



CONTRA COSTA CLEAN WATER PROGRAM REASONABLE ASSURANCE ANALYSIS UPDATE

**Submitted in Compliance with Provision C.11.f.iii
and C.12.h.iii**

Prepared for

Contra Costa Clean Water Program

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Project Number: CWR1032

March 2026

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ACRONYMS AND ABBREVIATIONS

BASMAA	Bay Area Stormwater Management Agencies Association
CCCWP	Contra Costa Clean Water Program
g	gram
GI	Green Infrastructure
GSI	Green Stormwater Infrastructure
HRU	Hydrologic Response Unit
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
O&M	Operations and Maintenance
PCBs	Polychlorinated Biphenyls
PG&E	Pacific Gas and Electric
RAA	Reasonable Assurance Analysis
RWSM	Regional Watershed Spreadsheet Model
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SFEI	San Francisco Estuary Institute
SWMM	Stormwater Management Model
TMDL	Total Maximum Daily Load
WLA	Wasteload Allocation
WY	Water Year

1. INTRODUCTION

This report presents the results of the reasonable assurance analysis (RAA) for Contra Costa County required by the Municipal Regional Permit (MRP) for urban stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Order No. R2-2022-0018). MRP Provisions C.11.f, and C.12.h require an RAA for the PCBs and mercury control measures that are described in the PCBs Control Measure Plan and the Mercury Control Measure Plan Update (Section 2 – the PCBs Control Measure Plan and Section 3 – the Mercury Control Measure Plan). The methodologies for estimating load reductions are described below with further details in Appendix A and Appendix B.

2. METHODOLOGY

2.1 Overview

The approach used to estimate the load reductions resulting from implementation of the PCBs Control Measure Plan and the Mercury Control Measure Plan includes a number of different model components. The methodology is consistent with the *Bay Area RAA Guidance Document* (BASMAA, 2017).

The model components include:

- Baseline Pollutant Loading Model – the baseline pollutant loading model was not updated for this revised analysis. The baseline model is a continuous simulation¹ hydrology model combined with pollutant loading inputs to obtain the average annual loading of PCBs and mercury across Contra Costa County during the TMDL baseline period (i.e., 2003 – 2005, see BASMAA, 2017). See Section 3 for the baseline model results.
 - Hydrology – this model component produces average annual runoff across Contra Costa County for the period of record using a hydrologic response unit (HRU) approach. The HRU approach involves modeling various combinations of land surface features (i.e., imperviousness, underlying soil characteristics, slope, etc.) present within Contra Costa County for a unit area drainage catchment.
 - Water Quality – the hydrology output is combined with average annual concentrations estimated by the Regional Monitoring Program’s Regional Watershed Spreadsheet Model (RWSM; SFEI, 2018) developed by SFEI to produce average annual PCBs and mercury loading for the period of record.

¹ Continuous simulation models calculate outputs (e.g., runoff) “continuously”, i.e., for many time steps over a long-term period of record (e.g., every 10 minutes for 10 years). Long-term “continuous” input data (e.g., hourly rainfall) is required. This is contrasted with design-event simulations which model a single rainfall event, e.g., a 24-hour storm with a 10-year recurrence frequency.

- GSI Performance Models – GSI performance models were developed to represent load reductions resulting from implementation of GSI.
- Source Control Measure Calculations – Calculation methods for estimating load reduction associated with implementation of the source control measures identified in the PCBs Control Measure Plan and the Mercury Control Measure Plan, as established in the approved *Source Control Load Reduction Accounting for Reasonable Assurance Analysis* report (BASMAA, 2022, provided in Appendix B).
- Future Estimated Conditions – the RAA future conditions incorporate future land use changes and control measure implementation that would result in pollutant load reduction. Future conditions were estimated to model load reductions at the end of MRP 4.0 (i.e., 2032) and extrapolated to estimate the compliance year. These include the following:
 - Future Land Use – changes to land use as a result of new development and redevelopment and the associated reduction in pollutant loading (i.e., with newer building materials and practices) is represented.
 - Future GSI Implementation – the GSI performance model output is applied to areas to be treated by GSI in the future based on the Permittees’ identified planned projects from the 2020 Green Infrastructure Plans and the *Contra Costa County Old Industrial Area Control Measure Plan* (OIA-CMP) (CCCWP, 2024).
 - Source Control Measure Implementation – Estimated future source control measure load reductions is extrapolated based on the incidence and location of existing control measures.

