# Attachment 9 Water Quality and Other Expected Benefits: Sunnydale Flood and Stormwater Management Sewer Improvement Project)


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## Introduction

In addition to the flood damage reduction benefits described in Attachment 7, the Sunnydale Flood and Stormwater Management Sewer Improvement Project (Sunnydale project) is expected to provide two other categories of quantifiable benefits, as follows:

- Water quality benefits from a reduction in the volume of Combined Sewer Discharges (CSDs) associated with avoided construction costs of CSD management facilities, and
- Deferral of sewer rehabilitation projects.

Both benefits amount to avoided sewer system costs which will directly benefit San Francisco Public Utilities Commission (SFPUC) customers. This attachment provides quantitative estimates of each of these benefits.

There are also additional benefits provided by Sunnydale project which, for various reasons, are more appropriately described qualitatively. These qualitative benefits include:

- Improved water quality for aquatic species and fisheries, and
- Reduced mercury loading to the San Francisco Bay from urban runoff.

These benefits would require significant water testing and long-term monitoring efforts in order to quantify, and are therefore more useful to describe qualitatively.

The benefits of general public recreation enhancement in Candlestick Point State Recreation Area (SRA) are captured in the cost/benefit analysis of the avoided construction costs of CSD management facilities, but are worth elaboration and are included in the final section of this attachment.

## Quantitative Benefits Description

### CSD Reduction Benefits

The Sunnydale project will allow SFPUC to avoid the construction of additional storage capacity near the existing Sunnydale Transport/Storage (T/S) Facilities for CSD performance. Hydraulic analysis has shown that implementation of the Sunnydale project will result in a reduction in the volume of CSDs from the South Basin CSD structures. This will directly result in an additional 3 million gallons (MG) of storage volume for CSD performance, which, when added to the capacity of the existing Sunnydale T/S Facilities,

will increase CSD storage capacity to 10 MG. This added capacity will increase the performance of the City's combined sewer system and assist with compliance of their permit and in meeting the City's level of service goals. Absent the Sunnydale project, SFPUC would need to construct a new box sewer and pump station near the existing Sunnydale T/S Facilities. Costs for a new box sewer and pump station are expected to range between $17 and $31 million (in 2010 dollars).[1,2] The midpoint of the cost range was used for the calculation of benefits.[3] It was further assumed that half the costs would be incurred in 2012 and half in 2013 – a construction schedule similar to the Sunnydale project. The present value benefit of avoiding construction of a new box sewer and pump station adjacent to the existing Sunnydale T/S Facilities, as shown in **Table 1**, is $19,395,825.

**Table 1: Benefit of Avoiding New Box Sewer and Pump Station Adjacent to Existing Sunnydale T/S Facilities**

| Year | Discount Factor | Avoided Box Sewer and Pump Station for CSD Management (2009 $) | Present Value of Avoided Cost (2009 $) |
|---|---|---|---|
| 2009 | 1.000 | $ - | $ - |
| 2010 | 0.943 | $ - | $ - |
| 2011 | 0.890 | $ - | $ - |
| 2012 | 0.840 | $ 11,886,787 | $ 9,980,376 |
| 2013 | 0.792 | $ 11,886,787 | $ 9,415,449 |
| **Total** | | **$ 23,773,575** | **$ 19,395,825** |

## Sewer Rehabilitation Deferral Benefits

The Sunnydale project will also enable SFPUC to defer rehabilitation of approximately 4,000 feet of existing sewer line at an expected cost of $3.5 million (2009 dollars). Absent the project, rehabilitation would need to occur by 2012. With the project, rehabilitation can be deferred up to 15 years. Implementation of the project will relieve the need for the existing sewer to be used for wet weather conveyance and as a result, reduce "wear and tear" on the existing sewer, extending its useful life and deferring rehabilitation. The present value benefit of deferring this cost, as summarized in **Table 2**, is $1,712,464.

[1] Memo from Nick Birth, BOE Hydraulics Section, to Manfred Wong, SFPUC, dated March 22, 2011. The cost range is based on the original costs of the Sunnydale T/S Facilities, updated to 2010 dollars with the ENR Construction Cost Index 9730, and scaled for capacity.

[2] It is worth noting that scarcity of available land for such a project could result in substantially higher costs than estimated for this analysis.

[3] Costs were converted to 2009 constant dollars using the GDP-deflator.

**Table 2: Benefit of Deferring Sunnydale Sewer Rehabilitation Costs**

| Year | Discount Factor | Sewer Rehabilitation Project | | | | Net Benefit of Deferral |
|---|---|---|---|---|---|---|
| | | Without Project | PV Annual | With Project | PV Annual | |
| 2009 | 1.000 | | $ - | | $ - | $ - |
| 2010 | 0.943 | | $ - | | $ - | $ - |
| 2011 | 0.890 | | $ - | | $ - | $ - |
| 2012 | 0.840 | $ 3,500,000 | $ 2,938,667 | | $ - | $ 2,938,667 |
| 2013 | 0.792 | | $ - | | $ - | $ - |
| 2014 | 0.747 | | $ - | | $ - | $ - |
| 2015 | 0.705 | | $ - | | $ - | $ - |
| 2016 | 0.665 | | $ - | | $ - | $ - |
| 2017 | 0.627 | | $ - | | $ - | $ - |
| 2018 | 0.592 | | $ - | | $ - | $ - |
| 2019 | 0.558 | | $ - | | $ - | $ - |
| 2020 | 0.527 | | $ - | | $ - | $ - |
| 2021 | 0.497 | | $ - | | $ - | $ - |
| 2022 | 0.469 | | $ - | | $ - | $ - |
| 2023 | 0.442 | | $ - | | $ - | $ - |
| 2024 | 0.417 | | $ - | | $ - | $ - |
| 2025 | 0.394 | | $ - | | $ - | $ - |
| 2026 | 0.371 | | $ - | | $ - | $ - |
| 2027 | 0.350 | | $ - | $ 3,500,000 | $ 1,226,203 | $(1,226,203) |
| Total | | $ 3,500,000 | $ 2,938,667 | $ 3,500,000 | $ 1,226,203 | $ 1,712,464 |

## Distribution of Benefits

The benefits of avoided costs of construction of a new box sewer and pump station and deferred costs for sewer rehabilitation would accrue directly to SFPUC customers.

## Uncertainty of Benefits

The benefits of avoided costs of construction of a new box sewer and pump station are reasonably certain. Absent the proposed Sunnydale project, expanded capacity for CSD management is expected to be required. The costs of a new box sewer and pump station are conservatively based on the costs of the existing Sunnydale T/S Facilities updated to current dollars using ENR cost indices. The avoided cost estimate is conservative for two reasons. First, it ignores scale economies of construction by proportioning down the historical costs from 7 MG to 3 MG of storage capacity – in reality the cost per MG of storage are likely to be higher for a 3 MG facility than a 7 MG facility. Second, it does not account for land constraints around the existing Sunnydale T/S Facilities and the impact this would have on land acquisition costs.

Benefits of deferring sewer rehabilitation are reasonably certain. The costs are based on similar projects undertaken by SFPUC in recent years in other parts of the City. There is some uncertainty in the extent

to which the rehabilitation projects could be deferred. It is possible that circumstances could dictate rehabilitation occurring sooner than 15 years and perhaps as soon as 10 years.

## Adverse Effects

No known adverse effects are associated with the benefits described in this attachment.

