provide.

	Current			Gray		NBS		Example 1 - Update Metrics, Retain Weights, Clarify Community Engagement (CE)			Gray		NBS	
Category/Goal	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School
Water Quality	*Wet Weather* - $/24-hr vol. managed	45%	50	0	0	11	11	*Wet Weather Impairment Redux Efficiency* - wet day pollutant load reduced/$	45%	50	50	30	50	50
	- % reduction of inflow			0	20	30	30							
	Dry Weather - 100% dry weather capture		40	20	20	20	20	*Dry Weather Impairment Redux Efficiency* - % days with dry weather flow eliminated/$		40	--	--	--	–
	- dry weather drainage area managed			20	20	10	10							
Water Supply	- $/ac-ft	23%	25	13	13	0	0	*New Water Capture Efficiency* - ac-ft/$	23%	25	25	10	15	10
	- ac-ft/yr			12	12	0	0							
Community Investments	- # of CIBs provided	9%	10	2	2	5	10	*CIB Value Delivery Efficiency* - Monetized CIB metrics/$	9%	10	0	0	8	10
Nature-Based Solutions	- "Level of natural"	14%	15	0	0	10	10	- Better define NBS vs Nature-Mimicking	14%	15	0	0	15	15
Leverage Funds and Community Support	- % funding matched	9%	10	0	0	0	0	- Leveraged funding deducted from costs	9%	10	--	--	--	–
	- Demonstrated support			0	0	0	0	- Better define engagement/robust support			0	0	0	0
Total			110	67	67	56	61			110	75	40	88	85

Figure A-2. Example scoring metrics and outcomes for the hypothetical projects under Example 1 (right) compared to the current scoring criteria (left). Under this example, it is clear that the "well lot" gray infrastructure project is not as cost-effective as the "park & ride" gray infrastructure project. Where two gray infrastructure projects might have performed equally under the current scoring criteria (due to re-categorization of many gray infrastructure projects to dry weather if not capturing the 85th percentile, 24-hour storm), Alternative Scoring Example #1 allows one to see distinctions in cost-effectiveness between two projects.

Table A-3 displays the current (third column) versus proposed (fifth column) scoring criteria thresholds in Alternative Example #2 for each scoring category section (first column). The maximum scores indicated in the second column are the current maximum number of points designated to each category. For Alternative Scoring Example #2, the following revisions are applied.

1. The second example applies the same assumptions as Example #1 but also offers 10 priority points for projects that serve DACs (per Recommendation #11).
2. This example also consolidates points between Nature-Based Solutions and Community Investment Benefits (25 points overall) so that projects can be assessed based on how well projects yield desired outcomes and benefits (instead of simply based on what type of project is implemented). The updated relative percentage between scoring categories is illustrated in Figure A-3.

Table A-3. Current vs. proposed scoring criteria thresholds for Alternative Scoring Example #2. The maximum scores indicated in the second column are the current maximum number of points designated to each category. The font in red indicates changes relative to Table A-2.

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Water Quality Wet + Dry Weather Part 1	20	Cost Effectiveness = (24-hour BMP Capacity) / (Construction Cost in $ Millions) • <0.4 = 0 points • 0.4-0.6 = 7 points • 0.6-0.8 = 11 points • 0.8-1.0 = 14 points • >1.0 = 20 points	50	Wet Weather Impairment Reduction Efficiency = Wet Day Pollutant Load Reduced (annual average pounds reduced)/$ in millions • <1.5 pounds per $ = 10 points • <2.0 pounds per $ = 20 points • <2.5 pounds per $ = 30 points • <3.7 pounds per $ = 40 points • >3.7 pounds per $ = 50 points
Water Quality Wet + Dry Weather Part 2	30	Primary Pollutant Reduction: • > 50% = 15 points • > 80% = 20 points Secondary Pollutant Reduction: • > 50% = 5 points • > 80% = 10 points		
Water Supply Part 1	13	• >$2500/ac-ft = 0 points • $2000-2500/ac-ft = 3 points • $1500-2000/ac-ft = 6 points • $1000-1500/ac-ft = 10 points • <$1000/ac-ft = 13 points	25	New Water Capture Efficiency = New Water Captured (annual average acre-feet captured)/$ in millions • <5.4 ac-ft per $ = 5 points • <7.0 ac-ft per $ = 10 points • <9.0 ac-ft per $ = 15 points • <11.4 ac-ft per $ = 20 points • >11.4 ac-ft per $ = 25 points
Water Supply Part 2	12	• <25 ac-ft/year = 0 points • 25-100 ac-ft/year= 2 points • 100-200 ac-ft/year = 5 points • 200-300 ac-ft/year = 10 points • >300 ac-ft/year = 12 points		
Community Investment	10	• One Benefit = 2 points • Three Benefits = 5 points • Six Benefits = 10 points	25	*New Trees Planted per Dollar Spent = New Trees (# trees)/$ in millions • <89.1 trees per $ = 10 points • <94.2 trees per $ = 15 points • <187.2 trees per $ = 20 points • >187.2 trees per $ = 25 points

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Nature Based Solutions	15	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or useable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points	0	Prioritized during WASC target setting
Leveraging Funding Part 1	6	• >25% Funding Matched = 3 points • >50% Funding Matched = 6 points	0	Leveraged funding deducted from costs for the Water Quality, Water Supply, and Community Investment Benefit scoring section
Leveraging Funding Part 2	4	The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs	10	Better define engagement/robust scoring according to Recommendation #8
DAC Benefits	0		+10	Ratio of DAC CIB / Total CIB

*For the purposes of this scoring example, new trees planted per dollar (in millions) spent was used. However, it is recommended that a monetized CIB metric be used to consolidate the numerous types of CIB that a project may provide.

	Current				Gray		NBS		Example 2 - Update Metrics, Retain Weights, Clarify CE, Add DAC Priority Points, Consolidate NBS-CIB			Gray		NBS	
Category/Goal	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School
Water Quality	*Wet Weather* - $/24-hr vol. managed - % reduction of inflow	45%	50	0 0	0 20	11 30	11 30	*Wet Weather Impairment Redux Efficiency* - wet day pollutant load reduced/$	42%	50	50	30	50	50
	Dry Weather - 100% dry weather capture - dry weather drainage area managed		40	20 20	20 20	20 10	20 10	*Dry Weather Impairment Redux Efficiency* - % days with dry weather flow eliminated/$		40	--	--	--	--
Water Supply	- $/ac-ft - ac-ft/yr	23%	25	13 12	13 12	0 0	0 0	*New Water Capture Efficiency* - ac-ft/$	21%	25	25	10	15	10
Community Investments	- # of CIBs provided	9%	10	2	2	5	10	*CIB Value Delivery Efficiency* - Monetized CIB metrics/$	21%	25	0	0	20	25
Nature-Based Solutions	- "Level of natural"	14%	15	0	0	10	10	- Prioritized during WASC target setting	--	--	--	--	--	--
Leverage Funds and Community Support	- % funding matched	9%	10	0	0	0	0	- Leveraged funding deducted from costs	8%	10	--	--	--	--
	- Demonstrated support			0	0	0	0	- Better define engagement/robust support			0	0	0	0
DAC Benefits	--	--	--	--	--	--	--	- DAC CIBs / Total CIBs	8%	+10	0	0	10	10
Total			110	67	67	56	61			110 (+10)	75	40	95	95

Figure A-3. Example scoring metrics and outcomes for the hypothetical projects under Example 2 (right) compared to the current scoring criteria (left). Because the two NBS projects are located in Disadvantaged Communities and thus provide local Community Investment Benefits, they receive an additional ten points.

Table A-4 displays the current (third column) versus proposed (fifth column) scoring criteria thresholds in Alternative Example #3 for each scoring category section (first column). The maximum scores indicated in the second column are the current maximum number of points designated to each category. For Alternative Scoring Example #3, the following revisions are applied.

1. The third option applies the same assumptions as Example 2, but hypothetically adjusts the weights and available points of each category to balance the value of the three major Goals (equally weighted). Adjustment of weights should be informed by the Needs Assessment.

Table A-4. Current vs. proposed scoring criteria thresholds for Alternative Scoring Example #3. The maximum scores indicated in the second column are the current maximum number of points designated to each category. The font in red indicates changes relative to Table A-3.

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Water Quality Wet + Dry Weather Part 1	20	Cost Effectiveness = (24-hour BMP Capacity) / (Construction Cost in $ Millions) • <0.4 = 0 points • 0.4-0.6 = 7 points • 0.6-0.8 = 11 points • 0.8-1.0 = 14 points • >1.0 = 20 points	34	Wet Weather Impairment Reduction Efficiency = Wet Day Pollutant Load Reduced (annual average pounds reduced)/$ in millions • <1.5 pounds per $ = 6.8 points • <2.0 pounds per $ = 13.6 points • <2.5 pounds per $ = 20.4 points • <3.7 pounds per $ = 27.2 points • >3.7 pounds per $ = 34.0 points
Water Quality Wet + Dry Weather Part 2	30	Primary Pollutant Reduction: • > 50% = 15 points • > 80% = 20 points Secondary Pollutant Reduction: • > 50% = 5 points • > 80% = 10 points		
Water Supply Part 1	13	• >$2500/ac-ft = 0 points • $2000-2500/ac-ft = 3 points • $1500-2000/ac-ft = 6 points • $1000-1500/ac-ft = 10 points • <$1000/ac-ft = 13 points	33	New Water Capture Efficiency = New Water Captured (annual average acre-feet captured)/$ in millions • <5.4 ac-ft per $ = 6.6 points • <7.0 ac-ft per $ = 13.2 points • <9.0 ac-ft per $ = 19.8 points • <11.4 ac-ft per $ = 26.4 points • >11.4 ac-ft per $ = 33.0 points
Water Supply Part 2	12	• <25 ac-ft/year = 0 points • 25-100 ac-ft/year= 2 points • 100-200 ac-ft/year = 5 points • 200-300 ac-ft/year = 10 points • >300 ac-ft/year = 12 points		
Community Investment	10	• One Benefit = 2 points • Three Benefits = 5 points • Six Benefits = 10 points	33	*New Trees Planted per Dollar Spent = New Trees (# trees)/$ in millions • <89.1 trees per $ = 13.2 points • <94.2 trees per $ = 19.8 points • <187.2 trees per $ = 26.4 points • >187.2 trees per $ = 33.0 points

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Nature Based Solutions	15	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or useable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points	0	Prioritized during WASC target setting
Leveraging Funding Part 1	6	• >25% Funding Matched = 3 points • >50% Funding Matched = 6 points	0	Leveraged funding deducted from costs for the Water Quality, Water Supply, and Community Investment Benefit scoring section
Leveraging Funding Part 2	4	The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs	+10	Better define engagement/robust scoring according to Recommendation #8
DAC Benefits	0		+10	Ratio of DAC CIB / Total CIB

*For the purposes of this scoring example, new trees planted per dollar (in millions) spent was used. However, it is recommended that a monetized CIB metric be used to consolidate the numerous types of CIB that a project may provide.

	Current			Gray		NBS		Example 3 - Update Metrics, Calibrate Weights to Watershed Needs, Add 10 Priority Pts for CE & DAC Benfits			Gray		NBS	
Category/Goal	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School
Water Quality	*Wet Weather* - $/24-hr vol. managed - % reduction of inflow	45%	50	0 0	0 20	11 30	11 30	*Wet Weather Impairment Redux Efficiency* - wet day pollutant load reduced/$	33%	34	34	20	34	34
	Dry Weather - 100% dry weather capture - dry weather drainage area managed		40	20 20	20 20	20 10	20 10	*Dry Weather Impairment Redux Efficiency* - % days with dry weather flow eliminated/$		34	--	–	--	–
Water Supply	- $/ac-ft	23%	25	13	13	0	0	*New Water Capture Efficiency* - ac-ft/$	33%	33	33	13	20	13
	- ac-ft/yr			12	12	0	0							
Community Investments	- # of CIBs provided	9%	10	2	2	5	10	*CIB Value Delivery Efficiency* - Monetized CIB metrics/$	33%	33	0	0	26	33
Nature-Based Solutions	- "Level of natural"	14%	15	0	0	10	10	- Prioritized during WASC target setting	–	--	--	–	--	–
Leverage Funds and Community Support	- % funding matched	9%	10	0	0	0	0	- Leveraged funding deducted from costs	+10%	+10	--	–	--	–
	- Demonstrated support			0	0	0	0	- Better define engagement/robust support			0	0	0	0
DAC Benefits	--	--	--	--	--	--	--	- DAC CIBs / Total CIBs	+10%	+10	0	0	10	10
Total			110	67	67	56	61			100 (+20)	67	34	90	90

Figure A-4. Example scoring metrics and outcomes for the hypothetical projects under Example 3 (right) compared to the current scoring criteria (left). The reallocation of points to weight more toward Community Investment Benefits results in lower scores for gray projects, as they do not intrinsically provide Community Investment Benefits without additional surface improvements.

Table A-5 displays the current (third column) versus proposed (fifth column) scoring criteria thresholds in Alternative Example #4 for each scoring category section (first column). The maximum scores indicated in the second column are the current maximum number of points designated to each category. For Alternative Scoring Example #4, the following revisions are applied.

1. The fourth option calibrates scoring weights and available points to align with hypothetical long-term targets derived from the watershed signature and targets. For this example, it is assumed that a certain scenario from the watershed signature is selected (e.g. 50 percent Nature-Based Solutions and 50 percent Gray Infrastructure), which provides Water Quality, Water Supply, and Community Investment Benefits in a ratio of 40 percent, 40 percent, and 20 percent (for example, see the "slice" of the watershed signature for the 50 percent Nature-Based Solutions, 50 percent Gray Infrastructure scenario in **Figure 4-1**, in which the distribution of benefits follows this weighting). This would theoretically incentivize the submission of projects that drive the Program toward the long-term targets.

Table A-5. Current vs. proposed scoring criteria thresholds for Alternative Scoring Example #4. The maximum scores indicated in the second column are the current maximum number of points designated to each category. The font in red indicates changes relative to Table A-4.

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Water Quality Wet + Dry Weather Part 1	20	Cost Effectiveness = (24-hour BMP Capacity) / (Construction Cost in $ Millions) • <0.4 = 0 points • 0.4-0.6 = 7 points • 0.6-0.8 = 11 points • 0.8-1.0 = 14 points • >1.0 = 20 points	40	Wet Weather Impairment Reduction Efficiency = Wet Day Pollutant Load Reduced (annual average pounds reduced)/$ in millions • <1.5 pounds per $ = 8 points • <2.0 pounds per $ = 16 points • <2.5 pounds per $ = 24 points • <3.7 pounds per $ = 32 points • >3.7 pounds per $ = 40 points
Water Quality Wet + Dry Weather Part 2	30	Primary Pollutant Reduction: • > 50% = 15 points • > 80% = 20 points Secondary Pollutant Reduction: • > 50% = 5 points • > 80% = 10 points		
Water Supply Part 1	13	• >$2500/ac-ft = 0 points • $2000-2500/ac-ft = 3 points • $1500-2000/ac-ft = 6 points • $1000-1500/ac-ft = 10 points • <$1000/ac-ft = 13 points	40	New Water Capture Efficiency = New Water Captured (annual average acre-feet captured)/$ in millions • <5.4 ac-ft per $ = 8 points • <7.0 ac-ft per $ = 16 points • <9.0 ac-ft per $ = 24 points • <11.4 ac-ft per $ = 32 points • >11.4 ac-ft per $ = 40 points
Water Supply Part 2	12	• <25 ac-ft/year = 0 points • 25-100 ac-ft/year= 2 points • 100-200 ac-ft/year = 5 points • 200-300 ac-ft/year = 10 points • >300 ac-ft/year = 12 points		
Community Investment	10	• One Benefit = 2 points • Three Benefits = 5 points • Six Benefits = 10 points	20	*New Trees Planted per Dollar Spent = New Trees (# trees)/$ in millions • <89.1 trees per $ = 8 points • <94.2 trees per $ = 12 points • <187.2 trees per $ = 16 points • >187.2 trees per $ = 20 points

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Nature Based Solutions	15	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or useable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points	0	Prioritized during WASC target setting
Leveraging Funding Part 1	6	• >25% Funding Matched = 3 points • >50% Funding Matched = 6 points	0	Leveraged funding deducted from costs for the Water Quality, Water Supply, and Community Investment Benefit scoring section
Leveraging Funding Part 2	4	The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs	+10	Better define engagement/robust scoring according to Recommendation #8
DAC Benefits	0		+10	Ratio of DAC CIB / Total CIB

*For the purposes of this scoring example, new trees planted per dollar (in millions) spent was used. However, it is recommended that a monetized CIB metric be used to consolidate the numerous types of CIB that a project may provide.

