PCBs from Electrical Utilities in San Francisco Bay Area Watersheds Stressor/Source Identification (SSID)

Prepared in support of provision C.8.e.iii of NPDES Permit # CAS612008

Project Work Plan

Prepared for:
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1.0 Introduction

This work plan supports the requirement to implement a Stressor/Source Identification (SSID) Project as required by Provision C.8.e.iii of the San Francisco Bay (Bay) Region Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Stormwater Permit (MRP) (Order No. R2-2015-0049, SFRWQCB 2015). Per MRP Provision C.8.e.ii, the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC)[1] members are working to initiate eight SSID projects during the five-year term of the MRP (i.e., 2016 – 2020). The RMC programs have agreed that seven SSID projects will be conducted to address local needs (for Santa Clara, Alameda, San Mateo, Contra Costa, Fairfield/Suisun and Vallejo counties), and one project (this project) will be conducted regionally (on behalf of all RMC members). SSID projects follow-up on monitoring conducted in compliance with MRP Provision C.8 (or monitoring conducted through other programs) with results that exceed trigger thresholds identified in the MRP. Trigger thresholds are not necessarily equivalent to Water Quality Objectives (WQOs) established in the San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan) (SFRWQCB, 2017) by the San Francisco Bay Regional Water Quality Control Board (SF Bay Water Board); however, sites where triggers are exceeded may indicate potential impacts to aquatic life or other beneficial uses.

This SSID work plan describes the steps that will be taken to investigate sources of polychlorinated biphenyls (PCBs) from electrical utility equipment in watersheds draining to the San Francisco Bay Basin. BASMAA will implement the work plan as a regional project. BASMAA retained EOA, Inc., of Oakland, CA to develop this work plan and implement the SSID project under the direction of a BASMAA Project Management Team (PMT). All work on this project is supported by funding provided by BASMAA.

1.1 Overview of SSID Project Requirements

SSID projects focus on taking action(s) to identify and reduce sources of pollutants, alleviate stressors, and address water quality problems. MRP Provision C.8.e.iii requires SSID projects to be conducted in a stepwise process, as described below.

Step 1: Develop a work plan that includes the following elements:

- Define the water quality problem (e.g., magnitude, temporal extent, and geographic extent) to the extent known;
- Describe the SSID project objectives, including the management context within which the results of the investigation will be used;
- Consider the problem within a watershed context and examine multiple types of related indicators, where possible (e.g., basic water quality data and biological assessment results);

[1] The BASMAA RMC is a consortium of San Francisco Bay Area municipal stormwater programs that joined together to coordinate and oversee water quality monitoring and several other requirements of the MRP. Participating BASMAA members include the Alameda Countywide Clean Water Program (ACCWP), Contra Costa Clean Water Program (CCCWP), Fairfield-Suisun Urban Runoff Management Program (FSURMP), San Mateo Countywide Water Pollution Prevention Program (SMCWPPP), Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), and City of Vallejo and Vallejo Flood and Wastewater District (formerly Vallejo Sanitation and Flood Control District).

- List potential causes of the problem (e.g., biological stressors, pollutant sources, and physical stressors);
- Establish a schedule for investigating the cause(s) of the trigger stressor/source which begins upon completion of the work plan. Investigations may include evaluation of existing data, desktop analyses of land uses and management actions, and/or collection of new data; and
- Establish the methods and plan for conducting a site-specific study (or non-site specific if the problem is widespread) in a stepwise process to identify and isolate the cause(s) of the trigger stressor/source.

Step 2: Conduct SSID investigations according to the schedule in the work plan and report on the status of the SSID investigation annually in the Urban Creeks Monitoring Report (UCMR) that is submitted to the SF Bay Water Board on March 31 of each year.

Step 3: Follow-up actions:

- If it is determined that discharges to the municipal separate storm sewer system (MS4) contribute to an exceedance of a water quality standard (WQS) or an exceedance of a trigger threshold such that the water body's beneficial uses are not supported, submit a report in the UCMR that describes Best Management Practices (BMPs) that are currently being implemented and additional BMPs that will be implemented to prevent or reduce the discharge of pollutants that are causing or contributing to the exceedance of WQS. The report must include an implementation schedule.
- If it is determined that MS4 discharges are not contributing to an exceedance of a WQS, the SSID project may end. The Executive Officer must concur in writing before an SSID project is determined to be completed.
- If the SSID investigation is inconclusive (e.g., the trigger threshold exceedance is episodic or reasonable investigations do not reveal a stressor/source), the Permittee may request that the Executive Officer consider the SSID project complete.

1.2 SSID Work Plan Organization

This work plan fulfills **Step 1** of the SSID process described above in Section 1.1. It describes the steps that will be conducted to investigate electrical utility equipment as a source of PCBs to the MS4 in watersheds draining to the Bay. The remainder of this work plan is organized according to the required elements described in Step 1:

Section 2.0 Problem Definition, Study Objectives, and Regulatory Background

Section 3.0 Study Area, Existing Data, and Potential Causes of Water Quality Problem