## Exhibit E Table 19

The benefits from avoiding the construction of a new box sewer and pump station and deferring sewer rehabilitation are summarized in **Exhibit E Table 19** of the PSP application.

Table 19 - Water Quality and Other Expected Benefits
(All benefits should be in 2009 dollars)
Project: Sunnydale Drainage Improvements Project

| (a) Year | (b) Type of Benefit | (c) Measure of Benefit (Units) | (d) Without Project | (e) With Project | (f) Change Resulting from Project (d) – (e) | (g) Unit $ Value (1) | (h) Annual $ Value (f) x (g) (1) | (i) Discount Factor (1) | (j) Discounted Benefits (h) x (i) (1) |
|---|---|---|---|---|---|---|---|---|---|
| **2009** | a | $ | | | 0 | | $0 | 1.000 | $0 |
| | b | $ | | | 0 | | $0 | 1.000 | $0 |
| **2010** | a | $ | | | 0 | | $0 | 0.943 | $0 |
| | b | $ | | | 0 | | $0 | 0.943 | $0 |
| **2011** | a | $ | | | 0 | | $0 | 0.890 | $0 |
| | b | $ | | | 0 | | $0 | 0.890 | $0 |
| **2012** | a | $ | $11,886,787 | | $11,886,787 | $1 | $11,886,787 | 0.840 | $9,980,376 |
| | b | $ | $3,500,000 | | $3,500,000 | $1 | $3,500,000 | 0.840 | $2,938,667 |
| **2013** | a | $ | $11,886,787 | | $11,886,787 | $1 | $11,886,787 | 0.792 | $9,415,449 |
| | b | $ | | | 0 | | $0 | 0.792 | $0 |
| **2014** | a | $ | | | 0 | | $0 | 0.747 | $0 |
| | b | $ | | | 0 | | $0 | 0.747 | $0 |
| **2015** | a | $ | | | 0 | | $0 | 0.705 | $0 |
| | b | $ | | | 0 | | $0 | 0.705 | $0 |
| **2016** | a | $ | | | 0 | | $0 | 0.665 | $0 |
| | b | $ | | | 0 | | $0 | 0.665 | $0 |
| **2017** | a | $ | | | 0 | | $0 | 0.627 | $0 |
| | b | $ | | | 0 | | $0 | 0.627 | $0 |
| **2018** | a | $ | | | 0 | | $0 | 0.592 | $0 |
| | b | $ | | | 0 | | $0 | 0.592 | $0 |
| **2019** | a | $ | | | 0 | | $0 | 0.558 | $0 |
| | b | $ | | | 0 | | $0 | 0.558 | $0 |
| **2020** | a | $ | | | 0 | | $0 | 0.527 | $0 |
| | b | $ | | | 0 | | $0 | 0.527 | $0 |
| **2021** | a | $ | | | 0 | | $0 | 0.497 | $0 |
| | b | $ | | | 0 | | $0 | 0.497 | $0 |
| **2022** | a | $ | | | 0 | | $0 | 0.469 | $0 |
| | b | $ | | | 0 | | $0 | 0.469 | $0 |
| **2023** | a | $ | | | 0 | | $0 | 0.442 | $0 |
| | b | $ | | | 0 | | $0 | 0.442 | $0 |
| **2024** | a | $ | | | 0 | | $0 | 0.417 | $0 |
| | b | $ | | | 0 | | $0 | 0.417 | $0 |
| **2025** | a | $ | | | 0 | | $0 | 0.394 | $0 |
| | b | $ | | | 0 | | $0 | 0.394 | $0 |
| **2026** | a | $ | | | 0 | | $0 | 0.371 | $0 |
| | b | $ | | | 0 | | $0 | 0.371 | $0 |
| **2027** | a | $ | | | 0 | | $0 | 0.350 | $0 |
| | b | $ | | $3,500,000 | -$3,500,000 | $1 | -$3,500,000 | 0.350 | -$1,226,203 |
| **Project Life** | | | | | | | | … | |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries | | $21,108,289 |

Comments:
a = avoided construction of box sewer and pump station adjacent to existing Sunnydale T/S Facilities.
b = deferral of Sunnydale sewer rehabilitation project.
See Attachment 9 for explanation of avoided cost and project deferral benefits.

# Qualitative Benefits Description

## Fisheries

The California Office of Environmental Health Hazard Assessment has current health warnings about consuming fish and shellfish from the San Francisco Bay due to elevated levels of pollutants such as mercury, PCBs, and dioxin. Species of higher trophic levels are of particular concern since many of the chemicals of concern bioaccumulate and become greater health and environmental risks. Most of the fish consumed in the San Francisco Bay Area are typically trophic level 3 and up, so there is a significant risk to human health from impaired water quality and fish habitat.[4] The reduction in these pollutants other chemical concentrations benefits local aquatic communities and their associated fisheries. Treating water to a secondary level of treatment reduces the concentrations of pollutants such as mercury and other chemicals in the water discharged to the Bay.[5]

The Sunnydale project will increase short-term storage capacity for combined sewer flows by three million gallons and allow for an increase in the proportion of combined sewer wet weather flows receiving secondary treatment, instead of primary level-equivalent treatment. The resulting reduction in primary treated combined sewer discharges translates to a reduction in the amount of harmful chemicals entering the San Francisco Bay. The exact amount of all the chemicals and pollutants entering the Bay currently from the Sunnydale project area is not defined and would be prohibitively difficult to determine, so a quantitative analysis is not feasible; however the project effectively demonstrates an improved capacity for storing runoff for increased secondary treatment of stormwater. This increased proportion of secondary treatment contributes the associated benefits of protecting water quality and aquatic habitat. Water quality benefits can be expected to be received upon completion of the project. Biological response to improved water quality tends to lag behind chemical improvements, so biological improvement results may not be apparent for several years after implementation. The scale of San Francisco Bay water quality improvements from this project may be focused, but the tendency for these chemicals and metals to bioaccumulate magnifies the impacts of contaminant loading and should be considered as an integrated component of larger Bay improvement efforts.

## Water Quality: Constituents – Mercury

Mercury is a high priority water quality impairment constituent in the San Francisco Bay, where it is a 303(d)-listed pollutant. The Total Maximum Daily Load (TMDL) and mercury water quality objectives are measured in the Bay based on two sets of criteria:

1) 0.2mg mercury per kg fish tissue (muscle tissue) to protect people who consume Bay fish, and

[4] Mercury in San Francisco Bay: Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. 2006. California Regional Water Quality Control Board, San Francisco Bay Region.

[5] Gray, D., Shang, Y., Hake, J.M., De Lange, V.P., Chien, M.H., Gardner, E.R. Konnan, J., Grinbergs, S. 2009. Characterizing the Quality of Effluent and Other Contributory Sources during Peak Wet Weather Events. WERF and IWA Publishing.