These components are summarized in the following sections.

2.2 Baseline

The baseline pollutant loading model is a representation of the loading of PCBs and mercury across the County during the TMDL baseline period (i.e., 2003 – 2005, see BASMAA, 2017). The baseline model utilizes an HRU approach to estimate runoff across the County. Generic HRUs, characterized by varying the values of specific identified parameters within a defined representative range, were modeled using USEPA’s Stormwater Management Model (SWMM). HRU parameters varied included precipitation and evaporation, slope, underlying soil type (i.e., subsurface infiltration rate) and compaction (i.e., developed versus undeveloped areas), and imperviousness. Continuous simulation HRU models were run on an hourly timestep for the identified baseline period of record (water years [WYs] 2000 – 2009).

An average annual runoff volume per acre was obtained for each HRU through the continuous simulation runs. The average annual runoff volume per acre associated with each specific HRU was multiplied by the area represented by that HRU within the entire area for analysis (i.e., across the county, estimated using geospatial data). Watershed-based drainage routing was accounted for through calibration efforts. Calibration of the generic HRU models was conducted on the average annual discharge volume for WYs 2000-2009, utilizing available stream flow

records. The objective of the calibration was to reasonably match the average annual runoff volume for this 10-year period (i.e., within the bounds included in BASMAA (2017). Additional details regarding the calibration efforts are provided in Appendix H of the 2020 Contra Costa County PCBs and Mercury Control Measure Plan and Reasonable Assurance Analysis (CCCWP, 2020).

To obtain pollutant loading, average annual concentrations estimated by the RWSM (SFEI, 2018), for each land use category (i.e., Old Industrial, Old Urban Commercial/Transportation, Old Urban Residential, New Urban, and Open Space) are multiplied by the calibrated average annual runoff volume estimated using the HRU approach. The average annual PCBs and mercury loading for the baseline period of record was validated using available in-stream concentration data, as described in Appendix H of the 2020 Contra Costa County PCBs and Mercury Control Measure Plan and Reasonable Assurance Analysis (CCCWP, 2020).

A flow chart representing the baseline loading model is provided in Figure 2-1 below.