Section 4.0 SSID Investigation Approach and Schedule

Section 5.0 References

2.0 Problem Definition, Study Objectives, and Regulatory Background

2.1 Problem Definition

Fish tissue monitoring in the Bay has revealed the bioaccumulation of PCBs in Bay sportfish at levels thought to pose a health risk to people consuming these fish. As a result, in 1994, the state of California issued a sport fish consumption advisory cautioning people to limit their consumption of fish caught in the Bay. The advisory led to the Bay being designated as an impaired water body on the Clean Water Act (CWA) "Section 303(d) list" due to elevated levels of PCBs. In response, in 2008, the SF Bay Water Board adopted a Total Maximum Daily Load (TMDL) water quality restoration program targeting PCBs in the Bay[2]. The general goals of the TMDL are to identify sources of PCBs to the Bay, implement actions to control the sources, restore water quality, and protect beneficial uses. The PCBs TMDL estimates baseline loads to the Bay from various source categories. The largest source category, at 20 kilograms (kg) per year, was estimated to be stormwater runoff. This category includes all sources to small tributaries draining to the Bay. The PCBs TMDL indicates that a 90% reduction in PCBs from stormwater runoff to the Bay is needed to achieve water quality standards and restore beneficial uses. The TMDL states that the wasteload allocation for stormwater runoff of 2 kg per year shall be achieved within 20 years (i.e., by March 2030). The PCBs TMDL is being implemented through NPDES permits to discharge stormwater issued to municipalities and industrial facilities in the Bay Area (e.g. the MRP).

This SSID project was triggered by monitoring conducted over the past 15+ years by BASMAA members that demonstrates municipal stormwater runoff is a source of PCBs to the Bay. PCBs are a group of persistent organic pollutants that were historically used in many applications, including electrical utility equipment and caulks and sealants used in building materials. However, the greatest use by far was in electrical equipment such as transformers and capacitors (McKee et al. 2006). Existing electrical utility equipment, which is often located in public rights-of-way (ROWs), may still contain PCBs that can be released to the MS4 when spills and leaks occur. Due to past leaks or spills of PCBs oil from electrical equipment, properties owned and operated by electrical utilities may potentially have elevated concentrations of PCBs in surrounding surface soils that can be released to the MS4. Because the cumulative releases of PCBs-laden soils from these properties, and spills or leaks of PCBs oils from electrical equipment to MS4s across the Bay Area may occur at levels that exceed the 2 kg per year TMDL waste load allocation (see Section 3.2.3), this potential source of PCBs may limit the ability of municipalities to meet the goals of the PCBs TMDL for the Bay. Therefore, this potential source warrants further investigation.

Electrical utility applications present special challenges for source identification and abatement[3] due to the quantity of equipment and facilities, their dispersed nature, and difficulty in sampling discharges when they occur. In addition, municipalities lack control over these properties and

[2] The PCBs TMDL was approved by the US Environmental Protection Agency (USEPA) on March 29, 2010 and became effective on March 1, 2010.

[3] Source identification and abatement is one type of stormwater control measure that Permittees use to reduce loads of PCBs in urban runoff. This control measure involves investigations of properties with elevated PCBs in stormwater or sediment to identify sources that contribute a disproportionate amount of PCBs to the MS4, and cause the properties to be abated, or refer the properties to the SF Bay Water Board or other regulatory authority for follow-up investigation and abatement. This control measure is described in more detail in the BASMAA Interim Accounting Methodology for TMDL Loads Reduced (BASMAA 2017).

equipment. Permittees have no jurisdiction over many large electrical utilities and therefore no control over the cleanup of PCBs-containing spills (e.g., dielectric fluids from transformers), or prompt notification when they happen. Release of PCBs from electrical utility applications has proved particularly difficult to document, quantify or control when private utility companies such as Pacific Gas and Electric, (PG&E) are involved. To date, neither Permittees nor the Region 2 Water Board have been able to verify that a sound and transparent cleanup protocol is used consistently by PG&E for PCBs spills from their electrical utility equipment and properties across Bay Area cities. Moreover, current state and federal regulatory levels for reporting and cleanup of PCBs spills (e.g., cleanup goals for soils) are higher than cleanup levels recommended by the SF Bay Water Board to meet the objectives of the PCBs TMDL (SFBRWQCB 2016). These differences create potential missed opportunities to cleanup spills to the more stringent levels that are more consistent with the PCBs TMDL requirements, and for Permittees to report the associated PCBs load reductions via the MRP load reduction tracking and reporting processes.

Due to these constraints, it is not feasible or appropriate for municipalities to develop and implement PCBs control and reporting programs for electrical utility companies. Therefore, municipalities will need to work with the SF Bay Water Board to investigate electrical utility operations. The overall goal of this project is to gather the information needed and provide justification for the SF Bay Water Board to compel the utilities to develop and implement improved procedures and practices that will reduce releases of PCBs to stormwater runoff.

2.2 SSID Project Objectives

The overall goal of this SSID project is to investigate electrical utility equipment as a source of PCBs to urban stormwater runoff and identify appropriate actions and control measures to reduce this source. Building on the information presented by SCVURPPP (2018), this project is designed to achieve the following three objectives:

1. Gather information from Bay Area utility companies to improve estimates of current PCBs loadings to MS4s from electrical utility equipment, and document current actions conducted by utility companies to reduce or prevent release of PCBs from their equipment;
2. Identify opportunities to improve spill response, cleanup protocols, or other programs designed to reduce or prevent releases of PCBs from electrical utility equipment to MS4s;
3. Develop an appropriate mechanism for municipalities to ensure adequate clean-up, reporting and control measure implementation to reduce urban stormwater loadings of PCBs from electrical utility equipment.