2) 0.03mg mercury per kg fish (whole fish 3-5cm in length) to protect aquatic organisms and wildlife.[6]

The high mercury concentrations found within the San Francisco Bay are primarily attributed to mining activities of the past, some of which continue to leach mercury, within the large Bay watershed. However, urban stormwater runoff contributes 13% of the total mercury to the San Francisco Bay and is the largest source of new, local mercury to the Bay.[7] The San Francisco Southeast Water Pollution Control Plant (SEWPCP), which receives water for secondary treatment from the Sunnydale project area, had a discharge of 2.7 kilograms of mercury per year for the years 2000-2003 and was granted a final allocation of 1.6 kilograms per year under the TMDL Basin Plan Amendment.[6] A report by the SFPUC in 2006 indicated an average mercury concentration in combined sewer discharge samples at Sunnydale from 1997 to 2002 and 2005 to 2006 of 0.23 µg/L.[8]

The project provides the benefits of reduced mercury loading to the San Francisco Bay associated with the increased proportion of combined sewer flows receiving secondary treatment at WPCP instead of only primary level-equivalent treatment before it is discharged to the Bay. The reduction in mercury will primarily be localized, but will benefit the greater San Francisco Bay because of the tendency for mercury to bioaccumulate in larger, higher trophic level and larger ranged species, and as a component of the efforts to reduce mercury concentrations throughout the Bay. The human health and environmental importance of reducing mercury loading to the San Francisco Bay is outlined in the Fisheries Benefits section above, as well as in the Mercury in San Francisco Bay Basin Plan Amendment for mercury TMDLs.[7] The benefits of reduced mercury loading are expected to begin upon completion of the project and will continue for the lifespan of the project.

## General Recreational Benefits Elaboration

The benefits of enhanced recreational benefits from decreased CSD volumes are already captured in the cost/benefit analysis of the avoided construction costs of CSD management facilities, but are not specifically targeted in that analysis. The following section elaborates on the recreational benefits in order to better reveal and clarify these benefits.

### Candlestick Point State Recreation Area Benefits

The Candlestick Point SRA is a coastal recreation area located in southern San Francisco, in the Sunnydale Drainage Basin. It is the first designated SRA in an urban environment in California. In 2009 the recreation area was visited by more than 130,000 individuals.[9] Recreational uses of the SRA include fishing, shellfish harvesting, water contact recreation and non-water contact recreation. The Sunnydale project is located near the Candlestick Point SRA and will have a positive impact on water quality in the nearshore coastal waters around Candlestick Point through a reduction in volume of CSDs. Hydraulic

[6] Mercury in San Francisco Bay: Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. 2006. California Regional Water Quality Control Board, San Francisco Bay Region.
[7] Information on the San Francisco Bay Mercury TMDL. 2004. Clean Estuary Partnership.
[8] Monitor to Effectively Characterize Overflow Impacts and the Efficacy of CSO Controls. June 2006. SFPUC.
[9] Candlestick Point State Recreation Area Ranger's Office. 2011.

modeling has demonstrated that the Sunnydale project will result in a 35 percent reduction of combined sewer discharge volumes from the Sunnydale basin, where the Candlestick Point SRA is located. The benefit of avoiding beach closures associated with reduced CSD volumes, as shown in **Table 3**, ranges from $53,000 to $98,000 for the lifespan of the project.

**Table 3: Benefit of Avoiding Beach Closures Per Year at Candlestick Point State Recreation Area**

| % of Visitors Using Beaches | Winter/Spring Visitors/Day | Visitor Days Impacted by CSD Closure | Lost Consumer Surplus | | Capitalized Value Per Avoided CSD/Yr | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Low Estimate | | | High Estimate | | |
| | | | Low | High | 50 yrs | 75 yrs | 100 yrs | 50 yrs | 75 yrs | 100 yrs |
| 0% | 0 | 0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| 10% | 28 | 53 | $640 | $1,175 | $10,086 | $10,530 | $10,634 | $18,522 | $19,338 | $19,528 |
| 20% | 57 | 106 | $1,280 | $2,350 | $20,172 | $21,061 | $21,268 | $37,044 | $38,675 | $39,055 |
| 30% | 85 | 159 | $1,920 | $3,525 | $30,259 | $31,591 | $31,901 | $55,566 | $58,013 | $58,583 |
| 40% | 113 | 212 | $2,560 | $4,700 | $40,345 | $42,121 | $42,535 | $74,088 | $77,350 | $78,110 |
| 50% | 142 | 264 | $3,200 | $5,876 | $50,431 | $52,652 | $53,169 | $92,610 | $96,688 | $97,638 |
| 60% | 170 | 317 | $3,839 | $7,051 | $60,517 | $63,182 | $63,803 | $111,132 | $116,025 | $117,165 |
| 70% | 198 | 370 | $4,479 | $8,226 | $70,604 | $73,712 | $74,437 | $129,654 | $135,363 | $136,693 |
| 80% | 227 | 423 | $5,119 | $9,401 | $80,690 | $84,243 | $85,070 | $148,176 | $154,700 | $156,220 |
| 90% | 255 | 476 | $5,759 | $10,576 | $90,776 | $94,773 | $95,704 | $166,698 | $174,038 | $175,748 |
| 100% | 283 | 529 | $6,399 | $11,751 | $100,862 | $105,303 | $106,338 | $185,220 | $193,375 | $195,275 |

## Distribution of Benefits

The benefits of avoided beach closures would accrue to beach users, particularly water contact visitors.

## Uncertainty of Benefits

The estimated benefits of avoided beach closures are based on several assumptions:

- Beach closure studies in California primarily address Southern California beaches. The low and high estimates used for the value of a beach visitor day are from studies of Los Angeles and Orange County beaches.
- Cost/benefit analysis assumes that visitors can substitute other beaches or other forms of recreation for the closed beach, thereby reducing the consumer surplus losses.

- For this analysis it is assumed that CSD events will occur in winter and spring months, and average visitor per day estimates are scaled accordingly.
- Finally, not all recreation area users will be impacted by beach closures. It is assumed that 50 percent of visitors will be impacted by the beach closures, although other percentages are also presented in Table 3.

# Attachment 9 Water Quality and Other Expected Benefits: Cesar Chavez Street Flood and Stormwater Management Sewer Improvement Project


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## Introduction

In addition to the flood damage reduction benefits described in Attachment 7, the Cesar Chavez Street Flood and Stormwater Management Sewer Improvement Project (Cesar Chavez project) is expected to provide three other categories of quantifiable benefits, as follows:

- Water quality benefits in the form of avoided sewer replacement costs along Cesar Chavez Street, and
- Reduction of 860,000 gallons/year of stormwater discharge starting in 2014 due to implementation of Low Impact Design (LID) stormwater catchment systems along Valencia Street.
- Air quality benefits in the form of carbon sequestration and PM10 reduction.

The first two benefits can be quantified by the avoided sewer system costs which will directly benefit San Francisco Public Utilities Commission (SFPUC) customers. Additionally, the LID stormwater catchment systems will reduce discharges of treated stormwater into State receiving waters (San Francisco Bay) by 860,000 gallons, sequester 0.77 tons of CO2, and eliminate 0.46 lbs of PM10 per year. This attachment provides quantitative estimates of each of these benefits.

There are also additional benefits provided by the Cesar Chavez project which, for various reasons, are more appropriately described qualitatively. These qualitative benefits include:

- General public recreation enhancement in Islais Creek and nearshore San Francisco Bay waters,
- Improved streetscape aesthetics by urban greening and low impact design implementation,
- Improved water quality for aquatic species and fisheries, and
- Reduced mercury loading to the San Francisco Bay from urban runoff.

Information on usership of Islais Creek recreation is not readily available so quantifying impacts of creek impairment events is not possible. The benefits of urban greening and improved aesthetics describe those in addition to previously analyzed air quality benefits. The additional greening benefits are not easily quantifiable and may be focused, but are worth noting, especially in the context of other urban greening efforts in the City of San Francisco. The last two benefits listed would require significant water testing and long-term monitoring efforts in order to quantify, and are therefore more useful to describe

qualitatively. The final section of this attachment provides descriptions of these additional qualitative benefits.