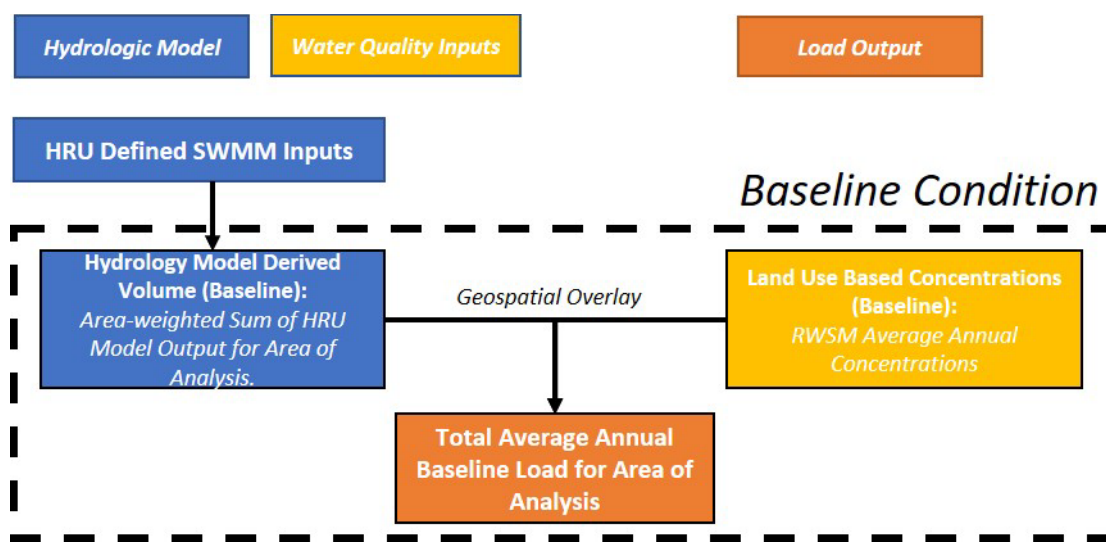


Figure 2-1: Baseline Condition Model Flow Chart

2.3 Loads Reduced

Loads reduced from baseline are estimated based on projected land use changes and control measure implementation. To calculate pollutant load reductions associated with land use changes, GSI, and source control implementation in the future, the difference between the pollutant loading in the baseline and future condition were calculated. Future conditions were estimated to model load reductions at the end of MRP 4 (i.e., 2032) and extrapolated to the estimate the compliance year. Loads reduced resulting from implementation of control measures are estimated through different methods depending on control measure type. Details relating to load reductions resulting from land use changes versus those from control measures are provided in the following sections.

2.3.1 Load Reduction Resulting from Land Use Changes

Land use-based pollutant loading was based on changes to the land use through new development and redevelopment that has occurred or is projected to occur since the 2003-2005 baseline. To forecast future private development area, CCCWP used the output of UrbanSim², a model developed by the Urban Analytics Lab at the University of California under contract to the Bay Area Metropolitan Transportation Commission (MTC). The UrbanSim modeling system was developed to support the need for analyzing the potential effects of land use policies and infrastructure investments on the development and character of cities and regions. The Bay Area's application of UrbanSim was developed specifically to support the development of Plan Bay Area, the Bay Area's Sustainable Communities planning effort.

MTC forecasts growth in households and jobs and uses the UrbanSim model to identify development and redevelopment sites to satisfy future demand. Model inputs include parcel-specific zoning and real estate data; model outputs show increases in households or jobs attributable to specific parcels. The methods and results of the Bay Area UrbanSim model have been approved by both MTC and Association of Bay Area Governments Committees for use in transportation projections and the regional Plan Bay Area development process.

In 2020 the CCCWP process used outputs from the Bay Area UrbanSim model to map parcels predicted to undergo development or redevelopment in each Contra Costa jurisdiction at the time increments specified in the MRP (i.e., 2020, 2030, and 2040). The resulting maps were reviewed by Permittee staff for consistency with local knowledge and local planning and economic development initiatives and revised as needed.

For this RAA update analysis, the mapped parcels predicted to undergo development or redevelopment were reclassified based on the updated time increments specified in the MRP that fall within the future conditions model, the end of MRP 4.0 (i.e., 2032). Any predicted parcels that were not developed or redeveloped by 2025 were removed from the maps.

If projected new development and redevelopment is assumed to alter the imperviousness of parcels identified for development, the HRU assigned at the parcel scale was revised from the baseline condition to represent the new imperviousness (no other HRU variables would be anticipated to change) in the future condition. Similarly, the overlying RWSM land use category designation was updated from the baseline condition to reflect new land uses from new development and redevelopment. Updated land use-based pollutant loading was then calculated for the future conditions, using the applicable updated HRU and RWSM land use category assignments.

2.3.2 Load Reductions Resulting from GSI Implementation

Load reduction through implementation of GSI facilities was estimated through the methods described as part of the *Quantitative Relationship between GSI Implementation and PCBs/Mercury Load Reductions Report* (CCCWP, 2018). The POC load reductions through GSI

² <http://www.urbansim.com/>

were developed through a combination of hydraulic modeling of GSI facilities combined with empirically derived effluent concentration estimates. The annual estimate of pollutant load reduction from the modeled drainage area is equivalent to the difference between the influent load and the sum of the pollutant load that bypasses the GSI facility and the effluent load. The effluent load is calculated as the proportion of runoff that is treated by the GSI facility multiplied by an effluent concentration. Water quality performance data from selected, representative studies were used to determine a method to predict effluent concentrations in stormwater following treatment through a bioretention GSI facility. A flow chart representing the GSI load reduction modeling is provided in *Quantitative Relationship between GSI Implementation and PCBs/Mercury Load Reductions Report* (CCCWP, 2018).