A possible outcome of this SSID project is a recommendation that Bay Area municipalities submit a referral to designate electrical utility equipment and properties as a *Categorical Source*, which is a type of source property as described in more detail in the BASMAA Interim Accounting Methodology for TMDL Loads Reduced (BASMAA, 2017). A *Categorical Source* designation would facilitate development of a regional approach to abate this source under the regulatory authority of the SF Bay Water Board. The *Categorical Source* designation was developed specifically to address potential sources of PCBs that are widespread and distributed across multiple jurisdictions, such as electrical utility applications. MRP Permittees, as a group, can refer an entire source category to the SF Bay Water Board. Although local agencies may still identify and refer individual electrical utility properties to the Water Board for abatement, addressing these facilities and equipment as a *Categorical Source* may prove to be a more effective and efficient way to reduce PCBs loads from this source category. The information gained during this project will also provide data that municipalities can use to develop a

methodology to account for PCBs load reductions that can be achieved through implementation of a regional control measure program for electrical utilities.

2.3 Management Questions

This SSID project will address a number of key management questions regarding electrical utility applications as sources of PCBs to MS4s, including:

1. What is the current magnitude and extent of PCBs stormwater loadings from electrical utility equipment and operations in the San Francisco Bay Area region?
2. What aspects of equipment or operational procedures should electrical utilities be required to report to the SF Bay Water Board?
3. Are improvements to spill and cleanup control measures needed to reduce water quality impacts from the release of PCBs in electrical utility equipment?
4. Are additional proactive management practices needed to reduce releases of PCBs from electrical utility equipment?
5. What are the PCBs load reductions that can be achieved through implementation of a regional reporting and control measure program?

2.4 Regulatory Context of PCBs WQOs

To better understand the issues of PCBs in the Bay, it is important to understand the regulatory context of the PCBs WQOs and human health risks associated with PCBs. The State Water Resources Control Board (SWRCB) is part of the California Environmental Protection Agency and administers water rights, water pollution control, and water quality functions for the state. It shares authority for implementation of the federal CWA and the state Porter-Cologne Act with the nine Regional Water Quality Control Boards. The Regional Water Boards regulate surface water and groundwater quality through development and enforcement of WQOs and implementation of Basin Plans that will protect the beneficial uses of the State's waters. These plans designate beneficial uses, WQOs that ensure the protection of those uses, and programs of implementation to achieve the WQOs.

The Basin Plan for the San Francisco Bay region (SFRWQCB 2017) provides the basis for water quality regulation in the San Francisco Bay region. It is implemented by the SWRCB and the SF Bay Water Board. The Basin Plan identifies beneficial uses of Bay waters, establishes narrative and numerical WQOs protective of those beneficial uses, identifies areas where discharges are prohibited, and sets forth a program of implementation to ensure that the Bay WQOs are achieved and beneficial uses are protected. Several beneficial uses are designated in the San Francisco Bay region including commercial and sport fishing (COMM), defined in the Basin Plan as:

- **COMM:** *"Uses of water for commercial or recreational collection of fish, shellfish, or other organisms, including, but not limited to, uses involving organisms intended for human consumption or bait purposes."*

To protect this beneficial use, the narrative WQO for PCBs in the Bay states that "controllable water quality factors shall not cause a detrimental increase in toxic substances found in bottom sediments or aquatic life". PCBs in Bay sportfish have been found at levels thought to pose a health risk to people consuming these fish. As a result, the COMM beneficial use of the Bay is not currently supported and the narrative WQO for PCBs has not been achieved.

3.0 Study Area, Existing Data, and Potential Causes of Water Quality Problem

3.1 Study Area

The study area for this SSID project is the portion of the San Francisco Bay Area region subject to the MRP. This section provides an overview of electrical utility systems and companies currently operating in the study area, and describes how and where PCBs are used within those systems.

Electrical utilities produce or buy electricity from generating sources, and then distribute that electricity to users through two networks: the transmission system and the distribution system. The **transmission system** carries bulk electricity at high voltages, often across long distances, directly from generation sources to substations via high voltage power lines. Substations connect the transmission and distribution systems. Substations may increase the voltage from nearby generating facilities for more efficient transmission over long distances or lower the voltage for transfer to the distribution system. Electricity at a typical substation flows from incoming transmission lines, to circuit breakers, to transformers (which step down the voltage), to voltage regulators and cut out switches (which protect the system from overvoltage), and finally to outgoing distribution lines.

The **distribution system** delivers lower voltage electricity from substations directly to homes and businesses over shorter distances. This system includes pole-mounted equipment, equipment in underground vaults, and aboveground equipment on cement pads that are often in green boxes in the public right-of-way (ROW). This equipment is smaller, but more numerous in terms of the number of units.

Electrical utility equipment and facilities in both the transmission and distribution systems are distributed across the entire Bay Area region. In the past, PCBs were routinely used in electrical utility equipment that contained dielectric fluid as an insulator. This is because prior to the 1979 PCBs ban, dielectric fluid was typically formulated with PCBs due to a number of desirable properties they have (e.g., high dielectric strength, thermal stability, chemical inertness, and non-flammability). Electrical equipment containing dielectric fluid is typically identified as Oil-Filled Electrical Equipment (OFEE). Any OFEE that contained PCBs in the past could still potentially be in use and contain PCBs today. The most common types of OFEE that may contain PCBs are transformers, capacitors, circuit breakers, reclosers, switches in vaults, substation insulators, voltage regulators, load tap changers, and synchronous condensers (PG&E 2000).