## Quantitative Benefits Description

### Avoided Sewer Replacement Benefits

The Cesar Chavez project will allow SFPUC to avoid the replacement of existing 8-inch and 12-inch diameter sewers under Cesar Chavez Street. Based on the existing condition of the sewers, it is estimated that 60 percent of the 8-inch and 12-inch diameter sewers on the north side of Cesar Chavez Street – about 2,000 linear feet of sewer lines – would need replacement in 2012. Additionally, it is estimated that additional sewer replacement would be required on Harrison Street from 26th Street to Cesar Chavez Street and on Coleridge Street from Fair Avenue to Coso Avenue. This would amount to approximately 1,400 linear feet of 12-inch and 18-inch diameter sewers. This work would also need to be completed in 2012. The combined costs of these sewer replacements are estimated at $1,250,000 (2009 $), or about $368 per linear foot. The present value benefit of avoiding the sewer replacement, as shown in **Table 1**, is $1,049,524.

Table 1: Benefit of Avoiding 3400 Linear Feet of Sewer Replacement on Cesar Chavez and Neighboring Streets

| Year | Discount Factor | Avoided Box Sewer and Pump Station for CSO Management (2009 $) | Present Value of Avoided Cost (2009 $) |
|---|---|---|---|
| 2009 | 1.000 | $ - | $ - |
| 2010 | 0.943 | $ - | $ - |
| 2011 | 0.890 | $ - | $ - |
| 2012 | 0.840 | $ 1,250,000 | $ 1,049,524 |
| **Total** | | **$ 1,250,000** | **$ 1,049,524** |

### Stormwater Discharge Reduction Benefits

The Cesar Chavez project includes construction of LID stormwater management systems along Valencia Street. These LID stormwater management improvements include the following:

- Reducing paved area by 12,580 square feet
- Increasing tree well area from 320 to 800 square feet through the addition of 30 trees
- Adding 2,100 square feet of bioretention area
- Adding 10,000 square feet of permeable pavement area

In combination, it is estimated these improvements will reduce stormwater discharge to sewers by 860,000 gallons per year starting in 2014. This is based on an analysis of 24 hour peak flows and runoff volumes for 1-year, 2-year, and 5-year design storms.

This is water that would otherwise flow into the combined sewer system for treatment and subsequent discharge into the San Francisco Bay. SFPUC treatment costs for stormwater discharge are

approximately $0.004/gallon (2009 dollars).[1] Thus, the planned improvements would avoid $3,619 in sewer operating costs annually starting in 2014. The present value of this annual benefit is $47,142, as shown in **Table 2**.

### CO2 and PM10 Reduction Benefits

It is estimated that the LID stormwater green-street improvements along Valencia Street will sequester 0.77 tons of CO2 and 0.46 lbs of PM10 per year. The estimate is based on sequestration rates per square foot of green-street (bioretention and tree planting) area estimated by City of Portland's Bureau of Environmental Services.[2] It is estimated that green-street improvements will sequester 0.000272 metric tons of CO2 and 0.0808 grams of PM10 per square foot per year. The Valencia Street LID improvements include 2,100 square feet of bioretention and 480 square feet of additional tree well area, for a total of 2,580 square feet of green-street improvements. Using the City of Portland's unit values for CO2 and PM10 sequestration, this translates to a reduction of 0.77 tons of CO2 and 0.46 lbs of PM10 per year.

The value of CO2 sequestration is based on $60/ton, which is the midpoint of CARB's 2020 cap-and-trade price forecast for CO2.[3] This results in an annual benefit of $46.41 and a present value benefit of $605. The value of PM10 reduction is based on a price of $42.45/lb/yr. This is the annualized value of the weighted average price paid for PM10 emission reduction credits (ERCs) in 2009 in the SCAQMD.[4] This results in an annual benefit of $19.51/year and a present value benefit of $254.

The annual and present value of CO2 and PM10 sequestration is summarized in **Table 3**.

### Distribution of Benefits

The benefits of avoiding sewer replacement costs would accrue to SFPUC customers. Similarly, avoided stormwater treatment costs would accrue to SFPUC customers. Reduced discharges of treated stormwater into San Francisco Bay would broadly benefit all direct and indirect users of Bay waters. CO2 benefits would be broadly distributed across the state. PM10 reduction would primarily benefit residents of San Francisco.

### Uncertainty of Benefits

The benefits of avoiding sewer replacement costs are highly certain. Absent the proposed Cesar Chavez project, the sewer replacements described previously would have to be undertaken. The costs of sewer

[1] This is based on a functional disaggregation of current sewer charges between wet-weather and dry-weather sewer operations and costs. "Evaluation of Stormwater Credits," prepared for SFPUC by Patricia McGovern Engineers and Raftelis Financial Consultants, Inc., March 5, 2009.

[2] "Portland's Green Infrastructure: Quantifying the Health, Energy, and Community Livability Benefits," City of Portland Bureau of Environmental Services, Prepared by Entrix, Inc., February 16, 2010. It is estimated that green-street improvements will sequester 0.000272 metric tons of CO2 and 0.0808 grams of PM10 per square foot per year. The Valencia Street LID improvements include 2,100 square feet of bioretention and 480 square feet of additional tree well area, for a total of 2,580 square feet of green-street improvements.

[3] California Air Resources Board, Cap-And-Trade Rulemaking Proceedings, Appendix N, Economic Analysis, Page N.12. The forecasted 2020 price for CO2 ranged between $20 and $100 per ton.

[4] The average value for a PM10 ERC in 2009 was $258,250/lb/day. Assuming the ERC confers a right in perpetuity, the annualized value of the credit, given a 6% discount rate, is $15,495/lb/day or $42.45/lb/year.

replacement are based on similar replacements undertaken by SFPUC in recent years in other parts of the City. The benefits of avoided stormwater discharge are reasonably certain. The estimated volume reduction in annual stormwater discharge due to the LID improvements is based on hydraulic modeling of 1-year, 2-year, and 5-year design storms and conventional methods for estimating stormwater catchment and infiltration rates for LID improvements with established performance parameters. Moreover, the benefits of the LID components of the project do not account for potential sewer system capacity benefits when considered in conjunction with longer range plans for implementing LID stormwater improvements throughout the City, and thus are conservatively estimated. The estimated amount of CO2 and PM10 sequestration is based on analyses done for City of Portland and some assumptions used to develop the unit sequestration values may be location-specific. Additionally, the prices for CO2 and PM10 are based off of forecasted values. However, the magnitudes of the CO2 and PM10 reduction benefits are such that they have no meaningful impact on the project's overall benefit-cost ratio.

### Adverse Effects

No known adverse effects are associated with the benefits described in this attachment.