	Current			Gray		NBS		Example 4 - Update Metrics, Calibrate Weights to Targets, Add 10 Priority Pts for CE & DAC Benefits			Gray		NBS	
Category/Goal	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School	Metric	Weight	Max. Points	Park & Ride	Well Lot	Well Lot	School
Water Quality	*Wet Weather* - $/24-hr vol. managed - % reduction of inflow	45%	50	0 0	0 20	11 30	11 30	*Wet Weather Impairment Redux Efficiency* - wet day pollutant load reduced/$	40%	40	40	24	40	40
	Dry Weather - 100% dry weather capture - dry weather drainage area managed		40	20 20	20 20	20 10	20 10	*Dry Weather Impairment Redux Efficiency* - % days with dry weather flow eliminated/$		40	--	--	--	--
Water Supply	- $/ac-ft - ac-ft/yr	23%	25	13 12	13 12	0 0	0 0	*New Water Capture Efficiency* - ac-ft/$	40%	40	40	16	24	16
Community Investments	- # of CIBs provided	9%	10	2	2	5	10	*CIB Value Delivery Efficiency* - Monetized CIB metrics/$	20%	20	0	0	16	20
Nature-Based Solutions	- "Level of natural"	14%	15	0	0	10	10	- Prioritized during WASC target setting	--	--	--	--	--	--
Leverage Funds and Community Support	- % funding matched	9%	10	0	0	0	0	- Leveraged funding deducted from costs	+10%	+10	--	--	--	--
	- Demonstrated support			0	0	0	0	- Better define engagement/robust support			0	0	0	0
DAC Benefits	--	--	--	--	--	--	--	- DAC CIBs / Total CIBs	+10%	+10	0	0	10	10
Total			110	67	67	56	61			100 (+20)	80	40	90	86

Figure A-5. Example scoring metrics and outcomes for the hypothetical projects under Example 4 (right) compared to the current scoring criteria (left).

The final example applies the same assumptions as the preceding examples, but calibrates scoring weights and points to both long-term goals (Example #4) and is specific to expectations of each project type. Table A-6 displays the current (third column) versus proposed (fifth column) scoring criteria thresholds in Alternative Example #5 for each scoring category section (first column) for Nature-Based Solutions. Table A-7 displays the current (third column) versus proposed (fifth column) scoring criteria thresholds in Alternative Example #5 for each scoring category section (first column) for hybrid projects. Table A-8 displays the current (third column) versus proposed (fifth column) scoring criteria thresholds in Alternative Example #5 for each scoring category section (first column) for Gray Infrastructure. The maximum scores indicated in the second column are the current maximum number of points designated to each category. For Alternative Scoring Example #5, the following revisions are applied.

1. The calibration to both long-term goals and project type enables projects to be assessed based on what types of benefits are reasonable to expect for each project type; for example, Gray Infrastructure projects would be assessed primarily based on their efficiency at capturing and treating water and pollutants (not providing Community Investment Benefits) resulting in a 50%-30%-0% allocation of points for the Water Quality, Water Supply, and Community Investment Benefits categories, respectively, whereas Nature-Based projects would be assessed based more heavily on their efficiency at delivering Community Investment Benefits along with Water Quality Benefits and---to a lesser extent---Water Supply Benefits resulting in a 35%-25%-40% allocation of points for the Water Quality, Water Supply, and Community Investment Benefits categories, respectively. Hybrid projects in conjunction with the scenario selected from the watershed signature (e.g., 50 percent NBS and 50 percent Gray Infrastructure) would have a 40%-40%-20% allocation of points for the Water Quality, Water Supply, and Community Investment Benefits categories, respectively, based on the ratio of benefits expected from such a scenario.

Table A-6. Current vs. proposed scoring criteria thresholds for Alternative Scoring Example #5, specifically Nature-Based Solutions. The maximum scores indicated in the second column are the current maximum number of points designated to each category.

<table>
<tr><th>Scoring Section</th><th>Max Score</th><th>Current Scoring Criteria Thresholds</th><th>Proposed Max Score</th><th>Proposed Scoring Criteria Thresholds</th></tr>
<tr><td>Water Quality Wet + Dry Weather Part 1</td><td>20</td><td>Cost Effectiveness = (24-hour BMP Capacity) / (Construction Cost in $ Millions)
• <0.4 = 0 points
• 0.4-0.6 = 7 points
• 0.6-0.8 = 11 points
• 0.8-1.0 = 14 points
• >1.0 = 20 points</td><td rowspan="2">35</td><td rowspan="2">Wet Weather Impairment Reduction Efficiency = Wet Day Pollutant Load Reduced (annual average pounds reduced)/$ in millions
• <1.5 pounds per $ = 7 points
• <2.0 pounds per $ = 14 points
• <2.5 pounds per $ = 21 points
• <3.7 pounds per $ = 28 points
• >3.7 pounds per $ = 35 points</td></tr>
<tr><td>Water Quality Wet + Dry Weather Part 2</td><td>30</td><td>Primary Pollutant Reduction:
• > 50% = 15 points
• > 80% = 20 points

Secondary Pollutant Reduction:
• > 50% = 5 points
• > 80% = 10 points</td></tr>
<tr><td>Water Supply Part 1</td><td>13</td><td>• >$2500/ac-ft = 0 points
• $2000-2500/ac-ft = 3 points
• $1500-2000/ac-ft = 6 points
• $1000-1500/ac-ft = 10 points
• <$1000/ac-ft = 13 points</td><td rowspan="2">25</td><td rowspan="2">New Water Capture Efficiency = New Water Captured (annual average acre-feet captured)/$ in millions
• <5.4 ac-ft per $ = 5 points
• <7.0 ac-ft per $ = 10 points
• <9.0 ac-ft per $ = 15 points
• <11.4 ac-ft per $ = 20 points
• >11.4 ac-ft per $ = 25 points</td></tr>
<tr><td>Water Supply Part 2</td><td>12</td><td>• <25 ac-ft/year = 0 points
• 25-100 ac-ft/year= 2 points
• 100-200 ac-ft/year = 5 points
• 200-300 ac-ft/year = 10 points
• >300 ac-ft/year = 12 points</td></tr>
<tr><td>Community Investment</td><td>10</td><td>• One Benefit = 2 points
• Three Benefits = 5 points
• Six Benefits = 10 points</td><td>40</td><td>*New Trees Planted per Dollar Spent = New Trees (# trees)/$ in millions
• <89.1 trees per $ = 16 points
• <94.2 trees per $ = 24 points
• <187.2 trees per $ = 32 points
• >187.2 trees per $ = 40 points</td></tr>
</table>

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Nature Based Solutions	15	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or useable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points	0	Prioritized during WASC target setting
Leveraging Funding Part 1	6	• >25% Funding Matched = 3 points • >50% Funding Matched = 6 points	0	Leveraged funding deducted from costs for the Water Quality, Water Supply, and Community Investment Benefit scoring section
Leveraging Funding Part 2	4	The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs	+10	Better define engagement/robust scoring according to Recommendation #8
DAC Benefits	0		+10	Ratio of DAC CIB / Total CIB

*For the purposes of this scoring example, new trees planted per dollar (in millions) spent was used. However, it is recommended that a monetized CIB metric be used to consolidate the numerous types of CIB that a project may provide.

Table A-7. Current vs. proposed scoring criteria thresholds for Alternative Scoring Example #5, specifically hybrid projects. The maximum scores indicated in the second column are the current maximum number of points designated to each category.

<table>
<tr><th>Scoring Section</th><th>Max Score</th><th>Current Scoring Criteria Thresholds</th><th>Proposed Max Score</th><th>Proposed Scoring Criteria Thresholds</th></tr>
<tr><td>Water Quality Wet + Dry Weather Part 1</td><td>20</td><td>Cost Effectiveness = (24-hour BMP Capacity) / (Construction Cost in $ Millions)
• <0.4 = 0 points
• 0.4-0.6 = 7 points
• 0.6-0.8 = 11 points
• 0.8-1.0 = 14 points
• >1.0 = 20 points</td><td rowspan="2">40</td><td rowspan="2">Wet Weather Impairment Reduction Efficiency = Wet Day Pollutant Load Reduced (annual average pounds reduced)/$ in millions
• <1.5 pounds per $ = 8 points
• <2.0 pounds per $ = 16 points
• <2.5 pounds per $ = 24 points
• <3.7 pounds per $ = 32 points
• >3.7 pounds per $ = 40 points</td></tr>
<tr><td>Water Quality Wet + Dry Weather Part 2</td><td>30</td><td>Primary Pollutant Reduction:
• > 50% = 15 points
• > 80% = 20 points

Secondary Pollutant Reduction:
• > 50% = 5 points
• > 80% = 10 points</td></tr>
<tr><td>Water Supply Part 1</td><td>13</td><td>• >$2500/ac-ft = 0 points
• $2000-2500/ac-ft = 3 points
• $1500-2000/ac-ft = 6 points
• $1000-1500/ac-ft = 10 points
• <$1000/ac-ft = 13 points</td><td rowspan="2">40</td><td rowspan="2">New Water Capture Efficiency = New Water Captured (annual average acre-feet captured)/$ in millions
• <5.4 ac-ft per $ = 8 points
• <7.0 ac-ft per $ = 16 points
• <9.0 ac-ft per $ = 24 points
• <11.4 ac-ft per $ = 32 points
• >11.4 ac-ft per $ = 40 points</td></tr>
<tr><td>Water Supply Part 2</td><td>12</td><td>• <25 ac-ft/year = 0 points
• 25-100 ac-ft/year= 2 points
• 100-200 ac-ft/year = 5 points
• 200-300 ac-ft/year = 10 points
• >300 ac-ft/year = 12 points</td></tr>
<tr><td>Community Investment</td><td>10</td><td>• One Benefit = 2 points
• Three Benefits = 5 points
• Six Benefits = 10 points</td><td>20</td><td>*New Trees Planted per Dollar Spent = New Trees (# trees)/$ in millions
• <89.1 trees per $ = 8 points
• <94.2 trees per $ = 12 points
• <187.2 trees per $ = 16 points
• >187.2 trees per $ = 20 points</td></tr>
</table>

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Nature Based Solutions	15	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or useable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points	0	Prioritized during WASC target setting
Leveraging Funding Part 1	6	• >25% Funding Matched = 3 points • >50% Funding Matched = 6 points	0	Leveraged funding deducted from costs for the Water Quality, Water Supply, and Community Investment Benefit scoring section
Leveraging Funding Part 2	4	The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs	+10	Better define engagement/robust scoring according to Recommendation #8
DAC Benefits	0		+10	Ratio of DAC CIB / Total CIB

*For the purposes of this scoring example, new trees planted per dollar (in millions) spent was used. However, it is recommended that a monetized CIB metric be used to consolidate the numerous types of CIB that a project may provide.

Table A-8. Current vs. proposed scoring criteria thresholds for Alternative Scoring Example #5, specifically Gray Infrastructure. The maximum scores indicated in the second column are the current maximum number of points designated to each category.

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Water Quality Wet + Dry Weather Part 1	20	Cost Effectiveness = (24-hour BMP Capacity) / (Construction Cost in $ Millions) • <0.4 = 0 points • 0.4-0.6 = 7 points • 0.6-0.8 = 11 points • 0.8-1.0 = 14 points • >1.0 = 20 points	50	Wet Weather Impairment Reduction Efficiency = Wet Day Pollutant Load Reduced (annual average pounds reduced)/$ in millions • <2.1 pounds per $ = 7 points • <3.2 pounds per $ = 14 points • <3.9 pounds per $ = 21 points • <5.1 pounds per $ = 28 points • >5.1 pounds per $ = 35 points
Water Quality Wet + Dry Weather Part 2	30	Primary Pollutant Reduction: • > 50% = 15 points • > 80% = 20 points Secondary Pollutant Reduction: • > 50% = 5 points • > 80% = 10 points		
Water Supply Part 1	13	• >$2500/ac-ft = 0 points • $2000-2500/ac-ft = 3 points • $1500-2000/ac-ft = 6 points • $1000-1500/ac-ft = 10 points • <$1000/ac-ft = 13 points	50	New Water Capture Efficiency = New Water Captured (annual average acre-feet captured)/$ in millions • <6.6 ac-ft per $ = 5 points • <9.4 ac-ft per $ = 10 points • <14.5 ac-ft per $ = 15 points • <22.0 ac-ft per $ = 20 points • >22.0 ac-ft per $ = 25 points
Water Supply Part 2	12	• <25 ac-ft/year = 0 points • 25-100 ac-ft/year= 2 points • 100-200 ac-ft/year = 5 points • 200-300 ac-ft/year = 10 points • >300 ac-ft/year = 12 points		
Community Investment	10	• One Benefit = 2 points • Three Benefits = 5 points • Six Benefits = 10 points	0	

Scoring Section	Max Score	Current Scoring Criteria Thresholds	Proposed Max Score	Proposed Scoring Criteria Thresholds
Nature Based Solutions	15	• Implements natural processes or mimics natural processes to slow, detain, capture, and absorb/infiltrate water in a manner that protects, enhances, and/or restores habitat, green space and/or useable open space = 5 points • Utilizes natural materials such as soils and vegetation with a preference for native vegetation = 5 points • Removes Impermeable Area from Project (1 point per 20% paved area removed) = 5 points	0	Prioritized during WASC target setting
Leveraging Funding Part 1	6	• >25% Funding Matched = 3 points • >50% Funding Matched = 6 points	0	Leveraged funding deducted from costs for the Water Quality, Water Supply, and Community Investment Benefit scoring section
Leveraging Funding Part 2	4	The Project demonstrates strong local, community-based support and/or has been developed as part of a partnership with local NGOs/CBOs	+10	Better define engagement/robust scoring according to Recommendation #8
DAC Benefits	0		+10	Ratio of DAC CIB / Total CIB

*For the purposes of this scoring example, new trees planted per dollar (in millions) spent was used. However, it is recommended that a monetized CIB metric be used to consolidate the numerous types of CIB that a project may provide.

	Current			Gray		NBS	
Category/Goal	**Metric**	**Weight**	**Max. Points**	**Park & Ride**	**Well Lot**	**Well Lot**	**School**
Water Quality	*Wet Weather*	45%					
	- $/24-hr vol. managed		50	0	0	11	11
	- % reduction of inflow			0	20	30	30
	Dry Weather						
	- 100% dry weather capture		40	20	20	20	20
	- dry weather drainage area managed			20	20	10	10
Water Supply	- $/ac-ft	23%	25	13	13	0	0
	- ac-ft/yr			12	12	0	0
Community Investments	- # of CIBs provided	9%	10	2	2	5	10
Nature-Based Solutions	- "Level of natural"	14%	15	0	0	10	10
Leverage Funds and Community Support	- % funding matched	9%	10	0	0	0	0
	- Demonstrated support			0	0	0	0
DAC Benefits	--	--	--	--	--	--	--
Total			110	67	67	56	61

	Example 5 - Update Metrics, Calibrate Weights to Project Types and Needs, Add 110% for CE & DAC Benefits							Gray		NBS	
Category/Goal	**Metric**	**NBS Weight**	**NBS Points**	**Hybrid Weight**	**Hybrid Points**	**Gray Weight**	**Gray Points**	**Park & Ride**	**Well Lot**	**Well Lot**	**School**
Water Quality	*Wet Weather Impairment Redux Efficiency*	35%		40%		50%					
	- wet day pollutant load reduced/$		35		40		50	50	30	35	35
	Dry Weather Impairment Redux Efficiency										
	- % days with dry weather flow eliminated/$		35		40		50	--	--	--	–
Water Supply	*New Water Capture Efficiency*	25%	25	40%	40	50%	50	50	20	15	10
	- ac-ft/$										
Community Investments	*CIB Value Delivery Efficiency*	40%	40	20%	20	–	–	0	0	32	40
	- Monetized CIB metrics/$										
Nature-Based Solutions	- Prioritized during WASC target setting	–	–	–	–	–	–	–	–	–	–
Leverage Funds and Community Support	- Leveraged funding deducted from costs	+10%	+10	+10%	+10	+10%	+10	--	--	--	–
	- Better define engagement/robust support							0	0	0	0
DAC Benefits	- (DAC CIBs / Total CIBs)*110%	+10%	+10	+10%	+10	+10%	+10	0	0	9.0	9.4
Total			100 (+20)		100 (+20)		100 (+20)	100	50	82	85

Figure A-6. Example scoring metrics and outcomes for the hypothetical projects under Example 5 (right) compared to the current scoring criteria (left)

The Pilot Analysis demonstrated that tuning the scoring metrics to align with the Working Group-recommended metrics (Recommendation #1) more clearly, quantitatively, and defensibly differentiates and prioritizes project benefits and cost-effectiveness. The analysis also suggested that the weighting (i.e., the points awarded for each category of benefits) can be calibrated in a structured way to better incentivize projects desired by each WASC as they advance toward their long-term targets. Additionally, the scoring can be used to better prioritize between two projects of the same type (e.g., Gray to Gray) that would have otherwise scored similarly under the current rubric, but are clearly differentiated under the alternative rubrics (allowing for a more efficient use of tax funds). The Working Group recommends starting with **Alternative Scoring Example #2** as an initial step to refining the scoring criteria.