In the Bay Area, there are eight electric utility companies operating as of February 2015 (State Energy Commission 2015):

Investor-Owned Utilities (IOUs)

1. Pacific Gas and Electric Company (PG&E)
   77 Beale Street
   San Francisco, CA 94105
   (415) 973-7000 (tel)

Publicly Owned Load Serving Entities (LSEs) and Publicly Owned Utilities (POUs)

2. Alameda Municipal Power
   2000 Grand Street
   Alameda, CA 94501-0263
   510.748.3905 (tel)
3. CCSF (also called the Power Enterprise of the San Francisco Public Utilities Commission)
   1155 Market Street, 4th Floor
   San Francisco, CA 94103
   209.989.2063 (tel)
4. City of Palo Alto, Utilities Department
   P.O. Box 10250
   Palo Alto, CA 94303
   650.329.2161 (tel)
5. Pittsburg Power Company Island Energy-City of Pittsburg,
   65 Civic Drive
   Pittsburg, CA 94565-3814
   925.252.4180 (tel)
6. Port of Oakland
   530 Water Street, Ste 3
   Oakland, CA 94607-3814
   510.627.1100 (tel)
7. Silicon Valley Power (SVP) - City of Santa Clara
   1500 Warburton Avenue
   Santa Clara, CA 95050
   408.615.2300 (tel)

Community Choice Aggregators

8. Marin Clean Energy (MCE)
   781 Lincoln Ave Ste 320
   San Rafael, CA 94901-3379
   888.632.3674 (tel)

PG&E is by far the largest electrical utility company in the Bay Area. PG&E is an investor-owned company that is not under the jurisdiction of any Bay Area municipality[4]. Three small publicly-owned utilities in the Bay Area (Alameda Municipal Power, City of Palo Alto Utilities Department, and Silicon Valley Power owned by the City of Santa Clara) maintain their own substations and distribution lines. The other public utilities partner with PG&E to deliver energy through PG&E's equipment. PG&E owns and operates several hundred electrical substations in the Bay Area, in addition to the smaller electrical utility equipment that is widely disbursed throughout urbanized areas and along rural corridors (e.g., small transformers on utility poles or in utility boxes). The total number of pieces of equipment that is in use across the Bay Area and that contains PCBs is not known but is likely in the range of tens to hundreds of thousands (see Section 3.2.2).

[4] PG&E is regulated by the California Public Utilities Commission (CPUC) and the Federal Energy Regulatory Commission (FERC).

3.2 Existing Data

This section presents an overview of the current state of knowledge about PCBs used by electrical utility companies in the Bay Area, the potential mass of PCBs released into the environment from this source over the past 50+ years, and the regulatory programs currently available for the purposes of managing PCBs and reporting and cleaning up spills. This information focuses on PG&E because this private company owns and operates the vast majority of electrical utility properties and equipment in the Bay Area. This information was originally reported by SCVURPPP (2018).

3.2.1 Regulatory Controls on PCBs in Electrical Utility Equipment

Existing federal and state regulations are primarily focused on controlling the management and handling of in-use PCBs and PCB-containing equipment when the concentrations are above the thresholds for hazardous waste. Under federal regulations, the hazardous waste threshold for PCBs is ≥ 50 parts per million (ppm). Under California regulations, the hazardous waste threshold for PCBs is ≥ 5 ppm in liquids (using the Waste Extraction Test, WET), and ≥ 50 ppm in solids. The allowable post-cleanup concentrations of remaining soils and other surface materials typically range from 10 to 25 ppm, depending on site-specific evaluations of human health risk. As a result, current efforts to control and cleanup PCB releases from electrical utility equipment are focused on these thresholds.

By comparison, Bay Area municipalities are concerned with much lower concentrations of PCBs. For example, currently Bay Area municipalities generally designate a site as a *potential* PCBs source to stormwater runoff if soil or sediment concentrations are ≥ 0.5 ppm and designate a site as a *confirmed* PCBs source to stormwater runoff if soil or sediment concentrations are ≥ 1.0 ppm. Control of PCBs sources at these substantially lower concentrations has been deemed necessary to make progress towards meeting the stringent stormwater runoff wasteload allocations called for in the PCBs TMDL.

3.2.2 PCBs Remaining in Electrical Utility Equipment

Although use of PCBs is highly restricted currently, McKee et al. (2006) estimated that 12.3 million kilograms of PCBs were used in the San Francisco Bay Area between 1950 and 1990. Roughly 65% (8 million kg) was used in electrical transformers and large capacitors (McKee et al. 2006). How much of this mass was released to the environment and how much remains in electrical equipment distributed across the Bay Area today is unknown. While the 1979 ban of PCBs did not require the immediate removal of PCBs from current applications, electrical utilities have made substantial efforts over the past 35+ years to reduce the amount of PCBs still used in their applications in the Bay Area. According to PG&E, the majority of OFEE containing PCBs in the Bay Area has already been removed or refurbished with dielectric fluids that do not contain PCBs through the following actions:

- Voluntary replacement programs;
- Ongoing removal of PCBs from OFEE as units are serviced or replaced due to routine maintenance programs; and
- OFEE replacement due to unplanned actions (e.g., transformer leaks and fires).

Voluntary actions conducted by PG&E, primarily in the mid-1980s, included the PCBs Distribution Capacitor Replacement Program and the PCBs Network Transformer Replacement Program (PG&E 2000). In addition, in the 1990s, PG&E implemented a program to remove oil-filled circuit breakers and replace them with equipment that contains sulfur hexafluoride gas

(PG&E 2000). Current ongoing PG&E efforts to remove PCBs-containing equipment are conducted primarily through maintenance programs. Past maintenance of older equipment may have included draining PCBs-containing oils and refilling the equipment with oils that did not contain PCBs. These refurbished OFEE may still contain PCBs at levels of concern to municipalities due to residual contamination from the original PCB-oil. Currently, as maintenance staff identify older equipment in-use, it is scheduled for replacement. However, PG&E has provided limited documentation of their past and current PCBs removal efforts. There remains much uncertainty on where PCBs transformers, PCBs capacitors, oil-filled circuit breakers, and PCBs-containing distribution system equipment were originally located, and which ones have already been removed or replaced.