**Table 2: Cesar Chavez Project Avoided Stormwater Treatment Costs**

| Year | Discount Factor | Avoided Stormwater Discharge Annual | Avoided Stormwater Discharge PV Annual | Year | Discount Factor | Avoided Stormwater Discharge Annual | Avoided Stormwater Discharge PV Annual |
|---|---|---|---|---|---|---|---|
| 2009 | 1.000 | $ - | $ - | 2049 | 0.097 | $ 3,619 | $ 352 |
| 2010 | 0.943 | $ - | $ - | 2050 | 0.092 | $ 3,619 | $ 332 |
| 2011 | 0.890 | $ - | $ - | 2051 | 0.087 | $ 3,619 | $ 313 |
| 2012 | 0.840 | $ - | $ - | 2052 | 0.082 | $ 3,619 | $ 295 |
| 2013 | 0.792 | $ - | $ - | 2053 | 0.077 | $ 3,619 | $ 279 |
| 2014 | 0.747 | $ 3,619 | $ 2,705 | 2054 | 0.073 | $ 3,619 | $ 263 |
| 2015 | 0.705 | $ 3,619 | $ 2,552 | 2055 | 0.069 | $ 3,619 | $ 248 |
| 2016 | 0.665 | $ 3,619 | $ 2,407 | 2056 | 0.065 | $ 3,619 | $ 234 |
| 2017 | 0.627 | $ 3,619 | $ 2,271 | 2057 | 0.061 | $ 3,619 | $ 221 |
| 2018 | 0.592 | $ 3,619 | $ 2,142 | 2058 | 0.058 | $ 3,619 | $ 208 |
| 2019 | 0.558 | $ 3,619 | $ 2,021 | 2059 | 0.054 | $ 3,619 | $ 196 |
| 2020 | 0.527 | $ 3,619 | $ 1,907 | 2060 | 0.051 | $ 3,619 | $ 185 |
| 2021 | 0.497 | $ 3,619 | $ 1,799 | 2061 | 0.048 | $ 3,619 | $ 175 |
| 2022 | 0.469 | $ 3,619 | $ 1,697 | 2062 | 0.046 | $ 3,619 | $ 165 |
| 2023 | 0.442 | $ 3,619 | $ 1,601 | 2063 | 0.043 | $ 3,619 | $ 156 |
| 2024 | 0.417 | $ 3,619 | $ 1,510 | 2064 | 0.041 | $ 3,619 | $ 147 |
| 2025 | 0.394 | $ 3,619 | $ 1,425 | 2065 | 0.038 | $ 3,619 | $ 139 |
| 2026 | 0.371 | $ 3,619 | $ 1,344 | 2066 | 0.036 | $ 3,619 | $ 131 |
| 2027 | 0.350 | $ 3,619 | $ 1,268 | 2067 | 0.034 | $ 3,619 | $ 123 |
| 2028 | 0.331 | $ 3,619 | $ 1,196 | 2068 | 0.032 | $ 3,619 | $ 116 |
| 2029 | 0.312 | $ 3,619 | $ 1,129 | 2069 | 0.030 | $ 3,619 | $ 110 |
| 2030 | 0.294 | $ 3,619 | $ 1,065 | 2070 | 0.029 | $ 3,619 | $ 104 |
| 2031 | 0.278 | $ 3,619 | $ 1,004 | 2071 | 0.027 | $ 3,619 | $ 98 |
| 2032 | 0.262 | $ 3,619 | $ 948 | 2072 | 0.025 | $ 3,619 | $ 92 |
| 2033 | 0.247 | $ 3,619 | $ 894 | 2073 | 0.024 | $ 3,619 | $ 87 |
| 2034 | 0.233 | $ 3,619 | $ 843 | 2074 | 0.023 | $ 3,619 | $ 82 |
| 2035 | 0.220 | $ 3,619 | $ 796 | 2075 | 0.021 | $ 3,619 | $ 77 |
| 2036 | 0.207 | $ 3,619 | $ 751 | 2076 | 0.020 | $ 3,619 | $ 73 |
| 2037 | 0.196 | $ 3,619 | $ 708 | 2077 | 0.019 | $ 3,619 | $ 69 |
| 2038 | 0.185 | $ 3,619 | $ 668 | 2078 | 0.018 | $ 3,619 | $ 65 |
| 2039 | 0.174 | $ 3,619 | $ 630 | 2079 | 0.017 | $ 3,619 | $ 61 |
| 2040 | 0.164 | $ 3,619 | $ 595 | 2080 | 0.016 | $ 3,619 | $ 58 |
| 2041 | 0.155 | $ 3,619 | $ 561 | 2081 | 0.015 | $ 3,619 | $ 55 |
| 2042 | 0.146 | $ 3,619 | $ 529 | 2082 | 0.014 | $ 3,619 | $ 51 |
| 2043 | 0.138 | $ 3,619 | $ 499 | 2083 | 0.013 | $ 3,619 | $ 49 |
| 2044 | 0.130 | $ 3,619 | $ 471 | 2084 | 0.013 | $ 3,619 | $ 46 |
| 2045 | 0.123 | $ 3,619 | $ 444 | 2085 | 0.012 | $ 3,619 | $ 43 |
| 2046 | 0.116 | $ 3,619 | $ 419 | 2086 | 0.011 | $ 3,619 | $ 41 |
| 2047 | 0.109 | $ 3,619 | $ 395 | 2087 | 0.011 | $ 3,619 | $ 38 |
| 2048 | 0.103 | $ 3,619 | $ 373 | **Total Benefits:** | | **$ 267,842** | **$ 47,142** |