Finally, Recommendation #15 suggests that the WASC should set targets to prioritize the level of investment in different project types *prior* to scoring (also see Recommendation 9 regarding prioritizing Nature-Based Solutions); this means that the scoring framework should not necessarily be used to compare different project types, but rather to select the highest value projects within each category (per agreed-upon metrics). In other words, the scores for Nature-Based Solutions projects should only be compared to other Nature-Based Solutions projects, and Gray projects should only be compared to Gray projects.

Figure A-7 illustrates how the alternative scoring examples better differentiate the total benefits provided by the hypothetical projects (based on the Working Group's recommended metrics and the assumed weight of each scoring category), and can be used to better inform project prioritization.

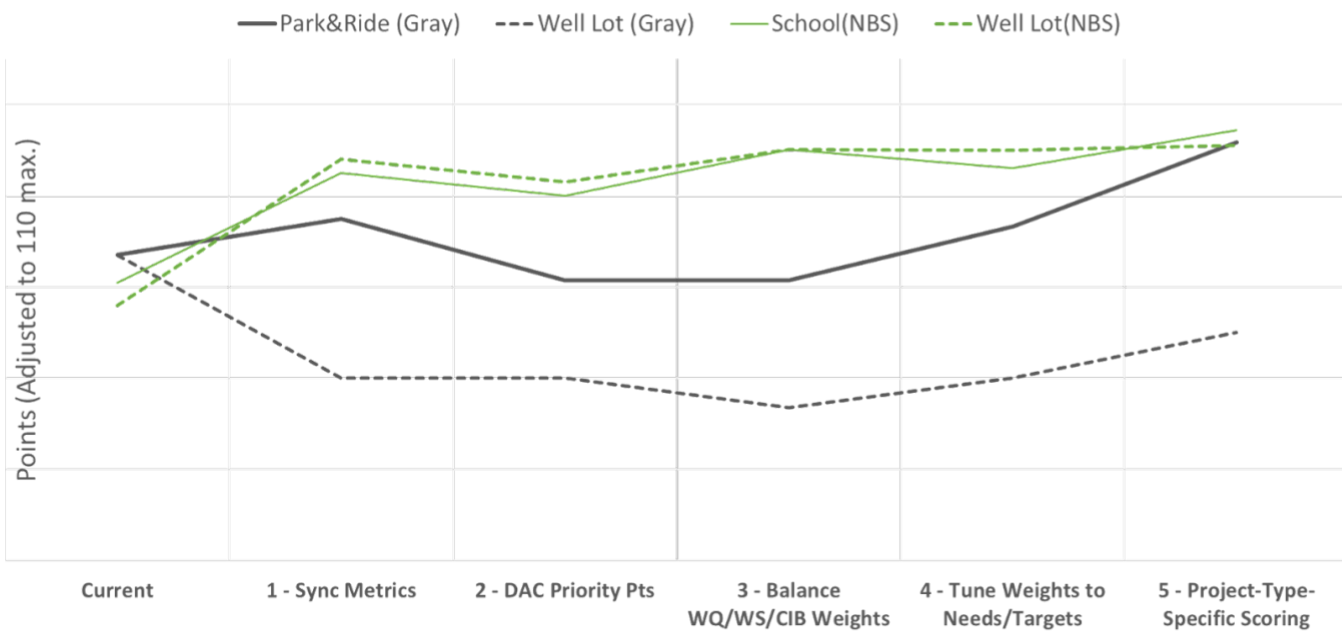


Figure A-7. Comparison of scores between hypothetical projects under each of the alternative scoring examples; moving from left to right, the scoring frameworks are tuned more specifically to project types and hypothetical watershed targets.

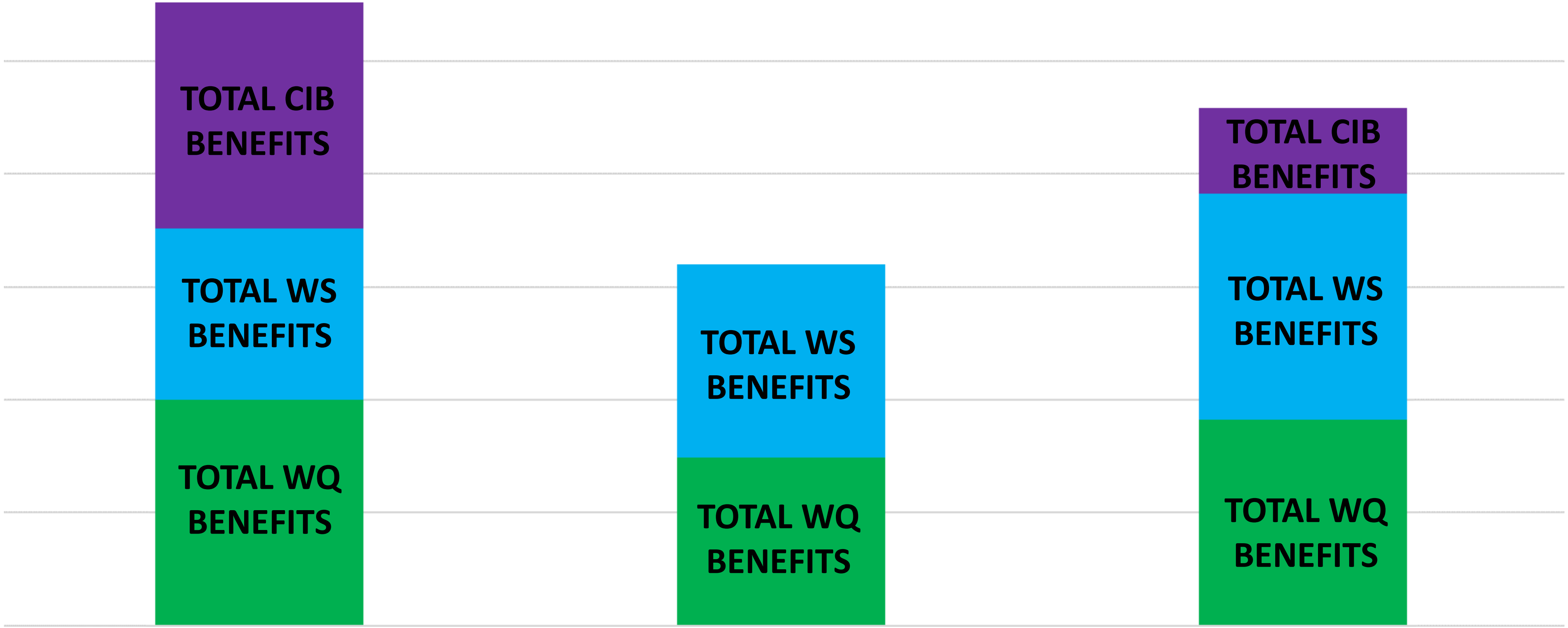
ATTACHMENT B: 110 PERCENT DAC BENEFIT CALCULATIONS

Supplemental Content: DAC Benefit Calculation Options

Interim ARLA Working Group Analyses

Calculating **Normalized _Total_ Benefits**
(benefits to everyone in watershed)

- Water Quality (WQ), Water Supply (WS), and Community Investment Benefits (CIB) were computed for each option below using the Working Group's metrics, and normalized to fit on the same graph (this is the same as the approach for the "watershed signature charts" we've shared)
- To normalize for comparing total benefits at the pilot watershed scale, all benefits are weighted by population served (assuming WQ & WS benefit everyone, CIBs benefit people in the service areas of new trees)
- See detailed calculations at end of these slides



OPTION 1 – 100% Cost-Effective NBS

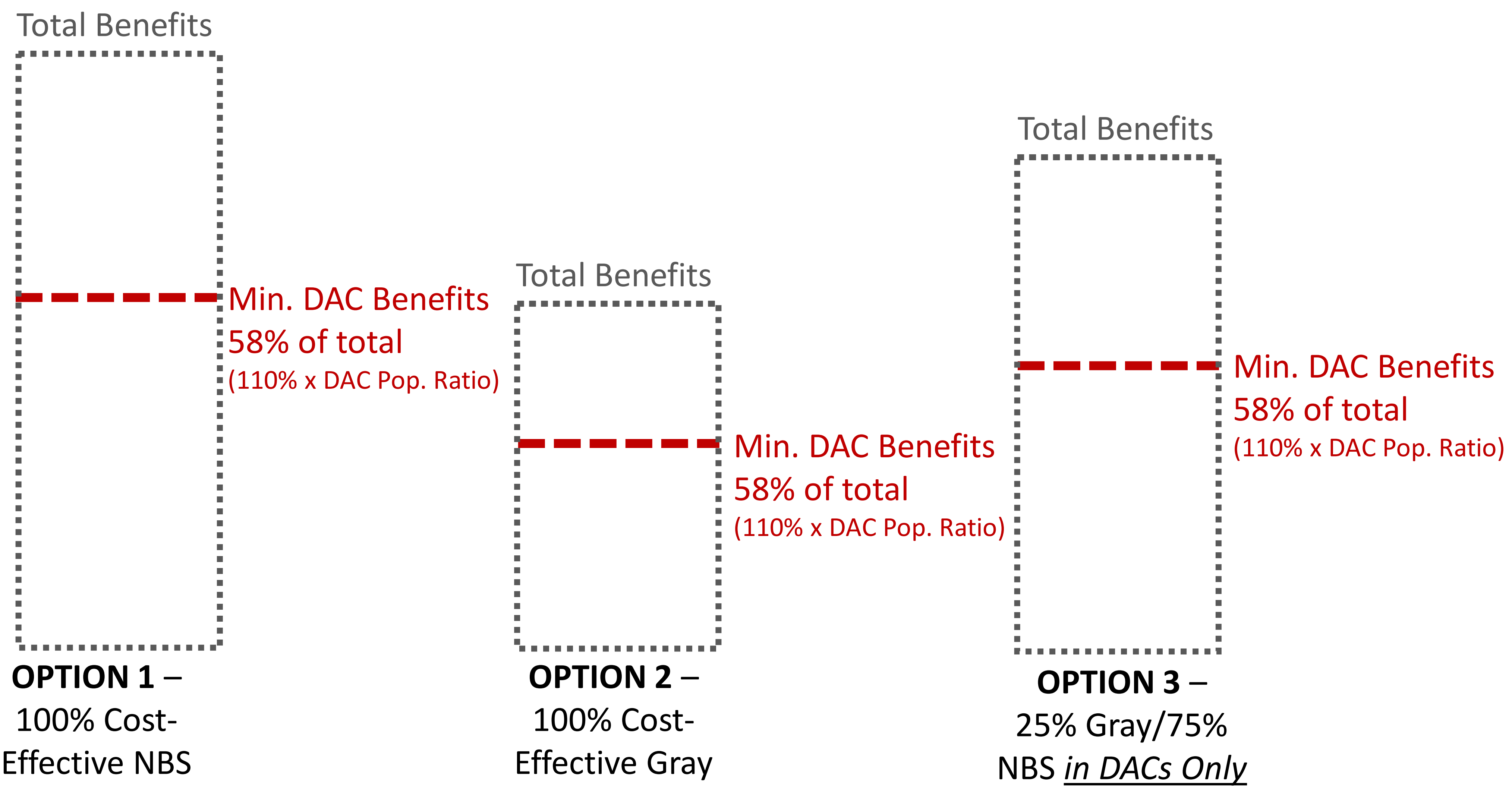
OPTION 2 – 100% Cost-Effective Gray

OPTION 3 – 25% Gray/75% NBS _in DACs Only_

DRAFT RESULTS FOR ALHAMBRA WASH

Establishing the 110% DAC Benefit Threshold

- The minimum DAC benefits required to meet the SCWP Ordinance requirements (i.e., the 110% threshold) is then established based on total benefits
- The *magnitude* of the DAC Benefit threshold is specific to each scenario because each scenario yields different benefits for the same $125M spent
- However, the *relative DAC* Benefit threshold is always 58% of the total benefits (110% x DAC population ratio = 110% x 53% = 58%)

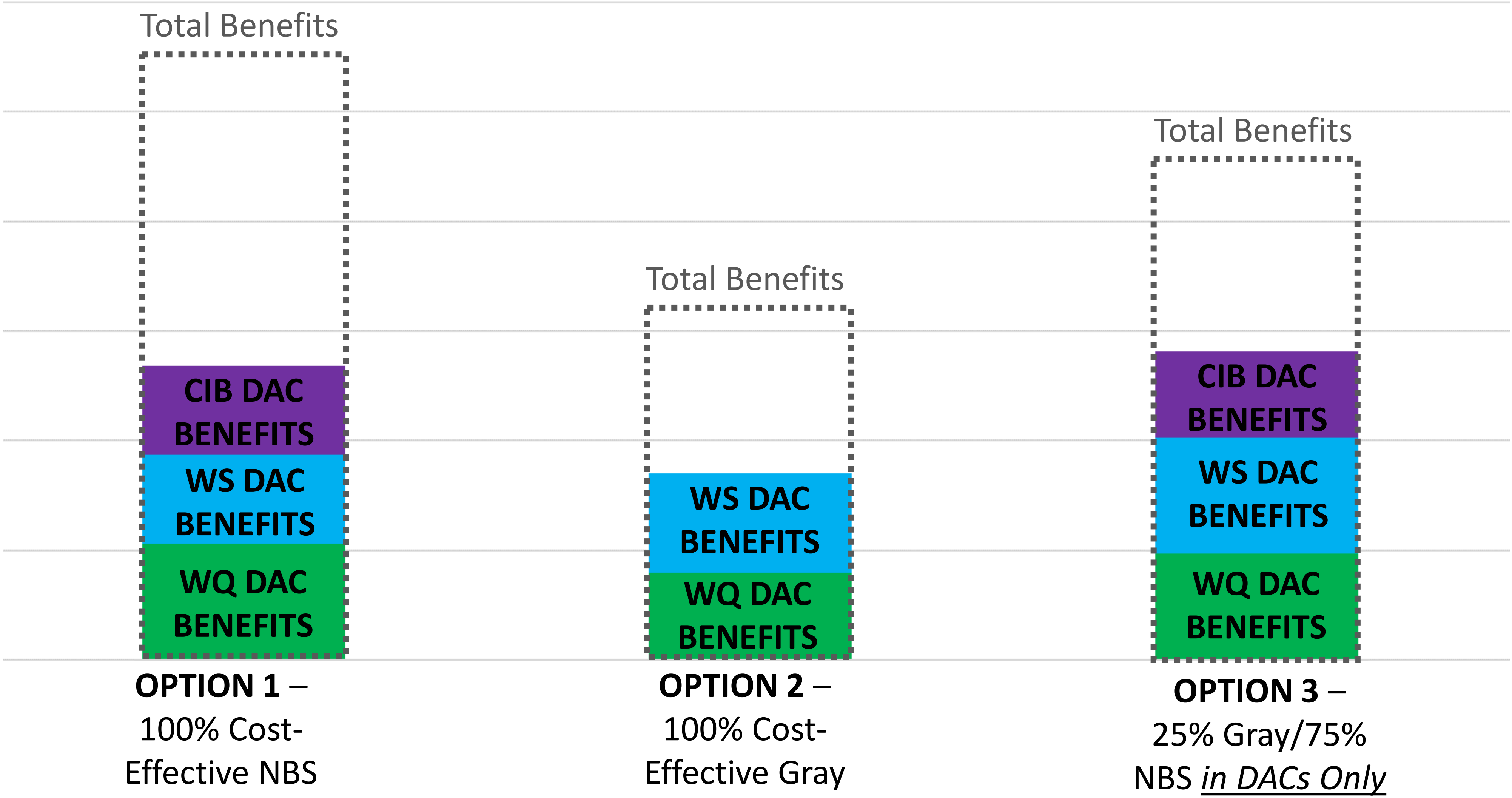


DRAFT RESULTS FOR ALHAMBRA WASH

Calculating **Normalized *DAC* Benefits**

(benefits to people in DACs)