Despite the removal efforts described above, PCBs may still be found in older and refurbished OFEE, and particularly OFEE located throughout the distribution system. In a recent meeting with SF Bay Water Board Staff, PG&E noted that any equipment installed prior to 1985 could contain PCBs, as it would have come from equipment stockpiled prior to the 1979 ban and was installed prior to the voluntary replacement programs (*personal communication*, Sanchez 2016). Because OFEE are not typically tested for PCBs until the fluid is removed during servicing or disposal, or in the event of a spill, the total number of PCBs-containing OFEE that remain in use is unknown. However, in a letter to the SF Bay Water Board in 2000, PG&E provided information that can be used to make some preliminary estimates, including the following (PG&E 2000):

- There are over 900,000 pieces of OFEE in service in the distribution system;
- In 1999, 22,000 pieces of equipment were serviced at the main PCBs-handling facilities in Emeryville;
- Approximately 10 percent of the units serviced and tested annually contain PCBs at concentrations of 50 parts per million (ppm) or greater, and fewer than 1 percent contained PCBs at concentrations of 500 ppm or greater; and
- The number of pieces of equipment containing PCBs concentrations > 50 ppm has declined over time.

The information above was used to calculate the following:

- Assuming the count of equipment processed in 1999 in Emeryville represents an average annual processing rate throughout the region and that there are at least 900,000 pieces of equipment in PG&E's distribution system it would take over 40 years at a minimum for all of this equipment to be replaced;
- Assuming the 1999 processing rate and 900,000 pieces of equipment in the distribution system in 1985, approximately 175,000 pieces would not yet have been serviced or replaced as of 2018; and
- Of the approximately 175,000 pieces of equipment remaining in-use in 2018, approximately 17,500 (10%) may contain PCBs concentrations > 50 ppm.

Although based on limited information, the above estimates demonstrate that a potentially large number of pieces of equipment containing PCBs over 50 ppm (i.e., 17,500 as of 2018) may remain in-use in the electrical utility distribution system. And the remaining 90% (roughly 157,000 pieces of equipment) may contain lower concentrations of PCBs that could still be of concern to Permittees in their efforts to meet TMDL requirements.

3.2.3 Estimated Loadings of PCBs from Electrical Utility Equipment to MS4s

Building upon their estimates of the total mass of PCBs used historically in the Bay Area, McKee et al. (2006) developed a transport and fate conceptual model that identified the major sources of PCBs to stormwater conveyances and described mass movement from these sources or source areas into the stormwater conveyance system. McKee et al. (2006) estimated the net mass input of PCBs to MS4s in the Bay Area in 2005 was approximately 28 kg per year.[5] Of this total, roughly 29% (8 kg/yr) was estimated to have originated from controlled closed systems (transformers and large capacitors) and 71% (20 kg/yr) was from dissipative uses (e.g., release of PCBs-containing building materials such as caulks and sealants during demolition and renovation). This includes both current and legacy uses that resulted in widespread distribution of PCBs across watershed surfaces. In other words, these estimates suggest that because of both current and past use, transformers and large capacitors, which are both electrical utility applications, may continue to contribute nearly one-third of the net PCBs mass to MS4s in the Bay Area. As noted earlier, such loadings would exceed the 2 kg per year TMDL waste load allocation for stormwater runoff (see Section 2.3.2) and limit the ability of municipalities to meet the goals of the PCBs TMDL for the Bay. Conversely, reduction of PCBs released to MS4s from electrical utility equipment may support attainment of TMDL goals.

3.2.4 Ongoing Release of PCBs from Electrical Utility Equipment

Although the bulk of PCBs remain contained within OFEE until the equipment is removed from use and transported to proper hazardous waste disposal facilities, releases of PCBs to the environment can and do occur. In order to document current spills, publicly available data in the California Office of Emergency Services (Cal OES) spill report database (Cal OES 2016), as well as internal spill records (PG&E 2000) supplied by PG&E to the SF Bay Water Board in September 2000 (that were provided pursuant to a California Water Code §13267 request for information) were reviewed. The Cal OES database and available PG&E spill records were searched for reports of spill releases related to OFEE in the Bay Area between 1994 and 2017. Over 1,200[6] reported release incidents from PG&E OFEE in the Bay Area were identified. The information provided by these records and a summary of the important issues identified for water quality concerns are summarized in the remainder of this section. It is important to note that current regulations do not require reporting of all releases from OFEE. The information provided below is based only on the reported releases for which records were available, and likely represents an underestimate of actual OFEE releases during the time period of review. However, these reports clearly demonstrate that PCBs may still be present in the electrical transmission and distribution systems in the Bay Area, and that releases from these systems can and do continue to occur.

Generally, the publicly available spill release records provide information about the spill release date, time, location, chemical, quantity released, actions taken, known or anticipated risks posed by the release, and additional comments. Other information that is sometimes reported for OFEE releases includes a description of the causes of the release and the equipment affected, and the concentrations of PCBs in that equipment (if known). Concentration information reported is likely assumed from equipment labels, as ranges are most often provided rather than specific values. Typically, the reports are limited to the information that was

[5] The PCBs TMDL estimates a PCBs loading of 20 kg per year from stormwater runoff (see Section 2.1).