GSI implementation levels corresponding to current conditions (used in estimating the ultimate TMDL compliance date) were modeled using the projects in the CCCWP ArcGIS Online (AGOL) tracking database as of June 30, 2025. GSI implementation levels corresponding to future conditions (i.e., during MRP 4.0 and post-MRP 4.0) were estimated based on Permittee planned project projections. In addition to identifying new planned projects the permittees reviewed and refined planned project boundaries that were rated “High-Planned” from the 2020 GI Plan and planned projects included in the 2024 OIA-CMP. The pollutant loading resulting from each of the GSI implementation scenarios was calculated by first applying the updated land use loading. Then, pollutant load reductions resulting from implementation of GSI were applied to identified GSI drainage areas (i.e., both redevelopment areas, where land uses are assumed to change, and GSI retrofit areas, where land uses are not assumed to change) to obtain a revised total pollutant loading for those land surfaces. Resulting pollutant loading for areas identified as draining to GSI and areas not draining to GSI were combined geospatially to obtain the pollutant loading associated with future GSI implementation.

2.3.3 Load Reductions Resulting from Implementation of Source Controls

Pollutant load reductions from the source controls described in the implementation plans are incorporated into future RAA estimates for MRP 4.0 (i.e., 2032) and extrapolated to estimate the TMDL compliance year. The load reduction calculation assumptions for the future conditions are summarized in Table 2-1. The calculation methods used to estimate load reduction are those described in the *Source Control Load Reduction Accounting for Reasonable Assurance Analysis* (BASMAA, 2022, provided in Appendix B). The resulting load reductions from source controls implemented are combined with the land use and GSI load reduction estimations to get the total estimated load reduction in the future.

Table 2-1: PCBs and Mercury Load Reduction Calculation Assumptions

Control Measure	Load Reduction Calculation Assumptions for Future Implementation
Source Property Identification and Abatement	All source properties referred during MRP 3.1 will be abated by 2037. All source properties referred during MRP 4 will be abated by 2042.
Moderate Property Control Program	All moderate properties identified during MRP 3.1 will be controlled by 2027. All moderate properties identified during MRP 4 will be controlled by 2032.
Operations and Maintenance	Assumed the current levels of storm drain line cleanout and enhanced street sweeping continues until the TMDL compliance date. No other targeted O&M projects in old industrial areas were assumed.
Moderate Area Treatment Retrofit	No load reductions were assumed for this control measure.
Redevelopment or Retrofit with GSI	Extrapolated the load reduction from 2022 - 2032 after 2032 until the WLA is met.
Full Trash Capture Treatment Control	Assume no new implementation after 2027; efficiency factor for inlet-based FTC devices is 18% and for large FTC devices is 20%.
Diversion to POTW	No load reductions were assumed for this control measure.
Controlling PCBs in Electrical Utilities	Maximum for the County = 205 g/yr. Linear annual rate of removal since 2005; all PCBs-containing OFEE removed by 2040.
Manage PCBs-Containing Building Materials	All credit taken during MRP 2 and thus no further credit taken.
Controlling PCBs from Bridges and Overpasses	Program started in MRP 4.0 and is fully implemented by 2080; assumed linear rate of load reductions 2027-2080.

3. BASELINE LOADS AND LOAD REDUCTION GOALS

3.1 PCBs

3.1.1 PCBs Baseline Load

The results of the RAA baseline modeling for PCBs are presented for Contra Costa County in Table 3-1 below.

Table 3-1: RAA Model Baseline Loading Estimates – PCBs

RWQCB Region	Above/Below Dam	Permit	Baseline Load Contra Costa County (kg/yr)
Region 2	Below Dam	MRP ¹	1.73
Region 2	Below Dam	NPDES ²	0.62
Region 2	Below Dam	Phase II ³	0.01
Region 2	<i>TMDL Baseline</i>	<i>TMDL Baseline</i>	2.36
Region 2	Above Dam	MRP ¹	0.04
Region 2	Above Dam	NPDES ²	<0.01
Region 2	Above Dam	Phase II ³	0
Region 5	Below Dam	MRP ¹	0.13
Region 5	Below Dam	NPDES ²	0.01
Region 5	Below Dam	Phase II ³	<0.01
Region 5	Above Dam	MRP ¹	<0.01
Region 5	Above Dam	NPDES ²	0
Region 5	Above Dam	Phase II ³	0
County-wide	County-wide	Total	2.55

¹ Municipal Regional Permit permitted areas, along with IGP facilities and facilities with individual NPDES Stormwater Industrial permits.