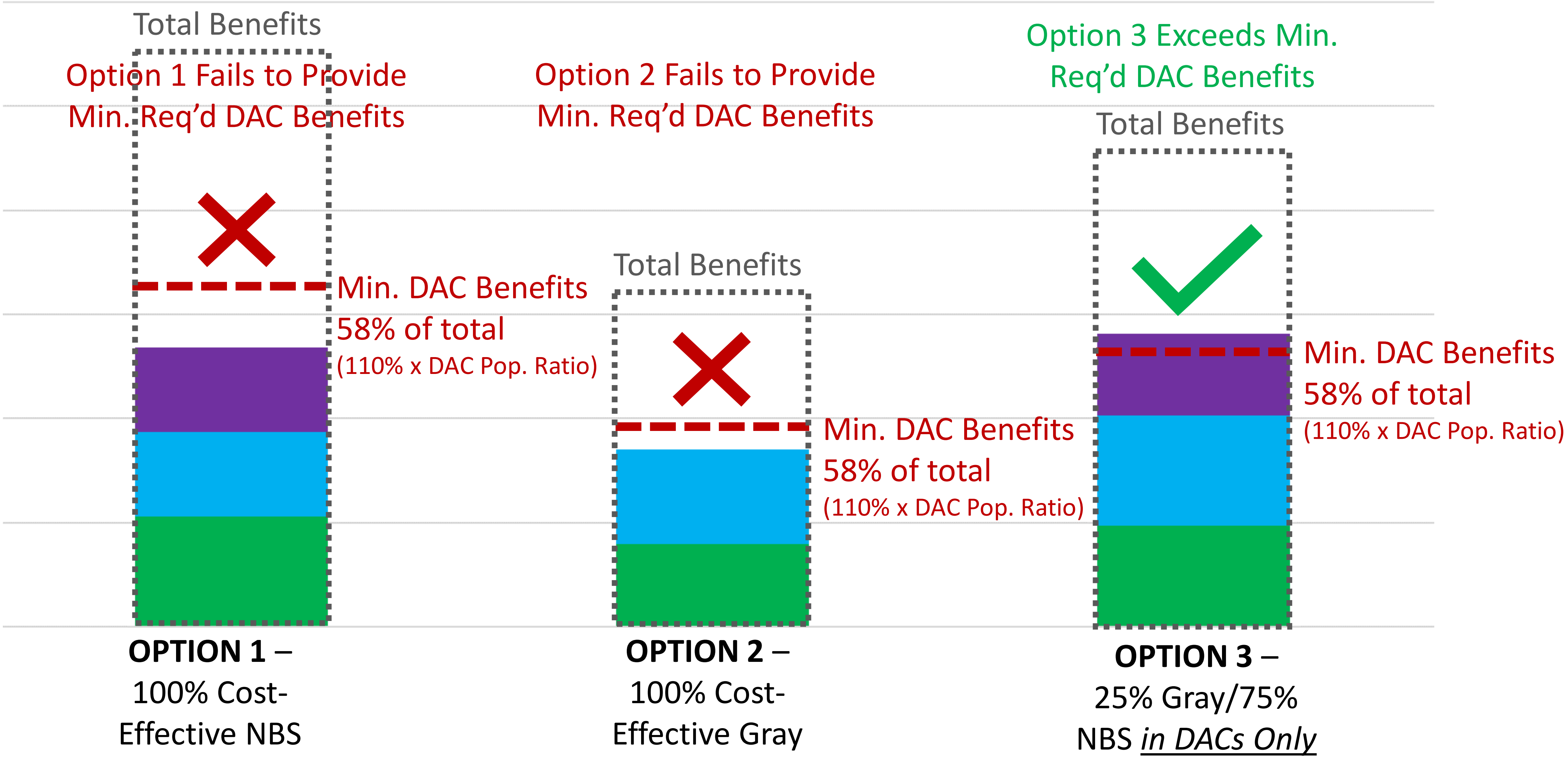
- DAC Benefits are then computed, attributed to DAC population, and normalized in the same way
- This example assumes all goals are weighted equally (i.e., the watershed-wide value of WQ = WS = CIB)



DRAFT RESULTS FOR ALHAMBRA WASH

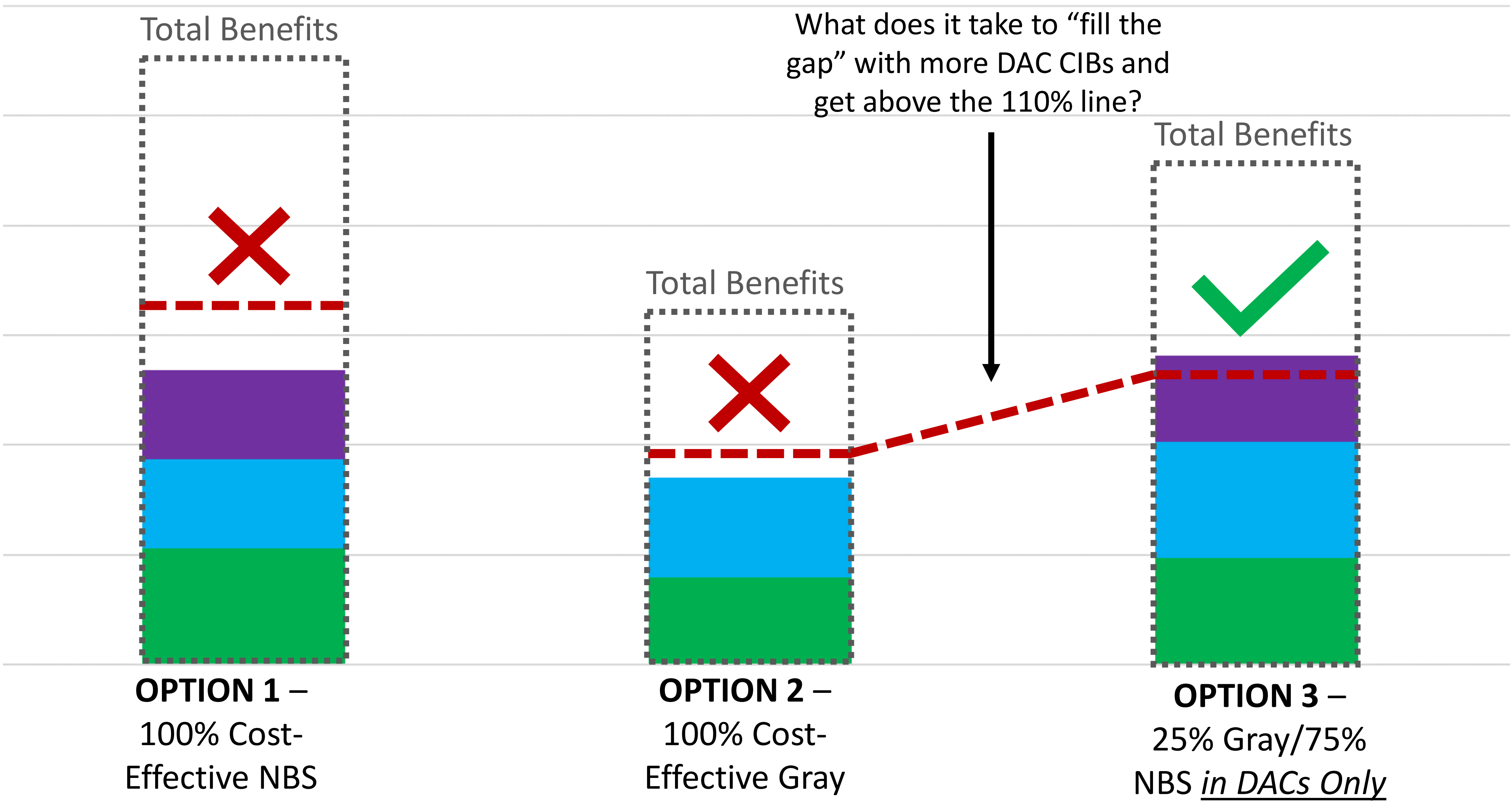
Comparing DAC Benefits to Minimum Required

- The normalized DAC benefits can then be compared to the normalized total benefits to determine if the minimum DAC Benefit threshold is exceeded in each scenario
- The results show that CIBs need to be focused in/near DACs to benefit enough DAC population to meet requirement



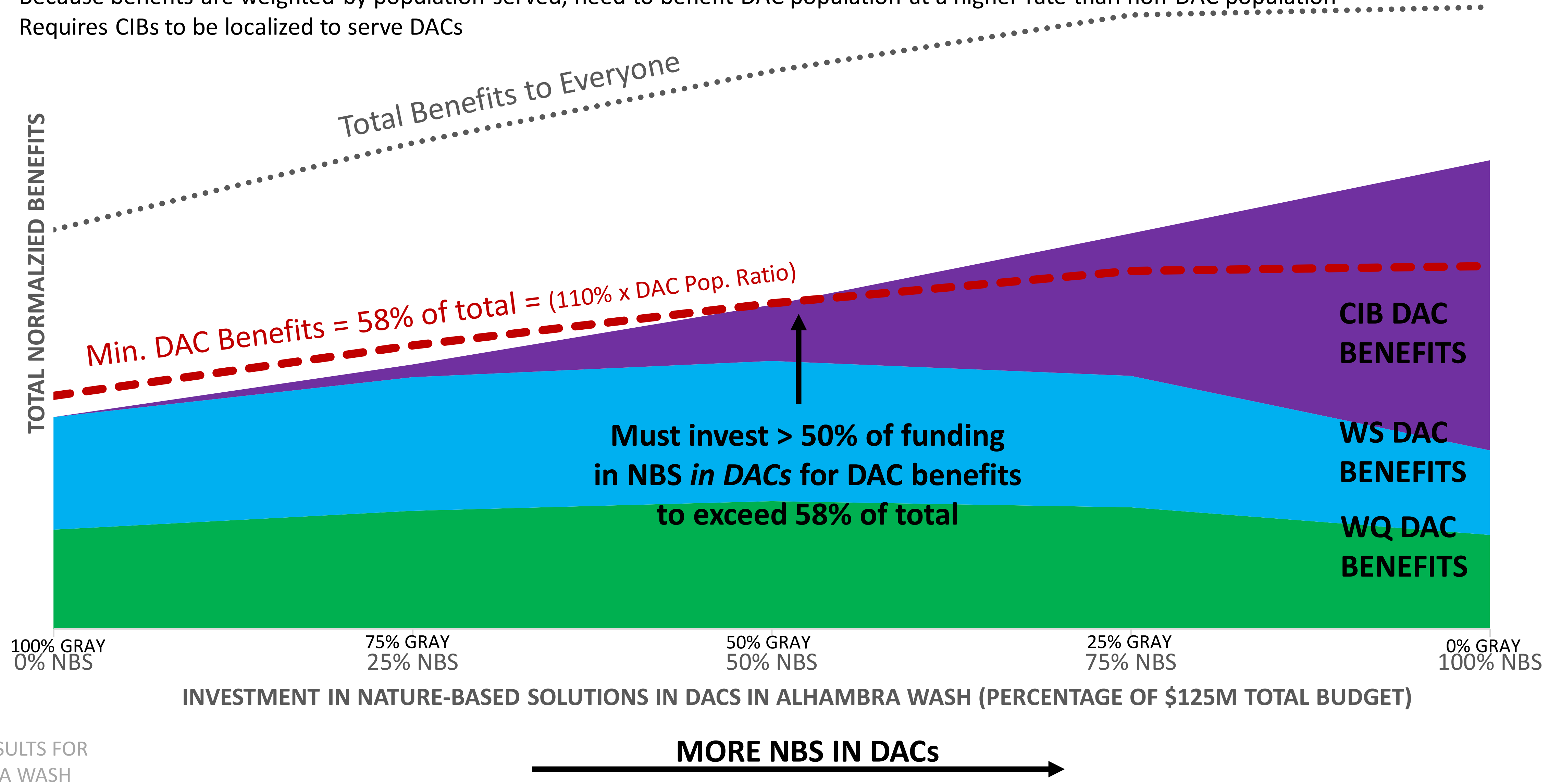
DRAFT RESULTS FOR
ALHAMBRA WASH

How Much NBS Must be Built to Serve DACs to Exceed the 110% Min. DAC Benefit Threshold?



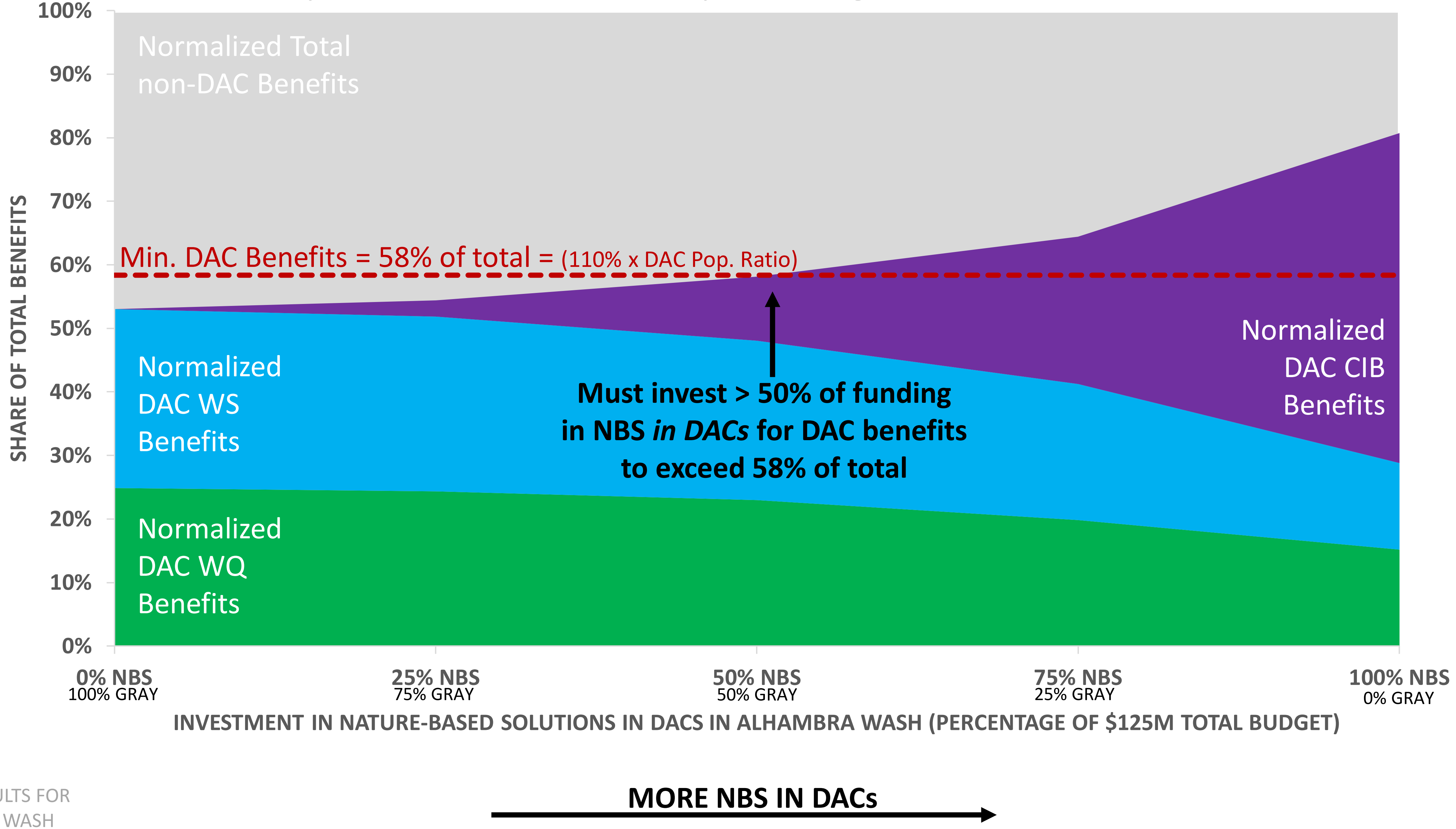
Filling the Gap Between All Gray and All DAC NBS