[6] The records span 24 years of spill reports, and include PG&E's own record of releases from 1994 thru 1999 and a portion of 2000. The number of reports PG&E submitted in 2000 represents less than half the number of reports for that year. Records did not include all the districts in the Bay Area. District documents submitted reported releases prior to June of 2000, with the exception of one district that submitted a June report. As a result, the number of additional reports from PG&E's records are assumed to be less than half the number of incidents for 2000.

available at the time the spill was initially reported. In some cases, follow-up information such as the results of analytical testing of the spilled materials is also provided, but this is not typical.

3.2.4.1 Number of Reported OFEE Releases

Between 1994 and 2017, over 1,000 spills from PG&E electrical equipment were reported to Cal OES. PG&E records contain information about 200 additional releases that were not reported to Cal OES between 1994 and 2000. A count of these reports by year is presented in Figure 1.

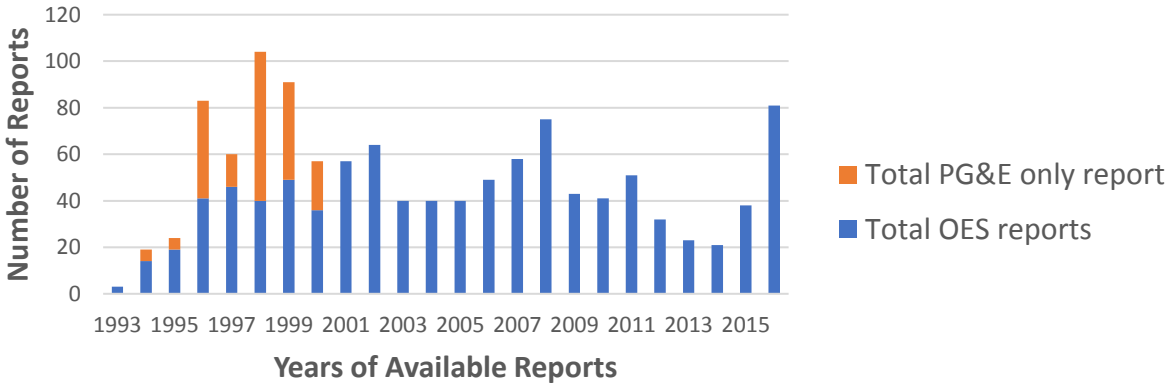

Figure 1. Oil-filled electric equipment spills reported to the California Office of Emergency Services (Cal OES) and/or identified through internal Pacific Gas & Electric (PG&E) reports between 1993 and 2017.

3.2.4.2 Volume of OFEE Releases

The total volume of material released from all reported OFEE spills in a given year in the Bay Area is presented in Figure 2. Mineral oil or transformer oil are the substances identified in over 99% of reported releases from OFEE in the Cal OES spill report database. In a phone conference with SF Bay Water Board staff in 2012, PG&E said they submit written reports to Cal OES for all PCBs spills that meet or exceed the mineral oil federal reportable quantities (RQ) of 42 gallons (*personal communication*, Jan O'Hara 2012). However, the reports reviewed indicate written reports are sometimes submitted for spills that are much less than 42 gallons.

The reported volumes of oil released during a single incident range from less than one gallon up to 5,000 gallons. Nearly half of all OFEE spill reports identify the volume of oil spilled as 5 gallons or less, and more than 90% of all spill reports identify the volume of fluid spilled as less than 100 gallons. Releases as large as 500 gallons from the distribution system and 5,000 gallons from the transmission system have been reported. Only five incidents reported releases that exceeded 1,000 gallons of oil. Nearly all (~99%) of reports provided information on the volume of oil released.

The reported volumes released do not necessarily equate to the volume of the oil that may have reached storm drains or local creeks. Estimates of those volumes were not available.

3.2.4.3 Location of OFEE Releases

Cal OES and PG&E records show releases occurred in all Bay Area counties. Leaks and spills of PCBs from electrical equipment have occurred onto roads, sidewalks, pervious areas, vegetation, structures, vehicles, and even people (Cal OES 2016). Most releases occurred in

the distribution system, often from equipment installed in public ROWs such as pole-mounted transformers installed along roadways.

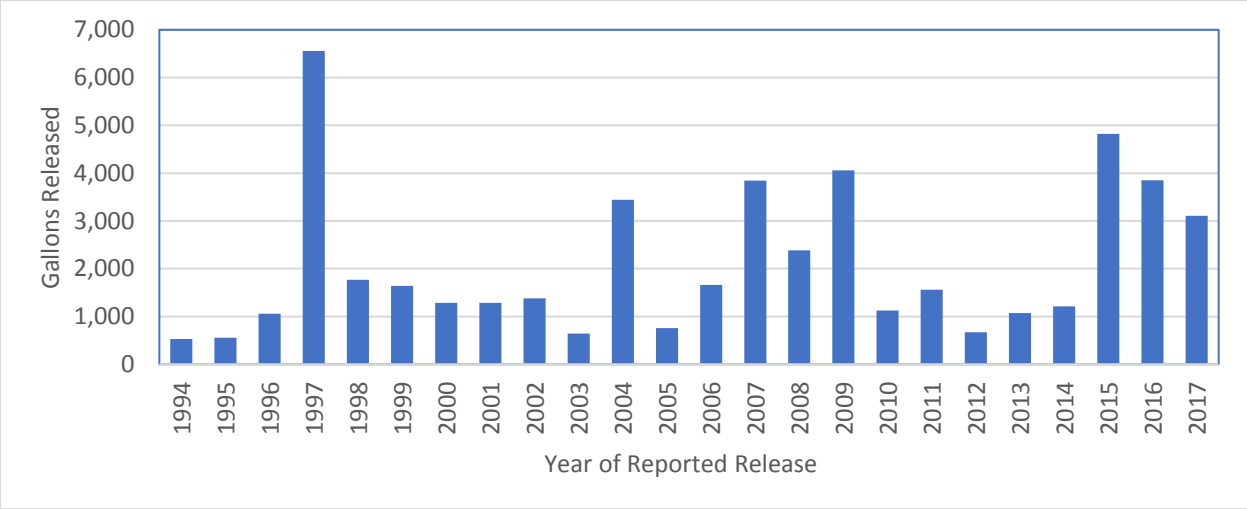

Figure 2. Total reported gallons of oil released each year (1994 – 2017) from spills from PG&E electrical utility equipment in the Bay Area.