**Table 3: Cesar Chavez Project CO2/PM10 Reduction Benefits**

| Year | Discount Factor | CO2, PM10 Reduction | | Year | Discount Factor | CO2, PM10 Reduction | |
|---|---|---|---|---|---|---|---|
| | | Annual | PV Annual | | | Annual | PV Annual |
| 2009 | 1.000 | $ - | $ - | 2049 | 0.097 | $ 66 | $ 6 |
| 2010 | 0.943 | $ - | $ - | 2050 | 0.092 | $ 66 | $ 6 |
| 2011 | 0.890 | $ - | $ - | 2051 | 0.087 | $ 66 | $ 6 |
| 2012 | 0.840 | $ - | $ - | 2052 | 0.082 | $ 66 | $ 5 |
| 2013 | 0.792 | $ - | $ - | 2053 | 0.077 | $ 66 | $ 5 |
| 2014 | 0.747 | $ 66 | $ 49 | 2054 | 0.073 | $ 66 | $ 5 |
| 2015 | 0.705 | $ 66 | $ 46 | 2055 | 0.069 | $ 66 | $ 5 |
| 2016 | 0.665 | $ 66 | $ 44 | 2056 | 0.065 | $ 66 | $ 4 |
| 2017 | 0.627 | $ 66 | $ 41 | 2057 | 0.061 | $ 66 | $ 4 |
| 2018 | 0.592 | $ 66 | $ 39 | 2058 | 0.058 | $ 66 | $ 4 |
| 2019 | 0.558 | $ 66 | $ 37 | 2059 | 0.054 | $ 66 | $ 4 |
| 2020 | 0.527 | $ 66 | $ 35 | 2060 | 0.051 | $ 66 | $ 3 |
| 2021 | 0.497 | $ 66 | $ 33 | 2061 | 0.048 | $ 66 | $ 3 |
| 2022 | 0.469 | $ 66 | $ 31 | 2062 | 0.046 | $ 66 | $ 3 |
| 2023 | 0.442 | $ 66 | $ 29 | 2063 | 0.043 | $ 66 | $ 3 |
| 2024 | 0.417 | $ 66 | $ 28 | 2064 | 0.041 | $ 66 | $ 3 |
| 2025 | 0.394 | $ 66 | $ 26 | 2065 | 0.038 | $ 66 | $ 3 |
| 2026 | 0.371 | $ 66 | $ 24 | 2066 | 0.036 | $ 66 | $ 2 |
| 2027 | 0.350 | $ 66 | $ 23 | 2067 | 0.034 | $ 66 | $ 2 |
| 2028 | 0.331 | $ 66 | $ 22 | 2068 | 0.032 | $ 66 | $ 2 |
| 2029 | 0.312 | $ 66 | $ 21 | 2069 | 0.030 | $ 66 | $ 2 |
| 2030 | 0.294 | $ 66 | $ 19 | 2070 | 0.029 | $ 66 | $ 2 |
| 2031 | 0.278 | $ 66 | $ 18 | 2071 | 0.027 | $ 66 | $ 2 |
| 2032 | 0.262 | $ 66 | $ 17 | 2072 | 0.025 | $ 66 | $ 2 |
| 2033 | 0.247 | $ 66 | $ 16 | 2073 | 0.024 | $ 66 | $ 2 |
| 2034 | 0.233 | $ 66 | $ 15 | 2074 | 0.023 | $ 66 | $ 1 |
| 2035 | 0.220 | $ 66 | $ 14 | 2075 | 0.021 | $ 66 | $ 1 |
| 2036 | 0.207 | $ 66 | $ 14 | 2076 | 0.020 | $ 66 | $ 1 |
| 2037 | 0.196 | $ 66 | $ 13 | 2077 | 0.019 | $ 66 | $ 1 |
| 2038 | 0.185 | $ 66 | $ 12 | 2078 | 0.018 | $ 66 | $ 1 |
| 2039 | 0.174 | $ 66 | $ 11 | 2079 | 0.017 | $ 66 | $ 1 |
| 2040 | 0.164 | $ 66 | $ 11 | 2080 | 0.016 | $ 66 | $ 1 |
| 2041 | 0.155 | $ 66 | $ 10 | 2081 | 0.015 | $ 66 | $ 1 |
| 2042 | 0.146 | $ 66 | $ 10 | 2082 | 0.014 | $ 66 | $ 1 |
| 2043 | 0.138 | $ 66 | $ 9 | 2083 | 0.013 | $ 66 | $ 1 |
| 2044 | 0.130 | $ 66 | $ 9 | 2084 | 0.013 | $ 66 | $ 1 |
| 2045 | 0.123 | $ 66 | $ 8 | 2085 | 0.012 | $ 66 | $ 1 |
| 2046 | 0.116 | $ 66 | $ 8 | 2086 | 0.011 | $ 66 | $ 1 |
| 2047 | 0.109 | $ 66 | $ 7 | 2087 | 0.011 | $ 66 | $ 1 |
| 2048 | 0.103 | $ 66 | $ 7 | **Total Benefits:** | | **$ 4,878** | **$ 859** |

### Exhibit E Table 19

The benefits of avoided sewer replacement and stormwater treatment costs are summarized in **Exhibit E Table 19** of the PSP application.