- We can analyze the spectrum of scenarios between 100% gray and 100% NBS to see what level of investment in DAB NBS is required to exceed the minimum DAC Benefit threshold
- Because benefits are weighted by population served, need to benefit DAC population at a higher rate than non-DAC population
- Requires CIBs to be localized to serve DACs



DRAFT RESULTS FOR ALHAMBRA WASH

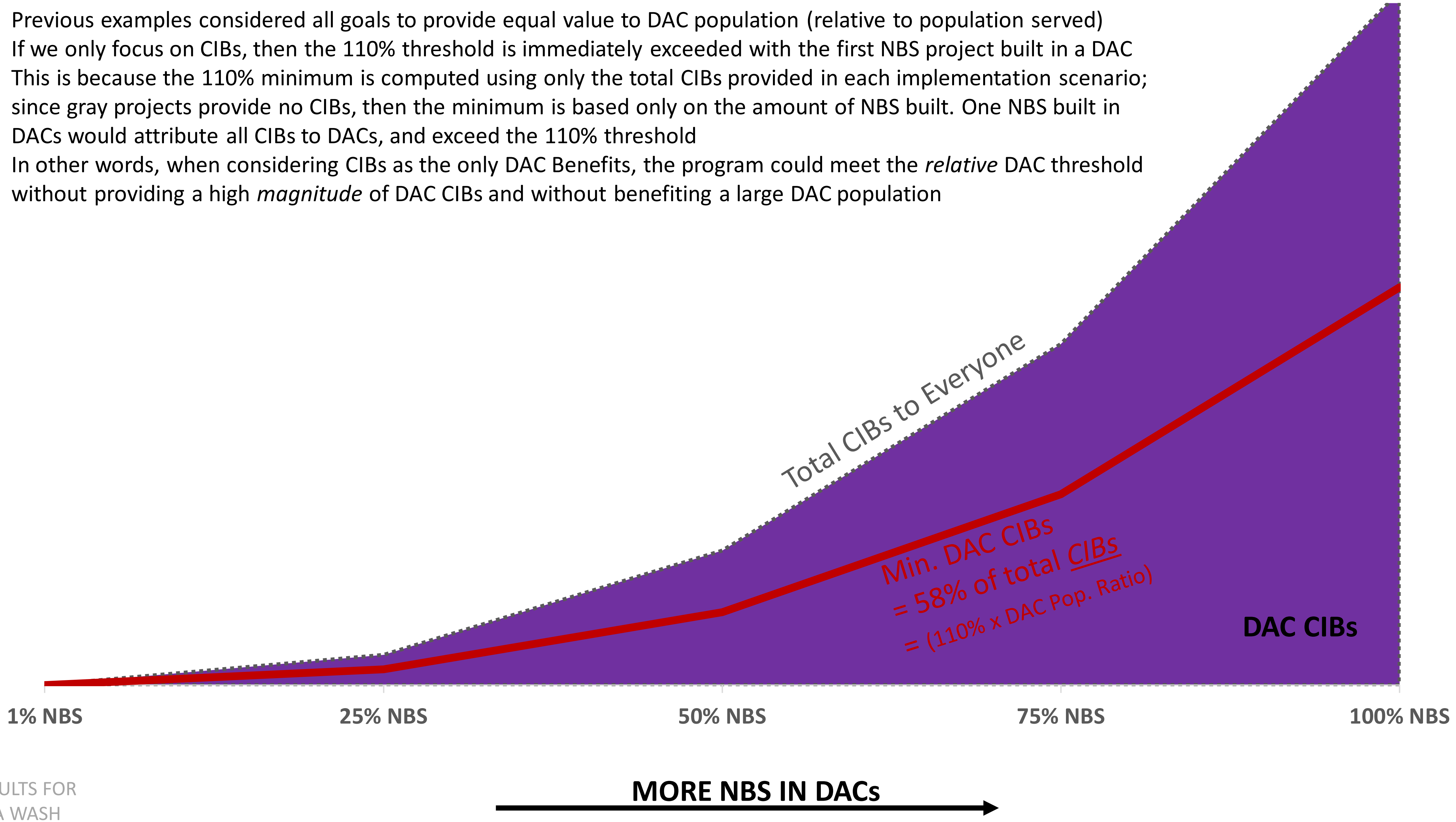
Another Perspective – Comparing Relative Total Benefits



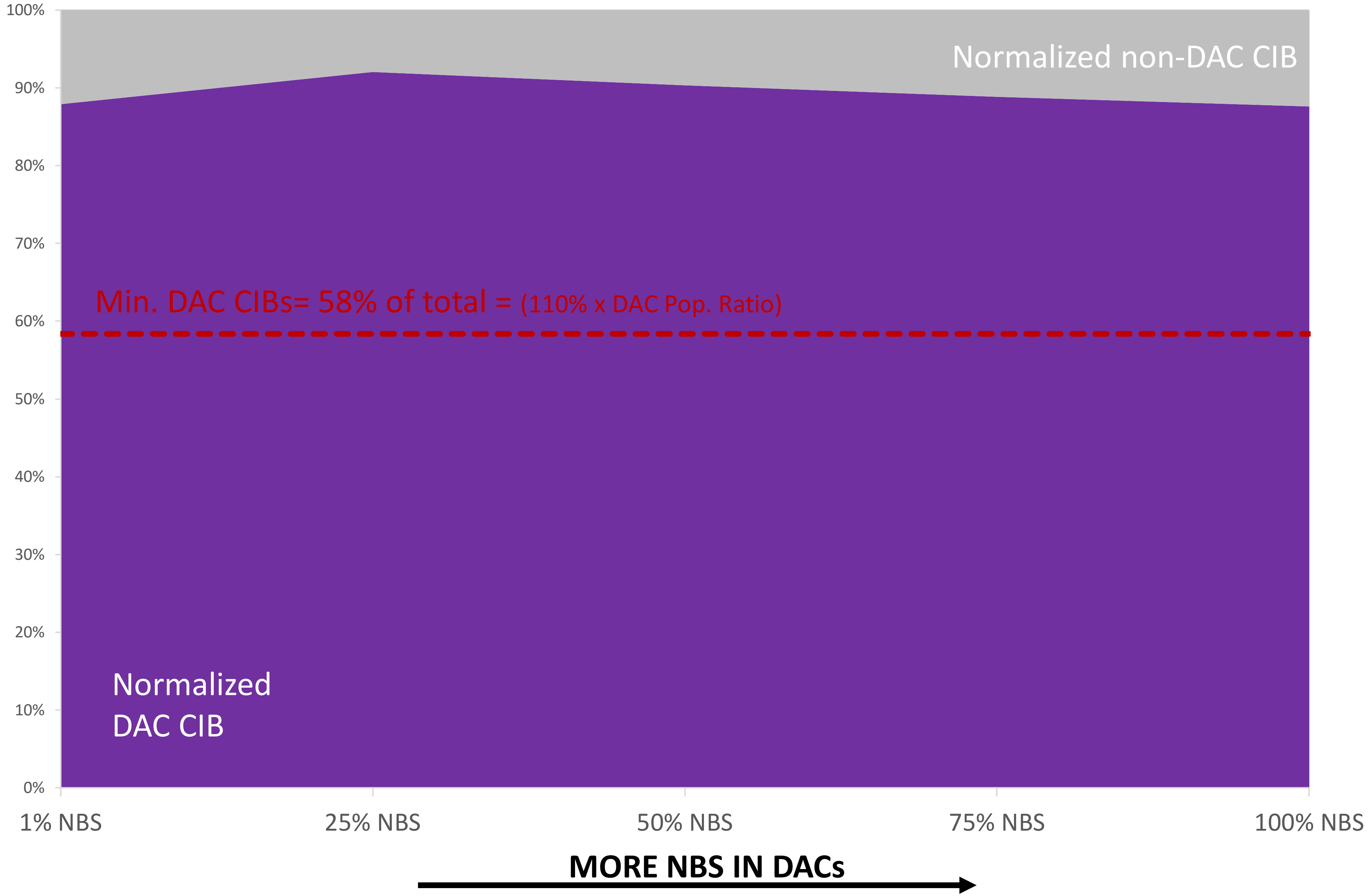
DRAFT RESULTS FOR ALHAMBRA WASH

Focusing on CIBs Only

- Previous examples considered all goals to provide equal value to DAC population (relative to population served)
- If we only focus on CIBs, then the 110% threshold is immediately exceeded with the first NBS project built in a DAC
- This is because the 110% minimum is computed using only the total CIBs provided in each implementation scenario; since gray projects provide no CIBs, then the minimum is based only on the amount of NBS built. One NBS built in DACs would attribute all CIBs to DACs, and exceed the 110% threshold
- In other words, when considering CIBs as the only DAC Benefits, the program could meet the *relative* DAC threshold without providing a high *magnitude* of DAC CIBs and without benefiting a large DAC population

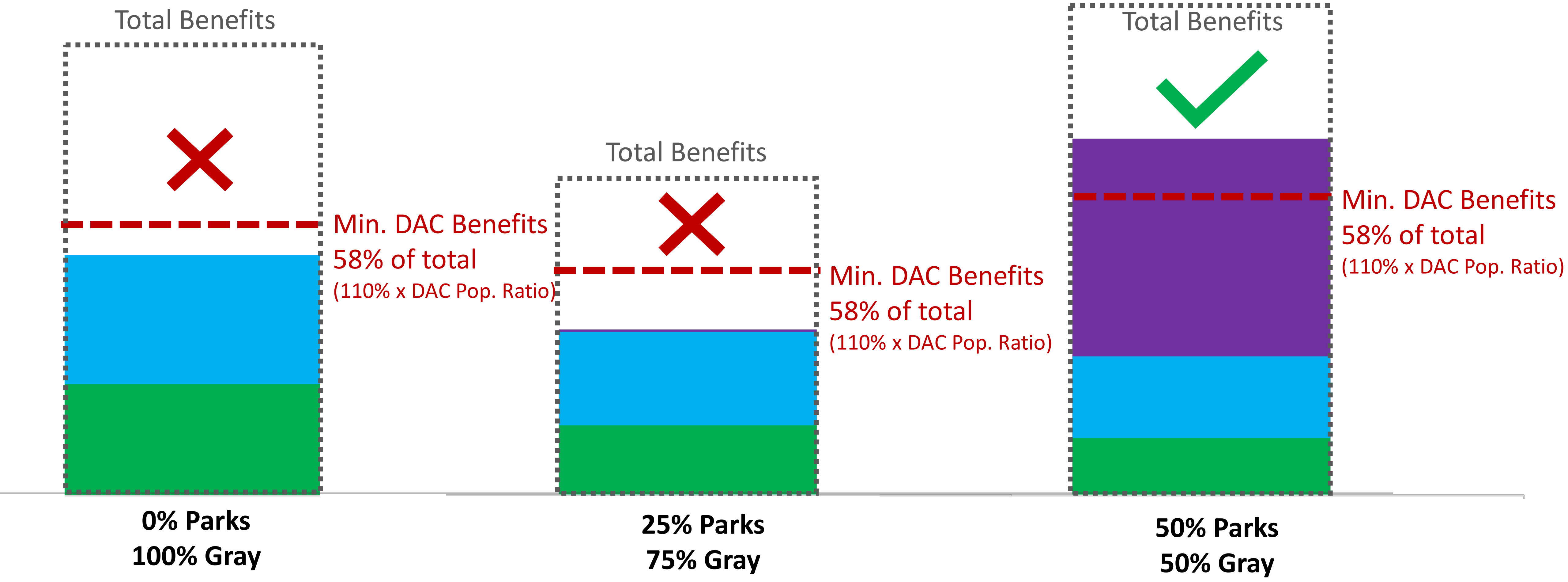


Focusing on CIBs Only



What about Parks and Surface Improvements?

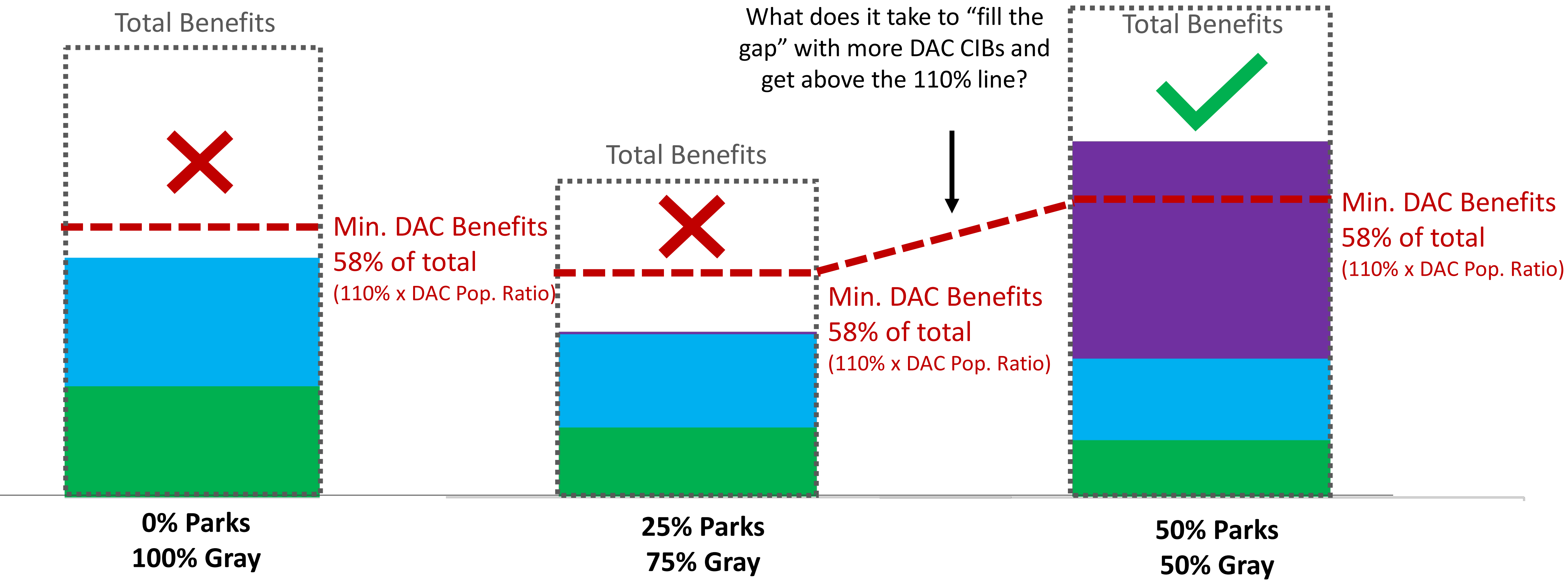
- Previous examples accrued CIBs based on the new trees associated with rain gardens
- Can also analyze how investment in surface improvements like new parks can help achieve the required DAC benefits
- Similar to NBS, investments in parks must provide sufficient magnitude of CIBs (*and* benefit enough DAC population) to exceed the 110% DAC benefit threshold
- Note that, while park improvements can serve a high population because of their wider service areas, they do not provide WQ and WS benefits, so investing in multi-benefit NBS in DACs would be a more efficient way to maximize *total* DAC benefits (note this analysis does not consider local needs)