A number of reports document direct releases from OFEE to the MS4, and potentially a downstream waterbody (e.g., creek). There are at least 17 incidents identified during the past 15 years that involved direct releases from PG&E OFEE directly to a waterbody or to storm drains that discharge to local creeks (Table 1). The majority of these releases were reported as having unknown PCBs concentrations, and no reports provide any follow-up information on the concentration of PCBs in the spilled materials based on chemical analysis.

It is important to note that in addition to the incidents identified in Table 1, materials spilled during any of the numerous other incidents may (or may not) have entered the MS4 and/or receiving waters such as local creeks directly or been washed into the MS4 and/or creeks by stormwater or irrigation runoff. Generally, the spill reports lack any details regarding this type of information.

Table 1. Examples of Information Reported on Releases of PCBs to Bay Area Storm Drains and Creeks.

Date	Gallons	Reported Concentration	Water Body	Municipality
1/24/2016	Unknown	<50 ppm	Coyote Creek	San José
2/17/2016	Up to 18	Unknown	Los Gatos Creek	Los Gatos
3/7/2016	10	Unknown	Culvert	Concord
8/16/2016	Unknown	<50 ppm	Guadalupe River	San José
11/17/2015	Unknown	Unknown	Cerrito Creek	Richmond
10/4/2015	5	Unknown	Creek	Los Gatos
5/3/2015	30	<2 ppm	Cerrito Creek	Richmond
3/2/2011	30	Unknown	Unknown Marsh	Menlo Park
6/2/2007	40	Unknown	Pond, Marsh Area	Vallejo
2/28/2006	20	<50 ppm	Calara Creek	Pacifica
5/27/2006	1	Unknown	Unknown Creek	Orinda
10/10/2005	Unknown	Unknown	Coyote Creek	San José
7/23/2005	<15	Unknown	Nearby Creek	Walnut Creek
12/8/2004	Small amount	<50 ppm	Moraga Creek	Orinda
3/7/2004	Unknown	Unknown	Blossom Creek	Calistoga
7/14/2003	8	< 50 ppm	Coyote Creek	San José
2/16/2002	15	Unknown	Napa River	Napa

3.2.4.4 Causes of OFEE Releases

Cal OES release reports and PG&E records document a number of causes of PCBs releases from OFEE. Most releases can be attributed to one of the following:

- **Equipment Failure**. This is the cause of the majority of the reported releases. Equipment failure in utility vaults has additional potential as an important source of PCBs because OFEE in these vaults may contain more than 100 gallons of oil. More than 50 release incidents were reported for equipment contained in electrical utility vaults during the time period reviewed. A number of these reports noted the presence of water in the vaults in addition to the PCBs oil released. Releases from equipment failure in utility vaults are mostly contained, but Cal OES spill reports document releases of PCBs oil that breached containment, including discharges that reached water bodies.

- **Accidents**. Approximately 20% of reported releases resulted from equipment knocked over by accident. In the distribution system, reports document 50 to 500 gallons released from poles knocked over during car accidents, by construction equipment, and during tree trimming. On rare occasion PCBs releases have occurred during accidents while equipment is in transport.
- **Storms, Fires, and Overheating from High Summer Temperatures**. These factors are the reported cause of more than 10% of the releases from the distribution system.
- **Field Repairs and Fluid Replacement**. The Cal OES database contains records that indicate draining fluids in the field may have been ongoing as recently as 2007, when a report documented that a valve left open from draining a transformer in the field caused a release. In 2016, Daniel Sanchez, who at the time was PG&E's Manager of Hazardous Materials and Water Quality Environmental Management Programs, informed SF Bay Water Board staff that PG&E does not drain and refill pole mounted PCB transformers in the field any longer; however, it is unclear when this practice ceased, and/or if it still occurs with equipment not mounted on poles.
- **Vandalism**. Between 1997 and 2015, there were at least 25 separate reported incidents of vandalism that resulted in PCBs releases. For example:
    - In 1997, gunshot damage caused the release of 5,000 gallons of oil from a substation transformer and regulators in San Mateo County;
    - In 2011, copper theft at a substation released 750 gallons of oil in Contra Costa County;
    - In 2013, vandalism of pad-mounted transformers resulted in the release of possibly 1,000s of gallons of oil before discovery in San José.