| Table 19 - Water Quality and Other Expected Benefits<br>(All benefits should be in 2009 dollars)<br>Project: Cesar Chavez Drainage Improvements Project (Phase I) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (a) | (b) | (c) | (d) | (e) | (f) | (g) | (h) | (i) | (j) |
| Year | Type of Benefit | Measure of Benefit (Units) | Without Project | With Project | Change Resulting from Project (d) – (e) | Unit $ Value (1) | Annual $ Value (f) x (g) (1) | Discount Factor (1) | Discounted Benefits (h) x (i) (1) |
| **2009** | a | | | | 0 | | $0 | 1.000 | $0 |
| | b | | | | 0 | | $0 | 1.000 | $0 |
| | c | | | | 0 | | $0 | 1.000 | $0 |
| | d | | | | 0 | | $0 | 1.000 | $0 |
| **2010** | a | | | | 0 | | $0 | 0.943 | $0 |
| | b | | | | 0 | | $0 | 0.943 | $0 |
| | c | | | | 0 | | $0 | 0.943 | $0 |
| | d | | | | 0 | | $0 | 0.943 | $0 |
| **2011** | a | | | | 0 | | $0 | 0.890 | $0 |
| | b | | | | 0 | | $0 | 0.890 | $0 |
| | c | | | | 0 | | $0 | 0.890 | $0 |
| | d | | | | 0 | | $0 | 0.890 | $0 |
| **2012** | a | LF of Sewer | 3400 | 0 | 3400 | $368 | $1,250,000 | 0.840 | $1,049,524 |
| | b | | | | 0 | | $0 | 0.840 | $0 |
| | c | | | | 0 | | $0 | 0.840 | $0 |
| | d | | | | 0 | | $0 | 0.840 | $0 |
| **2013** | a | | | | 0 | | $0 | 0.792 | $0 |
| | b | | | | 0 | | $0 | 0.792 | $0 |
| | c | | | | 0 | | $0 | 0.792 | $0 |
| | d | | | | 0 | | $0 | 0.792 | $0 |
| **2014** | a | | | | 0 | | $0 | 0.747 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.747 | $2,705 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.747 | $35 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.747 | $15 |
| **2015** | a | | | | 0 | | $0 | 0.705 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.705 | $2,552 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.705 | $33 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.705 | $14 |
| **2016** | a | | | | 0 | | $0 | 0.665 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.665 | $2,407 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.665 | $31 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.665 | $13 |
| **2017** | a | | | | 0 | | $0 | 0.627 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.627 | $2,271 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.627 | $29 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.627 | $12 |
| **2018** | a | | | | 0 | | $0 | 0.592 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.592 | $2,142 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.592 | $27 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.592 | $12 |
| **2019** | a | | | | 0 | | $0 | 0.558 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.558 | $2,021 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.558 | $26 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.558 | $11 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2020** | a | | | | 0 | | $0 | 0.527 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.527 | $1,907 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.527 | $24 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.527 | $10 |
| **2021** | a | | | | 0 | | $0 | 0.497 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.497 | $1,799 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.497 | $23 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.497 | $10 |
| **2022** | a | | | | 0 | | $0 | 0.469 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.469 | $1,697 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.469 | $22 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.469 | $9 |
| **2023** | a | | | | 0 | | $0 | 0.442 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.442 | $1,601 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.442 | $21 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.442 | $9 |
| **2024** | a | | | | 0 | | $0 | 0.417 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.417 | $1,510 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.417 | $19 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.417 | $8 |
| **2025** | a | | | | 0 | | $0 | 0.394 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.394 | $1,425 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.394 | $18 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.394 | $8 |
| **2026** | a | | | | 0 | | $0 | 0.371 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.371 | $1,344 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.371 | $17 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.371 | $7 |
| **2027** | a | | | | 0 | | $0 | 0.350 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.350 | $1,268 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.350 | $16 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.350 | $7 |
| **2028** | a | | | | 0 | | $0 | 0.331 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.331 | $1,196 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.331 | $15 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.331 | $6 |
| **2029** | a | | | | 0 | | $0 | 0.312 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.312 | $1,129 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.312 | $14 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.312 | $6 |
| **2030** | a | | | | 0 | | $0 | 0.294 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.294 | $1,065 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.294 | $14 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.294 | $6 |
| **2031** | a | | | | 0 | | $0 | 0.278 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.278 | $1,004 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.278 | $13 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.278 | $5 |
| **2032** | a | | | | 0 | | $0 | 0.262 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.262 | $948 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.262 | $12 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.262 | $5 |
| **2033** | a | | | | 0 | | $0 | 0.247 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.247 | $894 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.247 | $11 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.247 | $5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2034** | a | | | | 0 | | $0 | 0.233 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.233 | $843 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.233 | $11 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.233 | $5 |
| **2035** | a | | | | 0 | | $0 | 0.220 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.220 | $796 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.220 | $10 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.220 | $4 |
| **2036** | a | | | | 0 | | $0 | 0.207 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.207 | $751 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.207 | $10 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.207 | $4 |
| **2037** | a | | | | 0 | | $0 | 0.196 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.196 | $708 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.196 | $9 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.196 | $4 |
| **2038** | a | | | | 0 | | $0 | 0.185 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.185 | $668 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.185 | $9 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.185 | $4 |
| **2039** | a | | | | 0 | | $0 | 0.174 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.174 | $630 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.174 | $8 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.174 | $3 |
| **2040** | a | | | | 0 | | $0 | 0.164 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.164 | $595 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.164 | $8 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.164 | $3 |
| **2041** | a | | | | 0 | | $0 | 0.155 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.155 | $561 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.155 | $7 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.155 | $3 |
| **2042** | a | | | | 0 | | $0 | 0.146 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.146 | $529 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.146 | $7 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.146 | $3 |
| **2043** | a | | | | 0 | | $0 | 0.138 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.138 | $499 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.138 | $6 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.138 | $3 |
| **2044** | a | | | | 0 | | $0 | 0.130 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.130 | $471 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.130 | $6 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.130 | $3 |
| **2045** | a | | | | 0 | | $0 | 0.123 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.123 | $444 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.123 | $6 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.123 | $2 |
| **2046** | a | | | | 0 | | $0 | 0.116 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.116 | $419 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.116 | $5 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.116 | $2 |
| **2047** | a | | | | 0 | | $0 | 0.109 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.109 | $395 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.109 | $5 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.109 | $2 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2048** | a | | | | 0 | | $0 | 0.103 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.103 | $373 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.103 | $5 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.103 | $2 |
| **2049** | a | | | | 0 | | $0 | 0.097 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.097 | $352 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.097 | $5 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.097 | $2 |
| **2050** | a | | | | 0 | | $0 | 0.092 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.092 | $332 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.092 | $4 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.092 | $2 |
| **2051** | a | | | | 0 | | $0 | 0.087 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.087 | $313 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.087 | $4 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.087 | $2 |
| **2052** | a | | | | 0 | | $0 | 0.082 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.082 | $295 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.082 | $4 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.082 | $2 |
| **2053** | a | | | | 0 | | $0 | 0.077 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.077 | $279 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.077 | $4 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.077 | $2 |
| **2054** | a | | | | 0 | | $0 | 0.073 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.073 | $263 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.073 | $3 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.073 | $1 |
| **2055** | a | | | | 0 | | $0 | 0.069 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.069 | $248 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.069 | $3 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.069 | $1 |
| **2056** | a | | | | 0 | | $0 | 0.065 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.065 | $234 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.065 | $3 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.065 | $1 |
| **2057** | a | | | | 0 | | $0 | 0.061 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.061 | $221 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.061 | $3 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.061 | $1 |
| **2058** | a | | | | 0 | | $0 | 0.058 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.058 | $208 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.058 | $3 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.058 | $1 |
| **2059** | a | | | | 0 | | $0 | 0.054 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.054 | $196 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.054 | $3 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.054 | $1 |
| **2060** | a | | | | 0 | | $0 | 0.051 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.051 | $185 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.051 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.051 | $1 |
| **2061** | a | | | | 0 | | $0 | 0.048 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.048 | $175 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.048 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.048 | $1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2062** | a | | | | 0 | | $0 | 0.046 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.046 | $165 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.046 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.046 | $1 |
| **2063** | a | | | | 0 | | $0 | 0.043 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.043 | $156 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.043 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.043 | $1 |
| **2064** | a | | | | 0 | | $0 | 0.041 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.041 | $147 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.041 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.041 | $1 |
| **2065** | a | | | | 0 | | $0 | 0.038 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.038 | $139 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.038 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.038 | $1 |
| **2066** | a | | | | 0 | | $0 | 0.036 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.036 | $131 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.036 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.036 | $1 |
| **2067** | a | | | | 0 | | $0 | 0.034 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.034 | $123 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.034 | $2 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.034 | $1 |
| **2068** | a | | | | 0 | | $0 | 0.032 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.032 | $116 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.032 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.032 | $1 |
| **2069** | a | | | | 0 | | $0 | 0.030 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.030 | $110 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.030 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.030 | $1 |
| **2070** | a | | | | 0 | | $0 | 0.029 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.029 | $104 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.029 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.029 | $1 |
| **2071** | a | | | | 0 | | $0 | 0.027 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.027 | $98 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.027 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.027 | $1 |
| **2072** | a | | | | 0 | | $0 | 0.025 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.025 | $92 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.025 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.025 | $0 |
| **2073** | a | | | | 0 | | $0 | 0.024 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.024 | $87 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.024 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.024 | $0 |
| **2074** | a | | | | 0 | | $0 | 0.023 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.023 | $82 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.023 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.023 | $0 |
| **2075** | a | | | | 0 | | $0 | 0.021 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.021 | $77 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.021 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.021 | $0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2076** | a | | | | 0 | | $0 | 0.020 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.020 | $73 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.020 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.020 | $0 |
| **2077** | a | | | | 0 | | $0 | 0.019 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.019 | $69 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.019 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.019 | $0 |
| **2078** | a | | | | 0 | | $0 | 0.018 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.018 | $65 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.018 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.018 | $0 |
| **2079** | a | | | | 0 | | $0 | 0.017 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.017 | $61 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.017 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.017 | $0 |
| **2080** | a | | | | 0 | | $0 | 0.016 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.016 | $58 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.016 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.016 | $0 |
| **2081** | a | | | | 0 | | $0 | 0.015 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.015 | $55 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.015 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.015 | $0 |
| **2082** | a | | | | 0 | | $0 | 0.014 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.014 | $51 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.014 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.014 | $0 |
| **2083** | a | | | | 0 | | $0 | 0.013 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.013 | $49 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.013 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.013 | $0 |
| **2084** | a | | | | 0 | | $0 | 0.013 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.013 | $46 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.013 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.013 | $0 |
| **2085** | a | | | | 0 | | $0 | 0.012 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.012 | $43 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.012 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.012 | $0 |
| **2086** | a | | | | 0 | | $0 | 0.011 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.011 | $41 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.011 | $1 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.011 | $0 |
| **2087** | a | | | | 0 | | $0 | 0.011 | $0 |
| | b | Gallons | 860000 | 0 | 860000 | $0.0042 | $3,619 | 0.011 | $38 |
| | c | Tons | 0.773558 | 0 | 0.774 | $60.00 | $46 | 0.011 | $0 |
| | d | Lbs | 0.4595845 | 0 | 0.460 | $42.45 | $20 | 0.011 | $0 |
| | | | | | | | Total Present Value of Discounted Benefits Based on Unit Value<br>(Sum of the values in Column (j) for all Benefits shown in table)<br>Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries | | $1,097,525 |

Comments:
a = avoided sewer replacement on Cesar Chavez, Harrison, and Coleridge Streets
b = avoided stormwater treatment costs
c = CO2 sequestration
d = PM10 reduction

# Qualitative Benefits Description

## General Public Recreation

Islais Creek Park is a popular kayak launch site in the City of San Francisco. It is located near the Third Street Bridge Islais Creek crossing. Islais Landing was built in 1998 to improve kayak and canoe access to Islais Creek and San Francisco Bay. Kayaks Unlimited, a community sea-kayaking organization, are approved stewards of the Port-of-San Francisco owned landing. The park is used primarily by kayakers and other non-motorized boaters.