DRAFT RESULTS FOR ALHAMBRA WASH

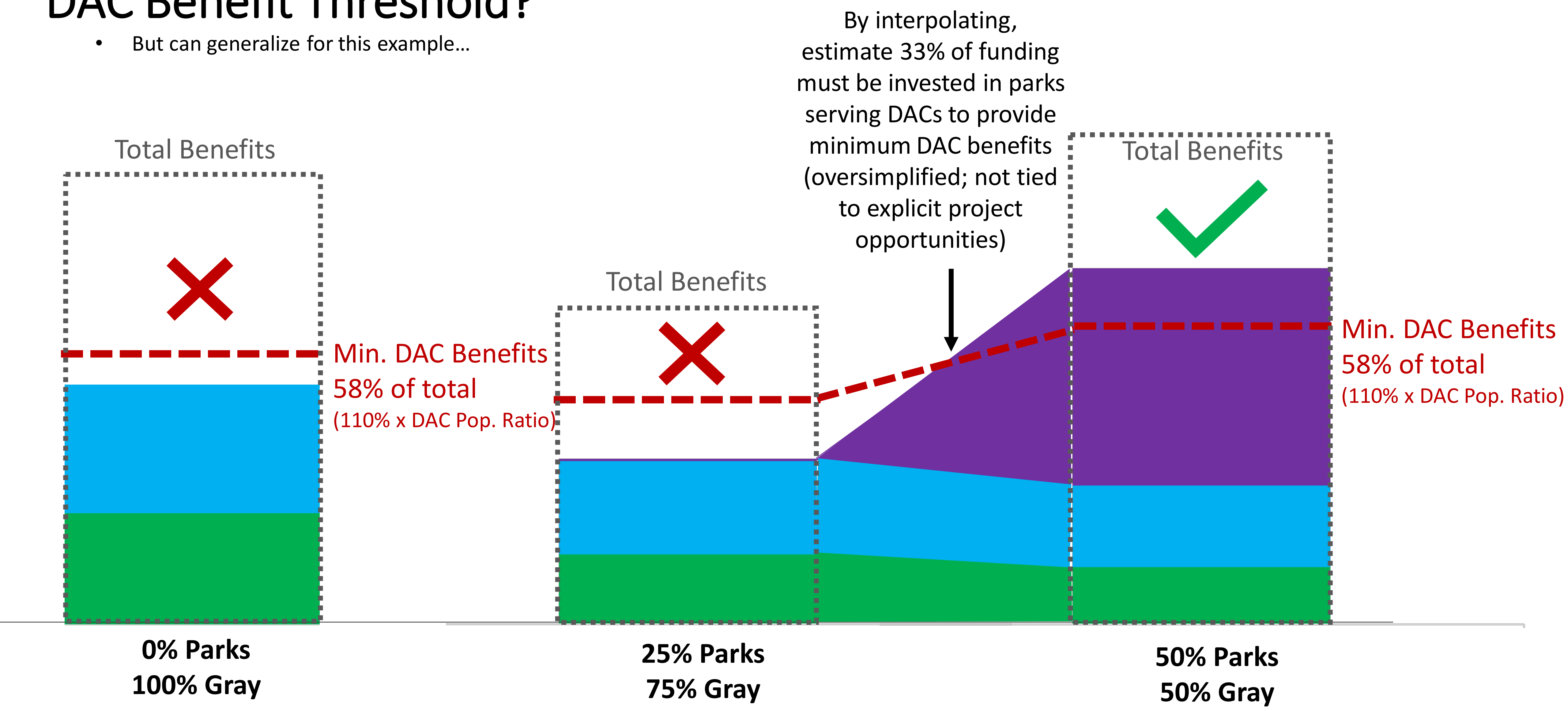
How Many Parks Must be Built Serving DACs to Exceed the 110% Min. DAC Benefit Threshold?

- Well… it depends on the size and service areas of the parks added. It's not as predictable as adding NBS
- If a large, regional park provides a lot of benefits to a lot of people living in DACs, that's great! But a small park that doesn't serve a lot of people will not move the needle as much



How Many Parks Must be Built Serving DACs to Exceed the 110% Min. DAC Benefit Threshold?

- But can generalize for this example…



DRAFT RESULTS FOR ALHAMBRA WASH

Example Calculations

Total Benefits To Everyone

Attributing Benefits to Population Served

WQ benefits serve the region

WQ

$$\frac{\text{Monetized WQ Benefits x Population Served}}{\text{Total Population in Pilot Area}} = \frac{\text{Monetized WQ Benefits x Total Population in Pilot Area}}{\text{Total Population in Pilot Area}}$$

WS benefits serve the region

WS

$$\frac{\text{Monetized WS Benefits x Population Served}}{\text{Total Population in Pilot Area}} = \frac{\text{Monetized WS Benefits x Total Population in Pilot Area}}{\text{Total Population in Pilot Area}}$$

CIBs serve local communities

CIBs

$$\frac{\text{Monetized CIBs x Population Served}}{\text{Total Population in Pilot Area}} = \frac{\text{Monetized CIBs x Population in Service Areas of New Trees \& Parks}}{\text{Total Population in Pilot Area}}$$

Example Calculation (Total Benefits)

TOTAL POPULATION: 156,760

Option #1: Fund the most cost-effective distributed rain gardens regardless of location.

- **WQ $**: **$116M x ~~156,760/156,760~~ = $116M**
- **WS $**: **$44M x ~~156,760/156,760~~ = $44M**
- **CIBs $**: **$29M x 78,841/156,760 = $15M**

Note WQ and WS benefit everyone, so population weighting cancels out

CIBs only apply to a subset of the watershed, so benefits are "weighted" by population served to compare all benefits at the same scale

Total Population Served by CIBs: 78,841

Option #2: Fund the most cost-effective regional gray projects regardless of location.

- **WQ $**: **$86M x ~~156,760/156,760~~ = $86M**
- **WS $**: **$50M x ~~156,760/156,760~~ = $50M**
- **CIBs $**: **$--**

Total Population Served by CIBs: 0

Option #3: Fund 25% to the most cost-effective regional gray projects regardless of location and 75% of the most cost-effective distributed rain gardens in DACs.

- **WQ $**: **$106M x ~~156,760/156,760~~ = $106M**
- **WS $**: **$58M x ~~156,760/156,760~~ = $58M**
- **CIBs $**: **$23M x 38,578/156,760 = $6M**

Total Population Served by CIBs: 38,578

Equal Weighting of Goals

In determining which projects to fund through SIPs, WASCs are always analyzing tradeoffs between funding different portfolios of projects. Therefore, to equally weigh the goals (<u>Water Quality</u>, <u>Water Supply</u>, and <u>CIBs</u>), benefits must be normalized (divided) by the "best performing" benefit within the portfolio of projects considered.

$$WQ_{SCENARIO} / WQ_{BEST} \sim [0, 1]$$

$$WS_{SCENARIO} / WS_{BEST} \sim [0, 1]$$

$$CIBs_{SCENARIO} / CIBs_{BEST} \sim [0, 1]$$

Example Calculation (Total Benefits)

Option #1: Fund the most cost-effective distributed rain gardens regardless of location.

- **WQ $**: $116M ← WQBEST
- **WS $**: $44M
- **CIBs $**: $15M ← CIBsBEST

Option #2: Fund the most cost-effective regional gray projects regardless of location.

- **WQ $**: $86M
- **WS $**: $50M
- **CIBs $**: $--

Option #3: Fund 25% to the most cost-effective regional gray projects regardless of location and 75% of the most cost-effective distributed rain gardens in DACs.

- **WQ $**: $106M
- **WS $**: $58M ← WSBEST
- **CIBs $**: $6M

DRAFT RESULTS FOR
ALHAMBRA WASH

Example Calculation (Total Normalized Benefits)

Option #1: Fund the most cost-effective distributed rain gardens regardless of location.

- **WQ $**: $116M / $116M = 1
- **WS $**: $44M / $58M = 0.8
- **CIBs $**: $15M / $15M = 1

2.8

Option #2: Fund the most cost-effective regional gray projects regardless of location.

- **WQ $**: $86M / $116M = 0.7
- **WS $**: $50M / $58M = 0.9
- **CIBs $**: $--

1.6

Option #3: Fund 25% to the most cost-effective regional gray projects regardless of location and 75% of the most cost-effective distributed rain gardens in DACs.

- **WQ $**: $106M / $116M = 0.9
- **WS $**: $58M / $58M = 1
- **CIBs $**: $6M / $15M = 0.4

2.3

DRAFT RESULTS FOR
ALHAMBRA WASH

Example Calculation (Total Benefits Normalized)

TOTAL POPULATION: 156,760
DAC POPULATION: 83,160

Option #1: Fund the most cost-effective distributed rain gardens regardless of location.

- **WQ $**: 1
- **WS $**: 0.8
- **CIBs $**: 1

2.8

Min. Benefits to DACs for this Option
= Total Benefits x 110% x (DAC Pop./Total Pop.)
= 2.8 x 110% x (83,160/156,760)
= 1.61

Option #2: Fund the most cost-effective regional gray projects regardless of location.

- **WQ $**: 0.7
- **WS $**: 0.9
- **CIBs $**: 0

1.6

Min. Benefits to DACs for this Option
= Total Benefits x 110% x (DAC Pop./Total Pop.)
= 1.6 x 110% x (83,160/156,760)
= 0.93

Option #3: Fund 25% to the most cost-effective regional gray projects regardless of location and 75% of the most cost-effective distributed rain gardens in DACs.

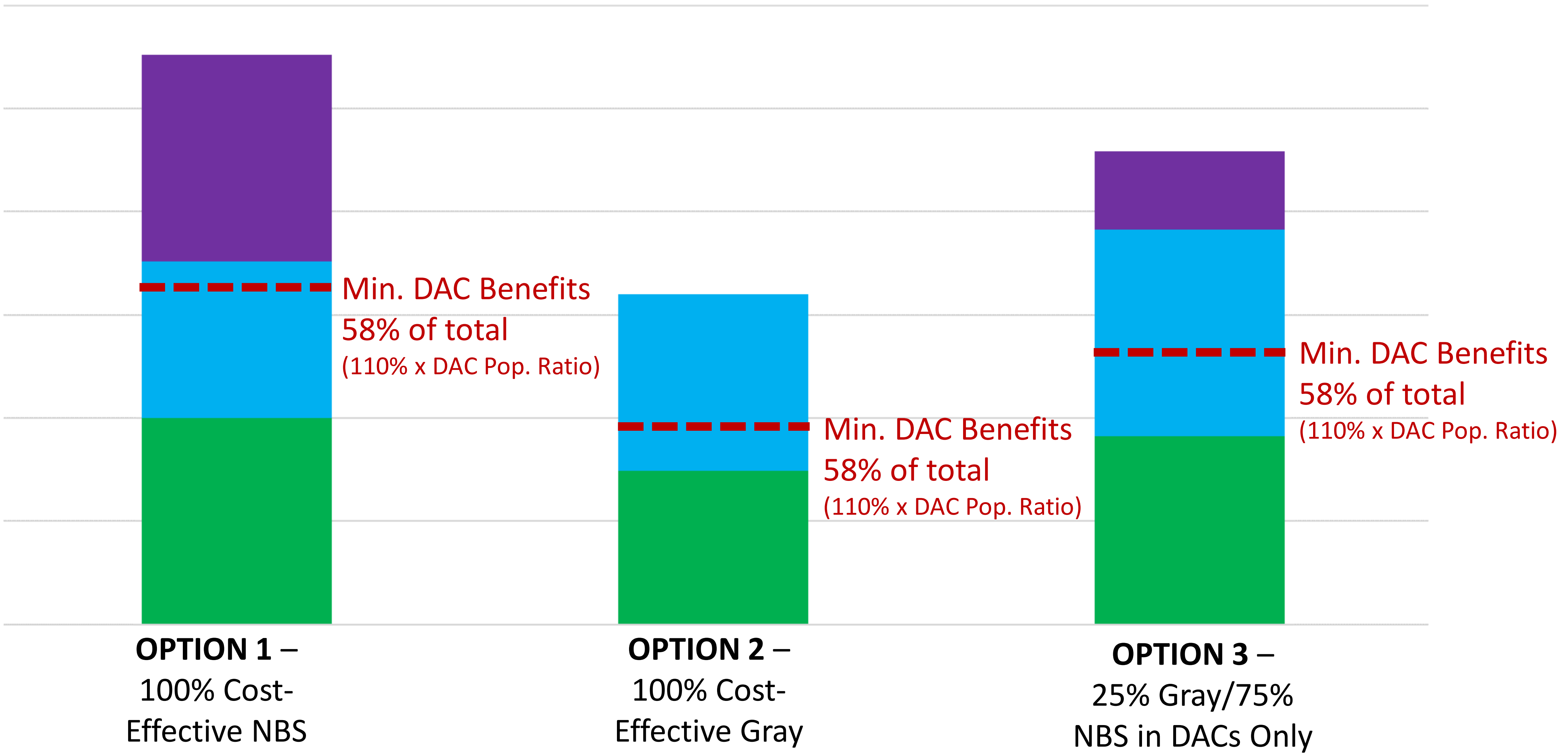
- **WQ $**: 0.9
- **WS $**: 1
- **CIBs $**: 0.4

2.3

Min. Benefits to DACs for this Option
= Total Benefits x 110% x (DAC Pop./Total Pop.)
= 2.3 x 110% x (83,160/156,760)
= 1.34

DRAFT RESULTS FOR ALHAMBRA WASH

Example Calculation
(Normalized *Total* Benefits)



DRAFT RESULTS FOR ALHAMBRA WASH

Benefits To People Living in DACs

Attributing Benefits to Population Served

WQ benefits serve the region

WQ

$$\frac{\text{Monetized WQ Benefits} \times \text{DAC Population Served}}{\text{Total Population in Pilot Area}} = \frac{\text{Monetized WQ Benefits} \times \text{Total DAC Population in Pilot Area}}{\text{Total Population in Pilot Area}}$$

WS benefits serve the region

WS

$$\frac{\text{Monetized WS Benefits} \times \text{DAC Population Served}}{\text{Total Population in Pilot Area}} = \frac{\text{Monetized WS Benefits} \times \text{Total DAC Population in Pilot Area}}{\text{Total Population in Pilot Area}}$$

CIBs serve local communities

CIBs

$$\frac{\text{Monetized DAC CIBs} \times \text{DAC Population Served}}{\text{Total DAC Population in Pilot Area}} = \frac{\text{Monetized DAC CIBs} \times \text{DAC Population in Service Areas of New Trees \& Parks}}{\text{Total DAC Population in Pilot Area}}$$

Based on CIBs that serve DACs only, so normalize by total DAC population

DRAFT RESULTS FOR
ALHAMBRA WASH

Example Calculation (DAC Benefits)

TOTAL POPULATION: 156,760

DAC POPULATION: 83,160

Option #1: Fund the most cost-effective distributed rain gardens regardless of location.

- **WQ $**: **$116M x (83,160/156,760) = $61M**
- **WS $**: **$44M x (83,160/156,760) = $23M**
- **CIBs $**: **$11M x (44,688/83,160) = $6M**

Value of trees serving DACs only

DAC Population Served by CIBs: 44,688

Option #2: Fund the most cost-effective regional gray projects regardless of location.

- **WQ $**: **$86M x (83,160/156,760) = $46M**
- **WS $**: **$50M x (83,160/156,760) = $27M**
- **CIBs $**: **$--**

DAC Population Served by CIBs: 0

Option #3: Fund 25% to the most cost-effective regional gray projects regardless of location and 75% of the most cost-effective distributed rain gardens in DACs.

- **WQ $**: **$106M x (83,160/156,760) = $56M**
- **WS $**: **$58M x (83,160/156,760) = $31M**
- **CIBs $**: **$16M x (30,882/83,160) = $6M**

Value of trees serving DACs only

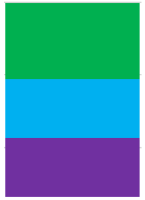
DAC Population Served (CIBs): 30,882

DRAFT RESULTS FOR
ALHAMBRA WASH

Example Calculation (Normalized DAC Benefits)

Option #1: Fund the most cost-effective distributed rain gardens regardless of location.