² Major and Non-Major dischargers with individual NPDES permits. See Appendix A of Appendix A of the 2020 Contra Costa County PCBs and Mercury TMDL Control Measure Plan and Reasonable Assurance Analysis (CCCWP, 2020).

³ Phase II General Permit permittees. See Appendix A of Appendix A of the 2020 Contra Costa County PCBs and Mercury TMDL Control Measure Plan and Reasonable Assurance Analysis (CCCWP, 2020).

The countywide baseline load below dams estimated using the RAA model is 2.36 kg/yr. The baseline load estimated for the Permittees after deducting the estimated baseline load for the NPDES dischargers within the County is 1.73 kg/yr. This baseline load is used to establish the PCBs TMDL load reduction goal described below.

3.1.2 TMDL Attainment Load Reduction Goal (2030)

Calculations were conducted to develop the PCBs load reduction goals as described in the *Bay Area RAA Guidance Document* (BASMAA, 2017). The calculation methodology is summarized below.

$$LR_{TMDLgoal} = \text{Baseline} - \text{WLA (kg/yr)}$$

Where:

$$LR_{TMDLgoal} = \text{The TMDL load reduction goal (kg/yr)}$$

$$\text{Baseline} = \text{The baseline pollutant loading as calculated through the RAA}$$

$$\text{WLA} = \text{The population-based wasteload allocation for Contra Costa County}$$

The TMDL population-based wasteload allocation for Contra Costa County is 0.3 kg/yr. This wasteload allocation must be distributed between the MRP permittees and other permitted stormwater dischargers (i.e., individual NPDES permittees and Phase II permittees). The

wasteload allocations calculated to reflect the relative percentage of the estimated baseline loads are provided in Table 3-2.

For example, as shown in Table 3-1, the MRP Permittees baseline load is estimated to be 1.73 kg/yr, which represents 73% of the total baseline load below dams (i.e., $1.73/2.36 \times 100 = 73\%$). Thus, the PCBs wasteload allocation for the MRP Permittees is equal to 73% of 0.3 kg/yr (i.e., $0.73 \times 0.3 \text{ kg/yr} = 0.22 \text{ kg/yr}$)

Table 3-2: TMDL Wasteload Allocations for Contra Costa County

Stormwater Discharger within TMDL Baseline Area¹	Percentage of Baseline Load (%)	PCBs WLA (kg/yr)
MRP Permittees	73%	0.22
NPDES Permittees	26%	0.08
Phase 2 Permittees	1%	0.002
Contra Costa County	100%	0.3

¹ All SFBRWQCB Region 2, above dams.

WLA – Wasteload Allocation

Using the calculated MRP Permittee proportion of the wasteload allocation and RAA-calculated baseline load, the load reduction goal is estimated to be 1.51 kg/yr (i.e., $1.73 \text{ kg/yr} - 0.22 \text{ kg/yr} = 1.51 \text{ kg/yr}$).

3.2 Mercury

3.2.1 Mercury Baseline Loads

The results of the RAA baseline modeling for mercury are presented for Contra Costa County in Table 3-3 below. The countywide baseline load estimated with the RAA model is 6.25 kg/yr. The baseline load estimated for the Permittees after deducting the estimated baseline load for the NPDES dischargers within the County is 6.02 kg/yr. This baseline load is used to establish the mercury TMDL load reduction goal described below.