The Islais Creek area is part of the Central Waterfront Area in San Francisco, which is undergoing redevelopment, mixed-use growth and community enhancement, and as a result is becoming an increasingly important recreational resource. Information regarding number of visitors to Islais Creek Park is not readily available because development and increased use is a recent trend. It is therefore unfeasible to quantify the recreational benefits of the park under existing with or without-project conditions. The Cesar Chavez project will protect water quality through decreased stormwater discharge into the combined sewer system, which will reduce flow volumes through the system during wet weather and reduce the potential for combined sewer discharges of primary-level treated effluent into the Bay via the Islais Creek CSD structure. As a result, there will be general public recreation benefits associated with the protection of water quality in the Bay for beneficial uses and avoided costs of water access closures for water contact recreation users. These benefits will be received after storms that would have resulted in potential beach closures due to public health risks and degraded water quality.

## Urban Greening

The area surrounding the Cesar Chavez project area is highly developed, with a large proportion of impermeable surfaces, as wells as catch basins and drains that funnel surface runoff directly into the combined sewer system. The Cesar Chavez project includes implementation of low impact design (LID) stormwater management features along Valencia Street between Cesar Chavez Street and Mission Street. The LID features will increase the ecological function of the landscape and provide both stormwater quantity and quality benefits by decreasing the rate and volume of stormwater entering the combined sewer. The proposed LID features include 30 additional trees planted, 2,100 square feet of bioretention areas and 10,000 square feet of permeable pavement. Hydraulic modeling has shown that the project will reduce the volume of stormwater entering the combined sewer system by 860,000 gallons per year through the implementation of LIDs. These benefits will be received during any storm event that currently generates runoff to the combined sewer system.

In addition to the stormwater benefits, the implementation of these features will also enhance street greening and neighborhood aesthetics. Some of the additional benefits associated with street greening not calculated in the air quality quantification above include reduced energy consumption (building shading and wind block) and increased livability[5]. The Valencia Street LID portion of the project is focused but will serve as a part of San Francisco's ongoing green infrastructure implementation efforts,

[5] The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits. 2010. Center for Neighborhood Technology and American Rivers.

and will expand the coverage of the proposed LID improvements to be implemented along Cesar Chavez Street through the Cesar Chavez Low Impact Development Greening Project. The implementation of LID features along Valencia Street could also present opportunities for demonstrative examples of LID stormwater management features for public education and outreach in San Francisco. All of the benefits will be received upon completion of the project and will be ongoing for the duration of the projects' lifespan.

### Fisheries

The California Office of Environmental Health Hazard Assessment has current health warnings about consuming fish and shellfish from the San Francisco Bay due to elevated levels of pollutants such as mercury, PCBs, and dioxin. Species of higher trophic levels are of particular concern since many of the chemicals of concern bioaccumulate and become greater human health and environmental risks. Most of the fish consumed in the San Francisco Bay Area are typically from trophic levels 3 and up, so there is a significant risk to human health from impaired water quality and fish habitat[6]. The reduction in these pollutants and other chemical concentrations benefits local aquatic communities and their associated fisheries. Treating water to a secondary level of treatment reduces the concentrations of mercury and other chemicals in the water discharged to the Bay[7].

The Cesar Chavez project will reduce the volume of stormwater entering the combined sewer system by 860,000 gallons per year. This reduction in runoff also translates to a potential reduction in the amount of harmful chemicals draining into the San Francisco Bay via water discharged with a wet-weather primary level of treatment in large storm events. The exact amount of all the chemicals and pollutants entering the Bay currently from the Sunnydale project area is not defined and would be prohibitively difficult to determine, so a quantitative analysis is not feasible; however the project effectively demonstrates a reduction in urban runoff and therefore contributes the associated benefits of improved water quality and aquatic habitat. Water quality benefits can be expected to be received immediately. Biological response to improved water quality tends to lag behind chemical improvements, so biological improvement results may not be apparent for several years after implementation. The scale of San Francisco Bay water quality improvements from this project may be focused, but the tendency for these chemicals and metals to bioaccumulate magnifies the impacts of contaminant loading and should be considered as an integrated component of larger Bay improvement efforts.

### Water Quality: Constituents – Mercury

Mercury is a high priority water quality impairment constituent in the San Francisco Bay, where it is a 303(d)-listed pollutant. The Total Maximum Daily Load (TMDL) and mercury water quality objectives are measured in the Bay based on two sets of criteria:

[6] Mercury in San Francisco Bay: Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. 2006. California Regional Water Quality Control Board, San Francisco Bay Region.

[7] Gray, D., Shang, Y., Hake, J.M., De Lange, V.P., Chien, M.H., Gardner, E.R. Konnan, J., Grinbergs, S. 2009. Characterizing the Quality of Effluent and Other Contributory Sources during Peak Wet Weather Events. WERF and IWA Publishing.

1) 0.2mg mercury per kg fish tissue (muscle tissue) to protect people who consume Bay fish, and
2) 0.03mg mercury per kg fish (whole fish, 3-5cm in length) to protect aquatic organisms and wildlife (CRWQCB, 2006).

The high mercury concentrations found within the San Francisco Bay are primarily attributed to mining activities of the past, some of which continue to leach mercury, within the larger Bay watershed. However, urban stormwater runoff contributes 13% of the total mercury to the San Francisco Bay and is the largest source of new, local mercury to the Bay[8]. The San Francisco Southeast Water Pollution Control Plant (SEWPCP), which receives water for secondary treatment from the Cesar Chavez project area, had a discharge of 2.7 kilograms of mercury per year for the years 2000-2003 and was granted a final allocation of 1.6 kilograms per year under the TMDL Basin Plan Amendment[9]. A report by the SFPUC in 2006 indicated an average mercury concentration in combined sewer discharge samples at Islais Creek from 1997 to 2002 and 2005 to 2006 of 0.35 µg/L[10].

Hydraulic modeling has shown that the project will reduce the volume of stormwater entering the combined sewer system by 860,000 gallons per year through the implementation of LIDs. This reduction in runoff not only results in less stormwater pollutant loading into combined flows, but will enable more stormwater to undergo secondary treatment, which significantly reduces mercury concentrations, prior to being discharged. The reduction in mercury will primarily be localized, but will benefit the greater San Francisco Bay because of the tendency for mercury to bioaccumulate in larger, higher trophic level and larger ranged species, and as a component of the efforts to reduce mercury concentrations throughout the Bay. The human health and environmental importance of reducing mercury loading to the San Francisco Bay is outlined in the Fisheries Benefits section above, as well as in the Mercury in San Francisco Bay Basin Plan Amendment for mercury TMDLs[9]. The benefits of reduced mercury loading are expected to begin upon completion of the LID components of the project and will continue for the lifespan of the project LID features.

[8] Information on the San Francisco Bay Mercury TMDL. 2004. Clean Estuary Partnership.
[9] Mercury in San Francisco Bay: Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL) and Proposed Mercury Water Quality Objectives. 2006. California Regional Water Quality Control Board, San Francisco Bay Region.
[10] Monitor to Effectively Characterize Overflow Impacts and the Efficacy of CSO Controls. June 2006. SFPUC.