- **WQ $**: **$61M / $116M = 0.5**
- **WS $**: **$23M / $58M = 0.4**
- **CIBs $**: **$6M / $15M = 0.4**



1.3

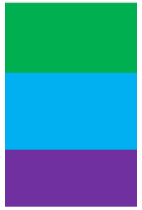
Option #2: Fund the most cost-effective regional gray projects regardless of location.

- **WQ $**: **$46M / $116M = 0.4**
- **WS $**: **$27M / $58M = 0.5**
- **CIBs $**: **$--**

0.9

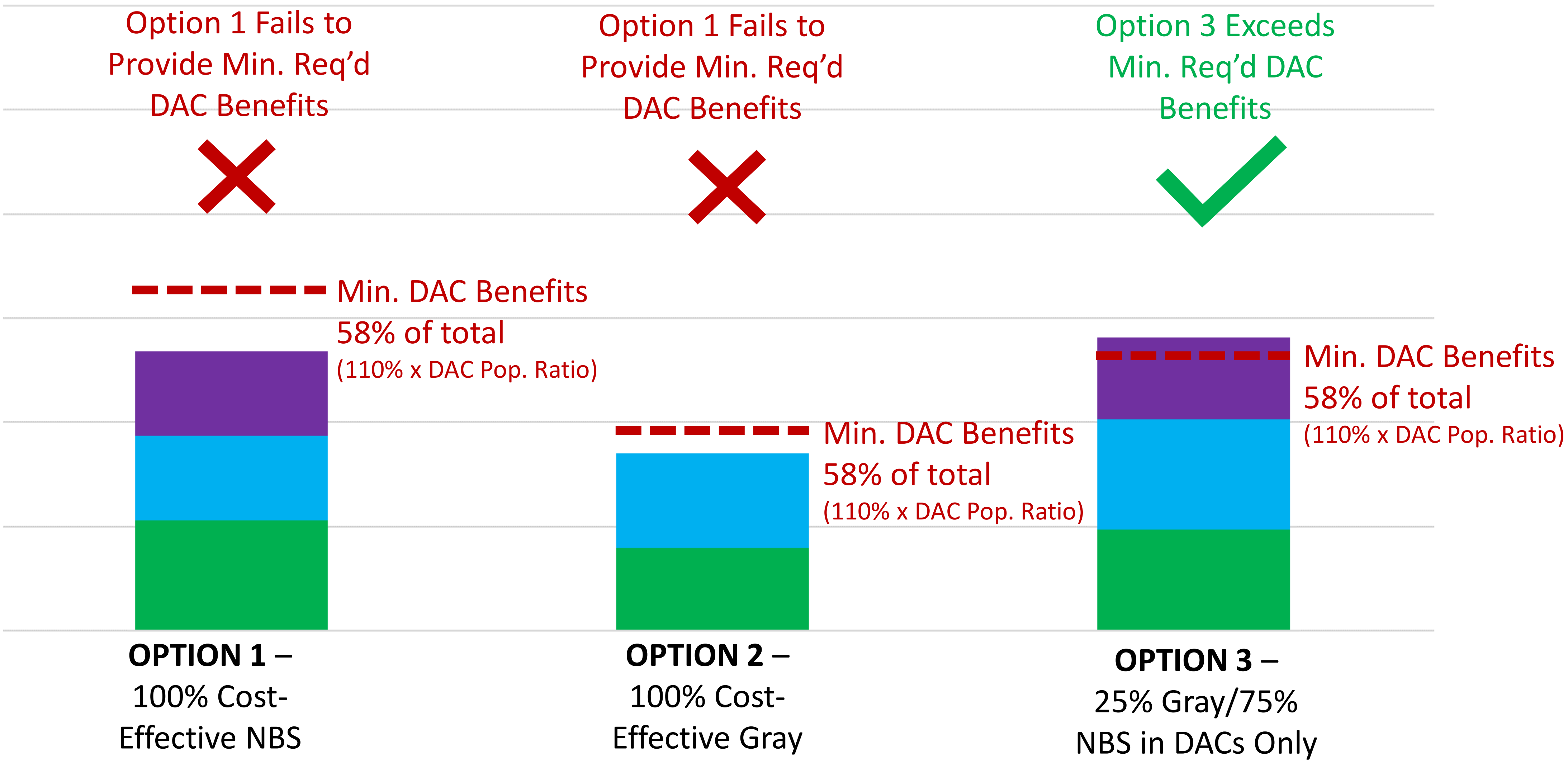
Option #3: Fund 25% to the most cost-effective regional gray projects regardless of location and 75% of the most cost-effective distributed rain gardens in DACs.

- **WQ $**: **$56M / $116M = 0.5**
- **WS $**: **$31M / $58M = 0.5**
- **CIBs $**: **$6M / $15M = 0.4**



1.4

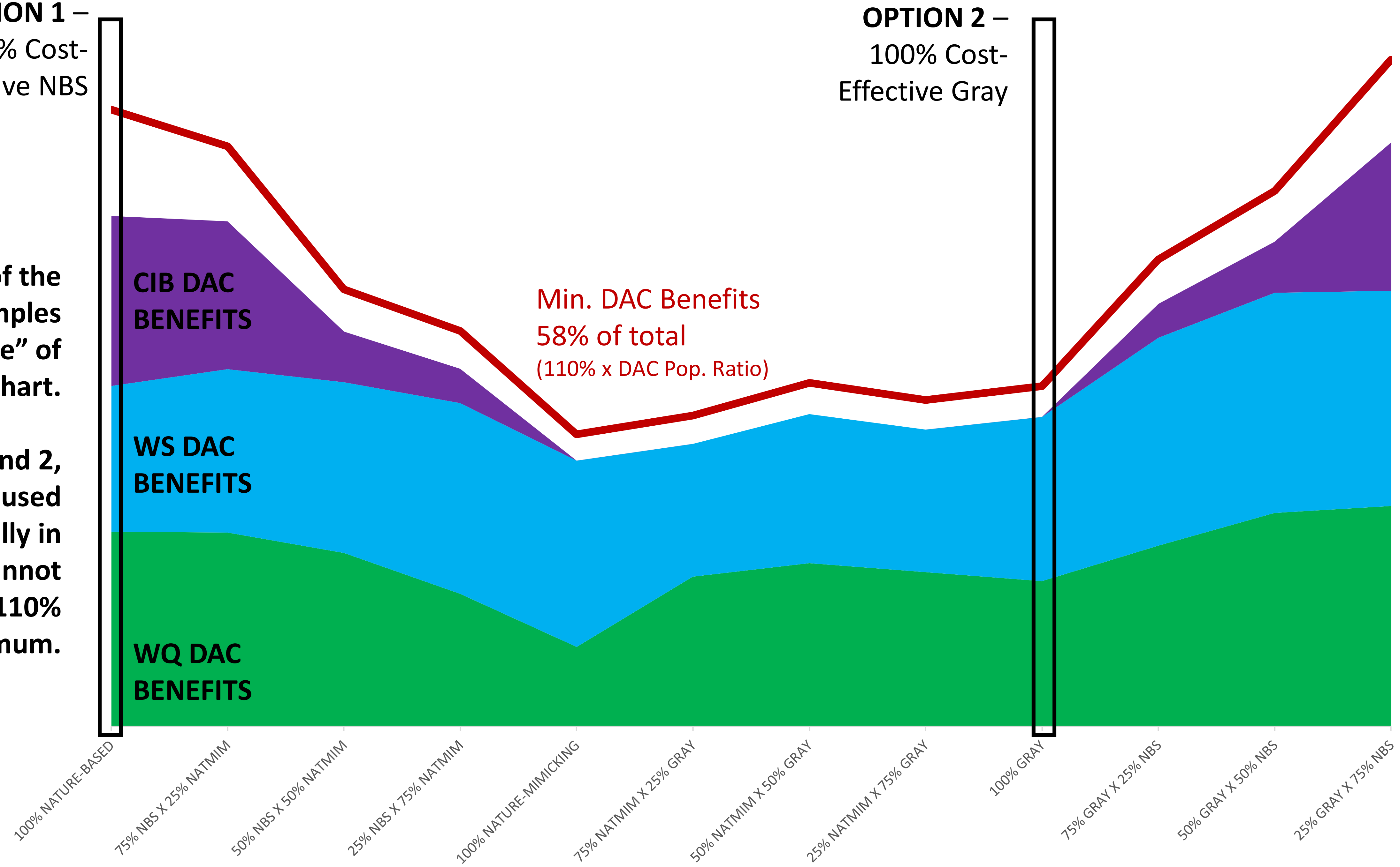
Example Calculation
(Normalized *DAC* Benefits)



DRAFT RESULTS FOR ALHAMBRA WASH

Each of the previous examples are a “slice” of this chart.

In Option 1 and 2, NBS is *not* focused specifically in DACs, so cannot exceed 110% minimum.

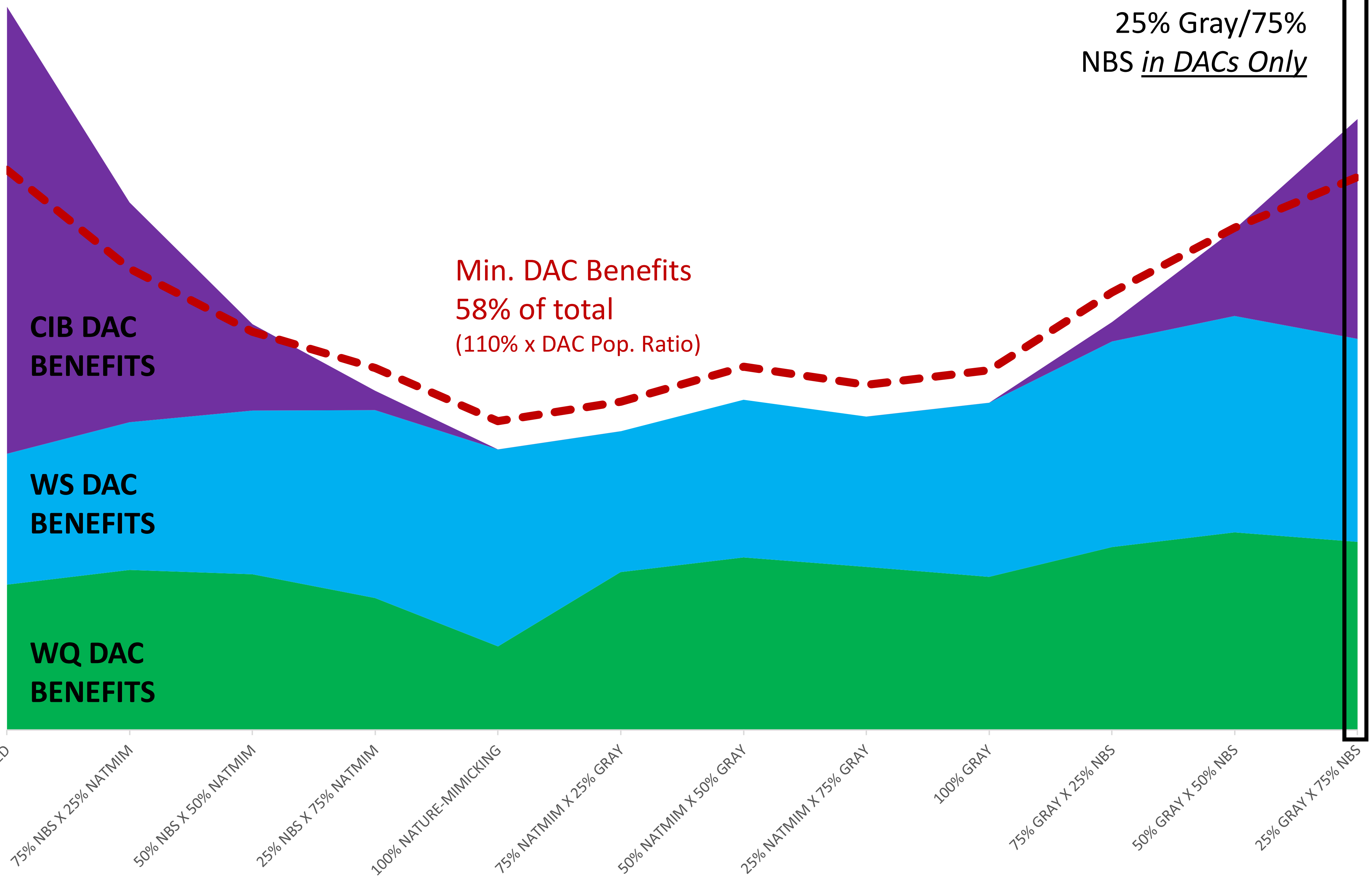


DRAFT RESULTS FOR ALHAMBRA WASH

NBS ANYWHERE **NBS ANYWHERE**

OPTION 3 –
25% Gray/75%
NBS *in DACs Only*

Option 3 implements NBS in DACs only, so exceeds the 110% minimum when the magnitude of DAC CIBs and the population served exceed 58% of the total