Table 3-3: RAA Model Baseline Loading Estimates – Mercury

RWQCB Region	Above/Below Dam	Permit	Baseline Load Contra Costa County (kg/yr)
Region 2	Below Dam	MRP¹	6.02
Region 2	Below Dam	NPDES ²	0.20
Region 2	Below Dam	Phase 2 ³	0.03
Region 2	<i>TMDL Baseline</i>	<i>TMDL Baseline</i>	6.25
Region 2	Above Dam	MRP ¹	1.59
Region 2	Above Dam	NPDES ²	0.002
Region 2	Above Dam	Phase 2 ³	0.00
Region 5	Below Dam	MRP ¹	1.02
Region 5	Below Dam	NPDES ²	0.004
Region 5	Below Dam	Phase 2 ³	0.001
Region 5	Above Dam	MRP ¹	0.35
Region 5	Above Dam	NPDES ²	0.00
Region 5	Above Dam	Phase 2 ³	0.00
County-wide	County-wide	Total	9.23

¹ Municipal Regional Permit permitted areas, along with IGP facilities and facilities with individual NPDES Stormwater Industrial permits.

² Major and Non-Major dischargers with individual NPDES permits. See Appendix A of the 2020 Contra Costa County PCBs and Mercury TMDL Control Measure Plan and Reasonable Assurance Analysis (CCCWP, 2020).

³ Phase II General Permit permittees. See Appendix A of the 2020 Contra Costa County PCBs and Mercury TMDL Control Measure Plan and Reasonable Assurance Analysis (CCCWP, 2020).

3.2.2 TMDL Attainment Load Reduction Goal (2028)

The mercury WLA for Contra Costa County is 11 kg/yr, while the estimated baseline load for the entire county below dams is only 6.25 kg/yr. Thus, the results of the RAA indicate that the TMDL wasteload allocation has been achieved.

4. REVISED ESTIMATE OF LOADS REDUCED

4.1 Loads Reduced – PCBs

The total estimated annual PCBs loads reduced through implementation of control measures outlined in the PCBs Control Measure Plan by June 30, 2027 (i.e., the end of MRP 3.1), June 30, 2032 (i.e., the end of MRP 4.0), and 2060 is provided in Table 4-1.

Table 4-1: Summary of PCBs Load Reductions Achieved through Control Measure Implementation

Control Measure	PCBs Load Reduction (kg/yr) by: 2003-2027	PCBs Load Reduction (kg/yr) by: 2027-2032	PCBs Load Reduction (kg/yr) by: Total by 2060
1. Source Property Identification and Abatement	0.31	0.14	0.48
2. Moderate Property Control Program	0.00	0.01	0.01
3. Operations and Maintenance	0.03	0.03	0.06
4. Redevelopment or Retrofit with GSI	0.12	0.04	0.30
5. Full Trash Capture Treatment Control	0.06	-	0.06
6. Diversion to POTW	-	-	-
7. Controlling PCBs in Electrical Utilities	0.13	0.03	0.21
8. Managing PCBs-Containing Building Materials	0.37	-	0.37
9. Controlling PCBs from Bridges and Overpasses	0.00	0.00	0.02
Total Load Reduced	1.02	0.25	1.51
Load Reduction Goal	1.51	1.51	1.51
Cumulative Remaining Load to be Reduced	0.49	0.24	0

4.1.1 TMDL Wasteload Allocation

As can be seen in Table 4-1, the required load reduction to achieve the TMDL wasteload allocation (1.51 kg/yr) is not met by the TMDL compliance date of 2032 but is predicted to be achieved by 2060. The RAA estimate of achieving the PCBs TMDL wasteload allocation by 2060 is based on many assumptions, and while the RAA demonstrates that Contra Costa will not achieve the PCBs load reduction goal before 2060, this goal may not be achieved until well after 2060.

The RAA results shown in Table 4-1 demonstrate that the majority of loads (90%) are reduced through four control measures: Source Property Identification and Abatement, Redevelopment or Retrofit with GSI, Controlling PCBs in Electrical Utilities, and Managing PCBs-Containing Building Materials during Demolition.

Public project implementation will depend on funding availability. Funding for implementation of public GSI retrofit projects will be obtained by the municipal agency, partnerships of agencies, or other stakeholder project sponsors working to implement the identified projects. Economic or socio-economic impacts and political shifts may cause increases or decreases in the amount of private investment and public funds available for development and control measure

implementation, and/or changes in the ability to provide services that are needed for implementation.

4.2 Loads Reduced – Mercury

The mercury loads reduced are estimated by applying the loads accounting methodology for mercury to the treatment control measures of GSI, full trash capture, and O&M is provided in Table 4-2. Table 4-2 shows that the current implementation level is about 0.33 kg/yr reduction, anticipated to increase to about 0.61 kg/yr by 2060. The majority of this predicted load reduction is achieved through Redevelopment or Retrofit with GSI (57%).

Note that these estimated load reductions do not account for loads reduced by the Mercury Load Avoidance and Reduction source control measure. CCCWP will continue to annually compile and report the number of mercury-containing products collected at household hazardous waste facilities. Translation of that collection information to loads reduced from urban stormwater discharges is challenging and may not be necessary to show attainment of the mercury TMDL.

Table 4-2: Summary of Mercury Load Reductions Achieved through Control Measure Implementation

Control Measure	Mercury Load Reduction (kg/yr) by: 2003-2027	Mercury Load Reduction (kg/yr) by: 2027-2032	Mercury Load Reduction (kg/yr) by: Total by 2060
1. Operations and Maintenance	0.06	0.04	0.12
2. Redevelopment or Retrofit with GSI	0.13	0.05	0.35
3. Full Trash Capture Treatment Control	0.14	-	0.14
Total Load Reduced	0.33	0.09	0.61

4.2.1 TMDL Wasteload Allocation

In contrast to PCBs, the mercury load reduction goal can't be calculated because the RAA indicates that the WLA for mercury in Contra Costa County stormwater has already been achieved. As is stated in Section 3.2.2 above, the mercury WLA for Contra Costa County is 11 kg/yr, while the estimated baseline load for the entire county below dams is only 6.25 kg/yr. Thus, the results of the RAA indicate that the TMDL wasteload allocation has been achieved.

The finding that the TMDL allocation has been “achieved” by recalculating the baseline does not lead CCCWP to conclude that mercury control measures are unnecessary. The main factor that drives the change on recalculation is eliminating areas above dams and areas subject to other permits. CCCWP assumes that the recalculated current load would need to be compared to a TMDL allocation developed based on similar assumptions. This recalculation of baseline for mercury is a nuance with no substantive effect on implementation, because of the assumption that achieving the PCBs WLA will lead to achieving the mercury WLA

4.3 RAA Modeling Uncertainty

As summarized in the RAA Guidance Document (BASMAA, 2017), according to USEPA's Guidance on the Development, Evaluation, and Application of Environmental Models (USEPA Model Guidance, 2009), model uncertainty describes the lack of knowledge about models, parameters, constants, data, and beliefs. The USEPA Model Guidance identifies two types of uncertainty related to models: model framework uncertainty, related to the scientific soundness of the model, and data uncertainty, arising from measurement errors, analytical imprecision, and limited data sample sizes. The methods and assumptions used for the analysis and described in detail in the appendices were developed with consideration of available data. The methods for developing baseline loading and GSI load reduction estimates went through a rigorous third-party peer review process. The source control load reduction calculations methods presented in Appendix B have been accepted by the SFBRWQCB. Therefore, the methods are considered to be reasonably rigorous given the data and resources available, and the primary source of uncertainty for these computational methods is expected to be data uncertainty.

The USEPA Model Guidance (USEPA, 2009) describes the three components that affect data uncertainty:

- Accuracy – the closeness of a measured or computed value to its “true” value.
- Variability – data differences arising from true heterogeneity or diversity in model parameters and their underlying input datasets.
- Precision – the quality of being reproducible in outcome or performance.

Due to natural variability, data limitations affect both accuracy and precision, resulting in higher data uncertainty. Because of this, data limitations will also inform the complexity of the model.

In addition, as indicated in the USEPA RAA Guide (USEPA, 2017), calibration and validation can be used to manage model uncertainty, though data limitations will still cause uncertainty in model output. Because of this, the USEPA RAA Guide suggests that it is important to update RAA modeling tools over time as additional data become available.

5. REFERENCES

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