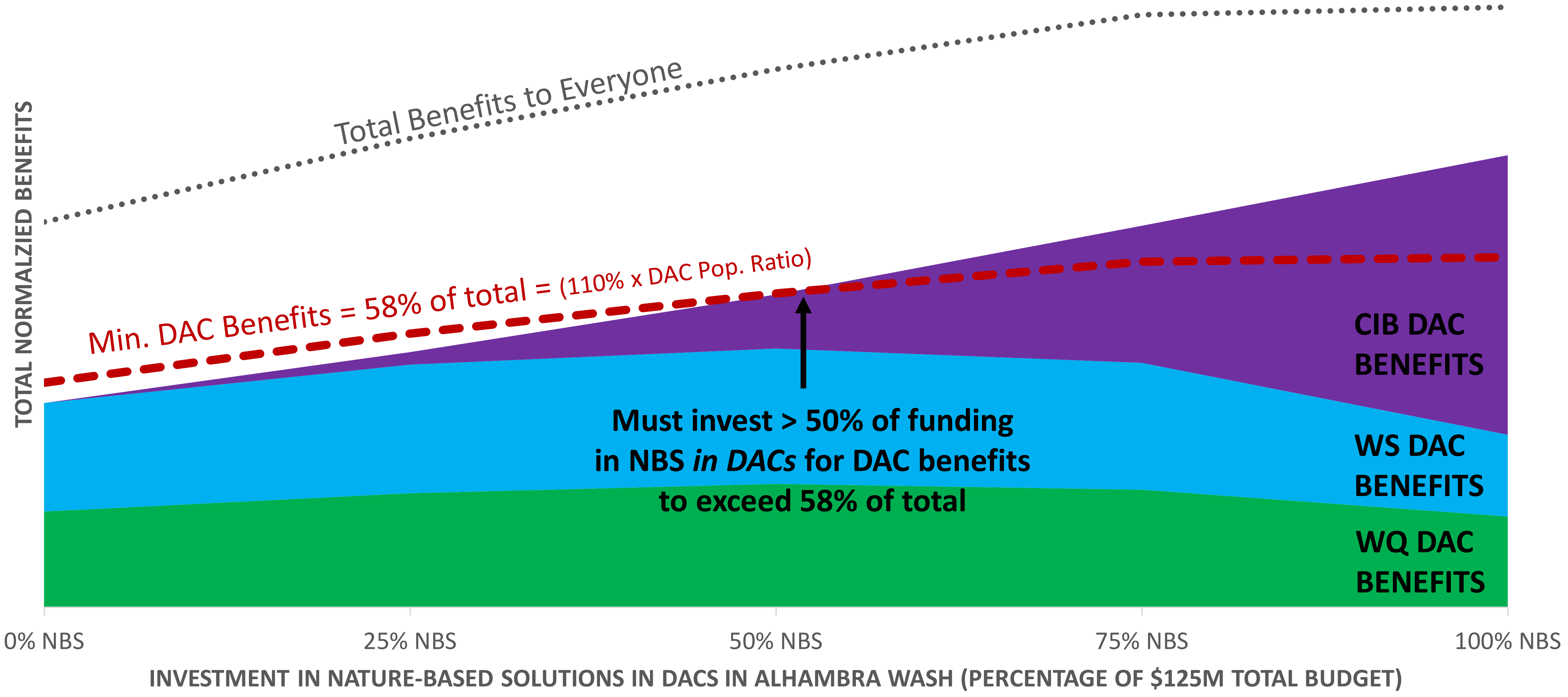


NBS IN DACS ONLY

NBS IN DACS ONLY

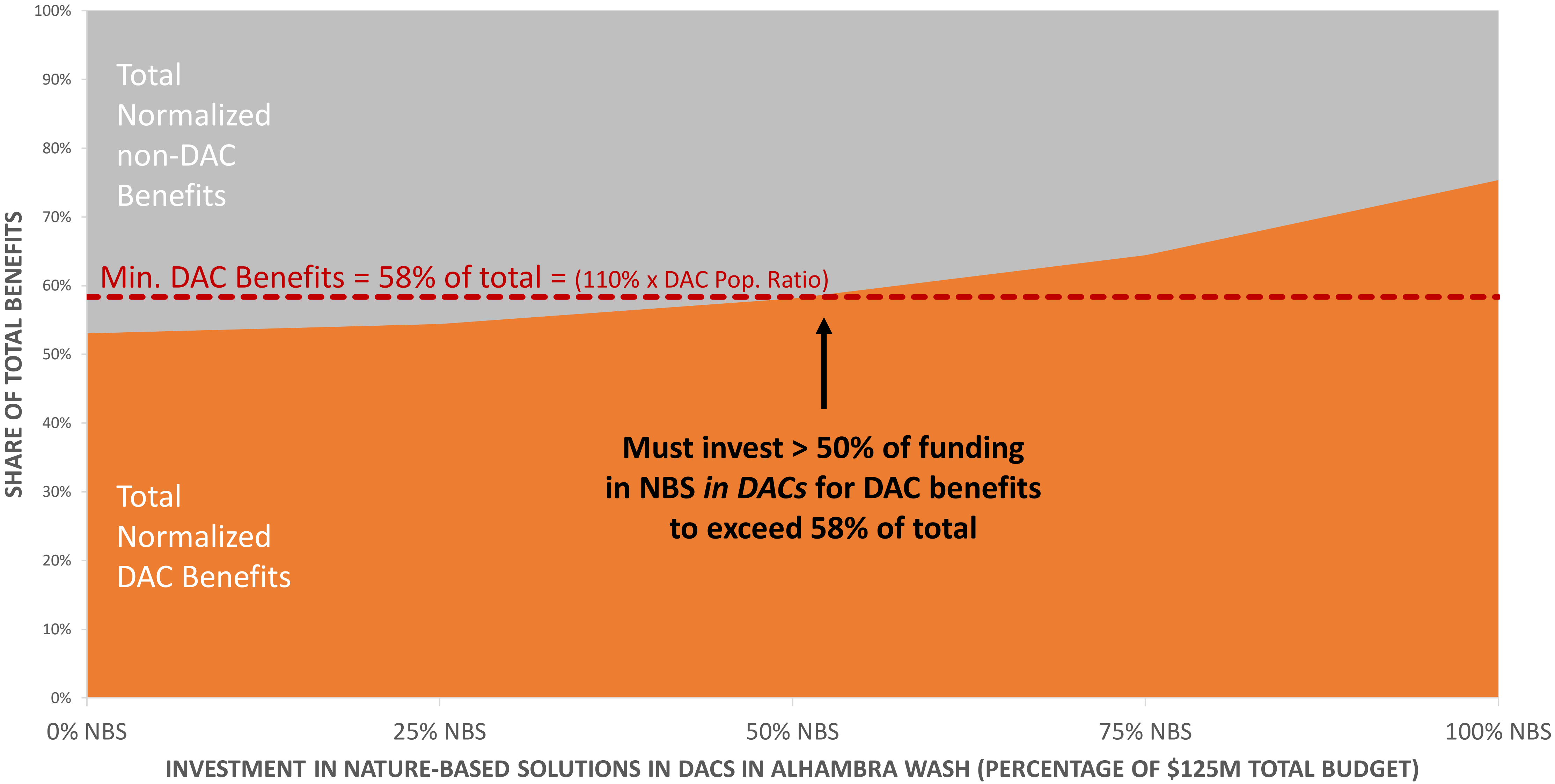
DRAFT RESULTS FOR
ALHAMBRA WASH

We can zoom in on the right side of the last chart to see how much investment in NBS in DACs is needed to exceed the minimum required DAC Benefits



DRAFT RESULTS FOR ALHAMBRA WASH

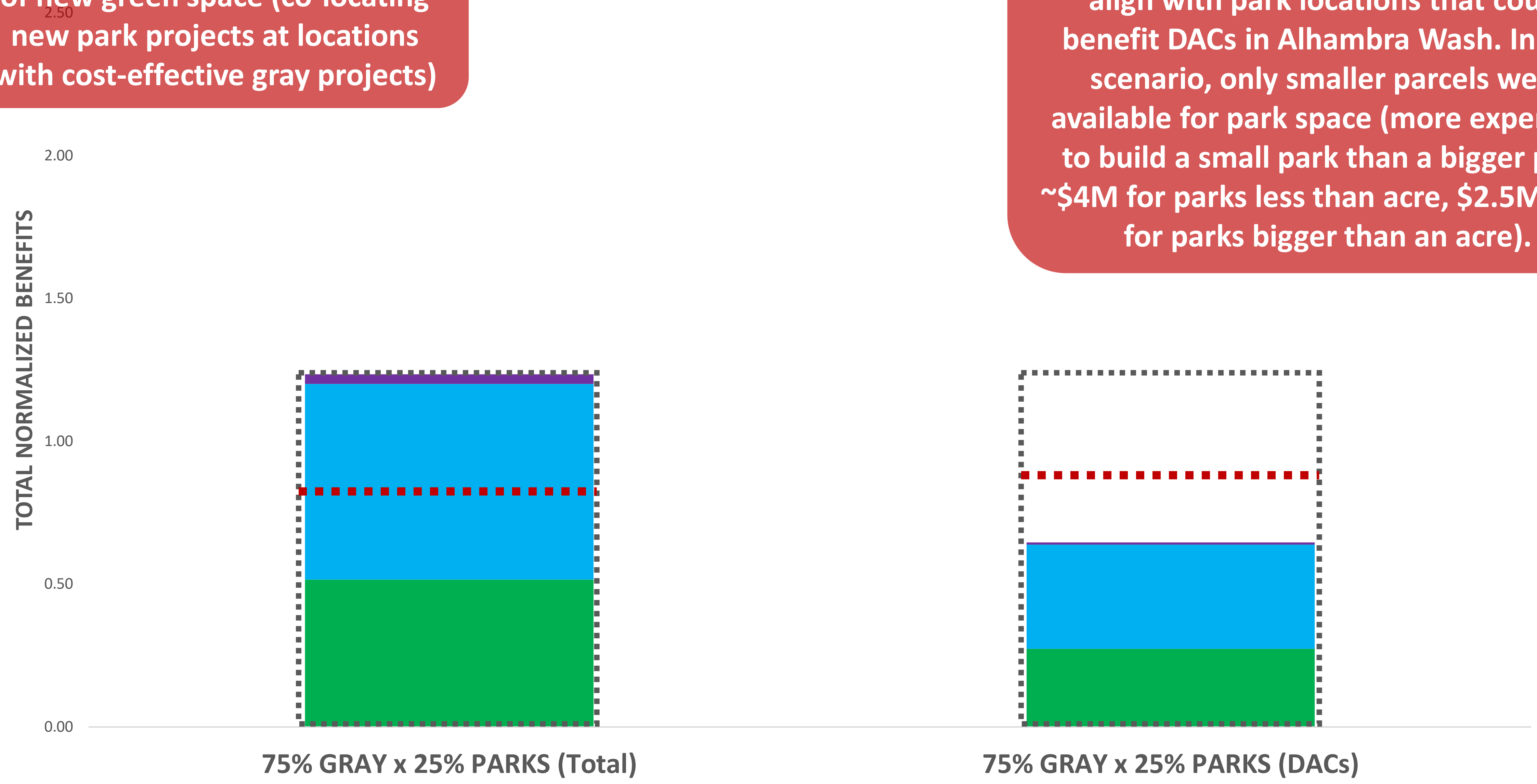
We can also look at this on a relative basis…



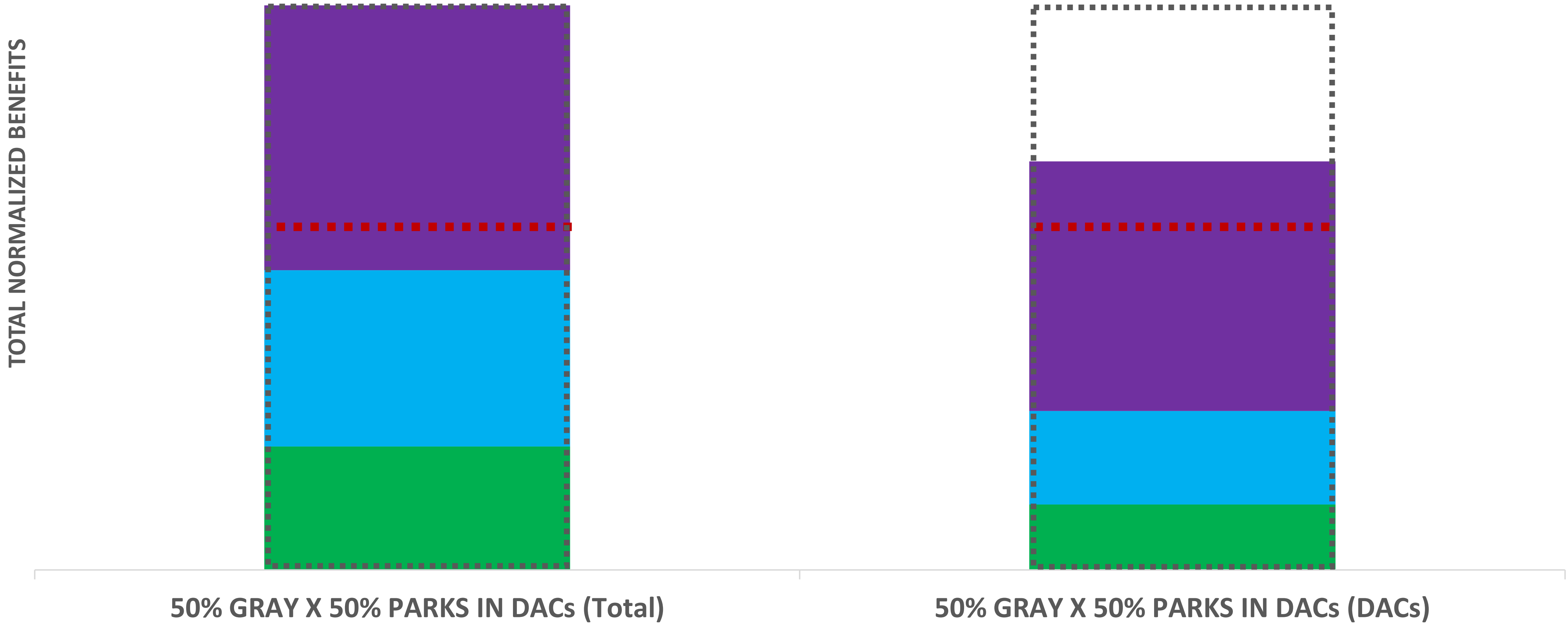
DRAFT RESULTS FOR ALHAMBRA WASH

Spent 25% of funds on 6.5 acres of new green space (co-locating new park projects at locations with cost-effective gray projects)

Notes: Best gray project locations did not align with park locations that could benefit DACs in Alhambra Wash. In this scenario, only smaller parcels were available for park space (more expensive to build a small park than a bigger park ~$4M for parks less than acre, $2.5M/acre for parks bigger than an acre).

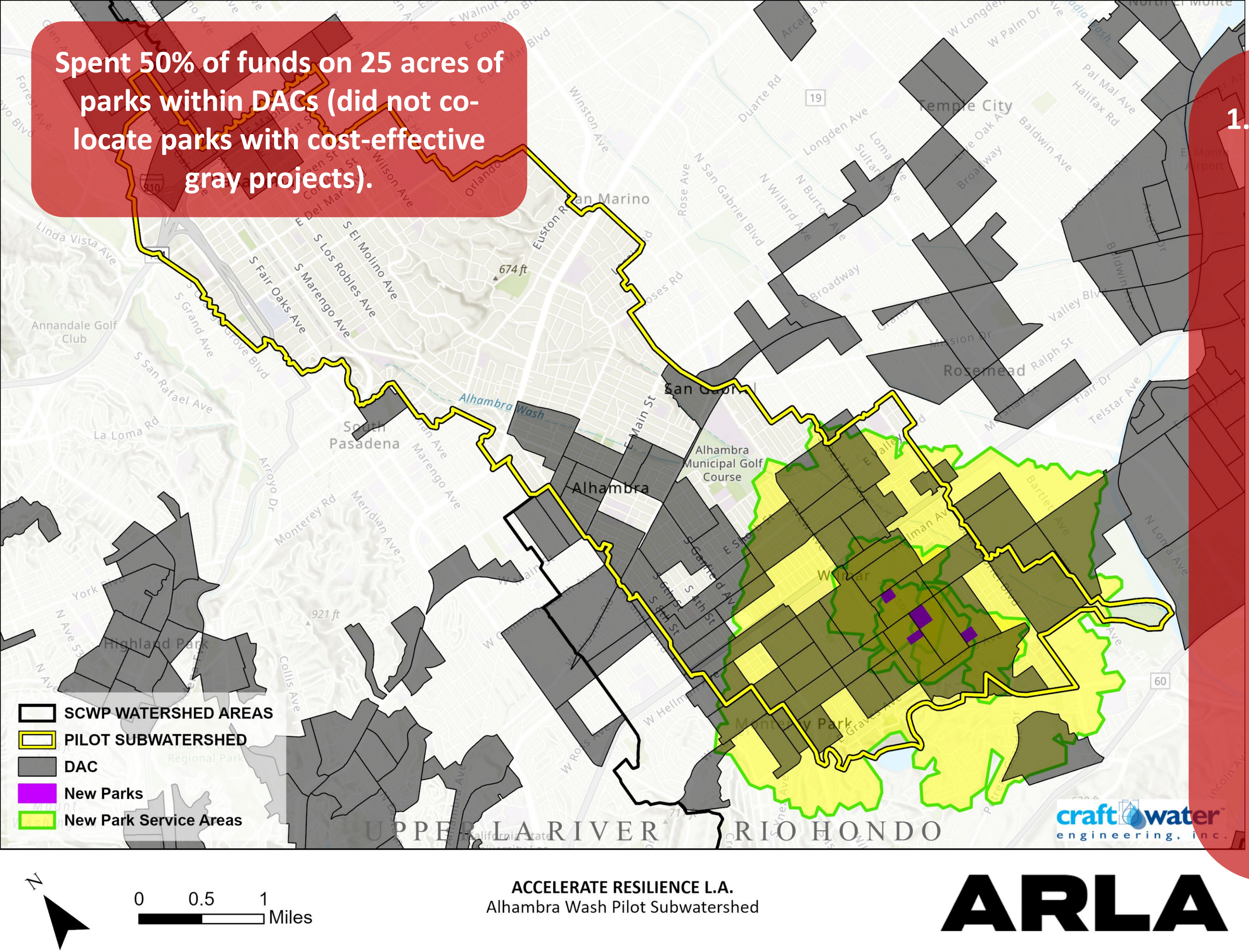


DRAFT RESULTS FOR
ALHAMBRA WASH



DRAFT RESULTS FOR
ALHAMBRA WASH

Spent 50% of funds on 25 acres of parks within DACs (did not co-locate parks with cost-effective gray projects).



Notes:

1. One of the new park parcels picked is greater than 10 acres, creating a 2-mile service area, thus benefitting high number of DAC population within Alhambra Wash. May not see same result if there are not as many parcels that could create 10 acres of new green space.
2. Access to park space + population benefitted depends on location of big spaces to build new parks & proximity of DAC population (may not be scalable for other Watershed Areas).

ACCELERATE RESILIENCE L.A.
Alhambra Wash Pilot Subwatershed

ARLA