3.2.4.5 PCBs Concentrations in OFEE Releases

Of the more than 1,200 spill reports that were reviewed, approximately one-third identified the PCBs concentration as unknown or did not provide any information on the PCBs concentration of the spilled material (Figure 3). Releases with high PCBs concentrations (> 500 ppm) were infrequently reported, accounting for only 1% of reported spills. Concentrations above 50 ppm represent about 8% of the reported spills. As recently as 2016, failure of a PG&E pole-mounted transformer resulted in release of mineral oil with 280 ppm PCBs to surrounding soils and brick structures. For approximately 44% of the reported releases, the PCBs concentration was identified as less than 50 ppm, based primarily on assumptions associated with a "Non-PCB" label. According to labeling requirements, a "Non-PCB" label indicates the PCBs concentrations in the oil are assumed to be below hazardous waste thresholds of 50 ppm (federal regulations, see Section 3.2.1). However, in most cases, no additional information was provided in the spill reports to indicate how the "Non-PCB" category was arrived at, or whether the federal (> 50 ppm) or state (> 5 ppm in liquid) "Non-PCB" category was assumed. For the vast majority of these reports, no follow-up chemical analysis results were provided that confirmed the "Non-PCB" designations. In a limited number of reports, follow-up PCBs analysis results were provided for materials that were identified as "Non-PCB" during initial reporting. Generally, these results found PCBs concentrations between 5 and 49 ppm, suggesting that the labels were correctly applied. However, any concentration of PCBs in electrical equipment oils is potentially significant in terms of water quality impacts and implementation of the PCBs TMDL. These results clearly demonstrate that the "Non-PCB" designation represents a threshold that is far too high to necessarily be protective of water quality.

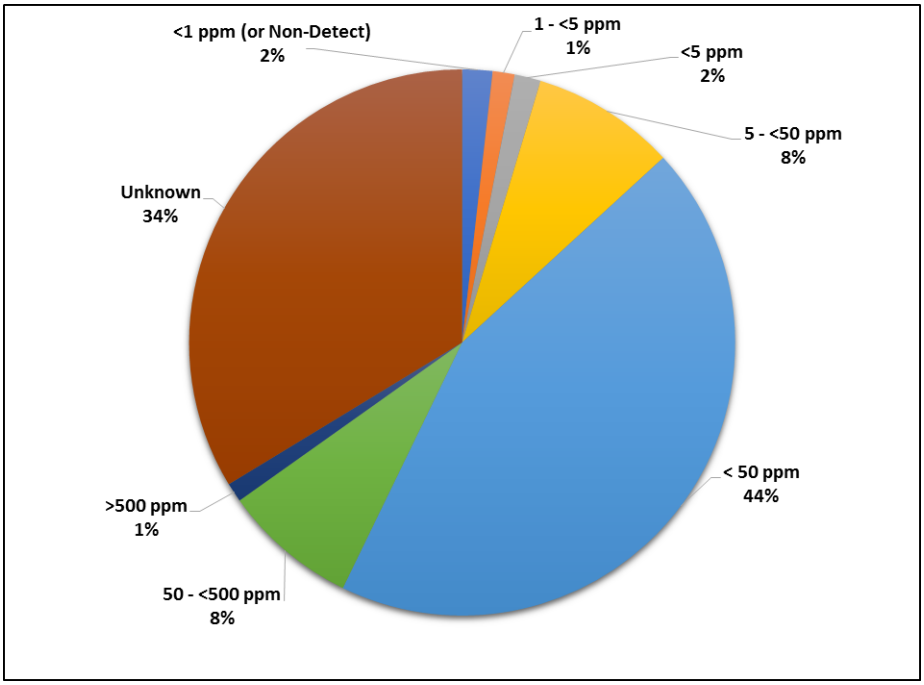

Figure 3. PCB Concentration data reported for releases from PG&E electrical equipment between 1993 and 2016.

Only 1% of the reported releases identified the PCBs concentrations as either below 1 ppm, or below detection limits. Although the quality of the PCBs concentration data in the release reports varies widely, these results clearly demonstrate that PG&E's electrical equipment in the Bay Area can still contain PCBs at concentrations of concern for water quality protection programs.

3.2.5 Cleanup Methods and Actions Taken in Response to OFEE Releases

Limited information is available on the spill response protocols used by electrical utility companies during cleanups. Based on information publicly available, electrical utility companies typically address spills or leaks from their equipment with Standard Operating Procedures (SOPs) that should conform to both State and Federal requirements. According to information provided to the SF Bay Water Board (PG&E 2000), PG&E spill response is guided by internal documents, including:

- ***Utility Operations Standard D-2320*** - for PCBs spills in the distribution system;
- ***PCB Management at Substations -*** for PCBs spills in the transmission system.

However, these documents are not publicly available for review.

The Cal OES reports provide almost no information on actions taken to stop active spills, or the methods used to cleanup spilled materials from surrounding surfaces, storm drain infrastructure, or creeks. Municipalities need this type of information to better understand any potential risks that remain following initial cleanup. Because of the challenges with achieving the stormwater runoff wasteload allocation in the PCBs TMDL, additional remedial actions may be warranted in some cases.

3.3 Potential Causes of Water Quality Problem

Given the history of PCBs use in electrical utility equipment, the current estimates of electrical equipment still in use that contain PCBs, and existing documentation that spills of PCBs from electrical utility equipment continue to occur, electrical utility equipment is likely a significant source of PCBs to stormwater runoff, and ultimately to the Bay. PG&E, the largest electric utility company in the Bay Area, was likely the largest single user of PCBs in the Bay Area, and as such, likely remains the largest current source of PCBs releases to MS4s from electrical utility equipment.

4.0 SSID Investigation Approach and Schedule

The overall approach for this SSID Investigation is to (1) conduct a desktop analysis and (2) propose a source control framework for electrical utility equipment to reduce ongoing PCBs loads to the Bay in stormwater runoff. The purpose of the desktop analysis is to better understand the extent and magnitude of electrical utility equipment as a source of PCBs to urban stormwater runoff, document past and current efforts to reduce PCBs releases from electrical utility equipment during spills or other accidental releases, and document measures already taken or underway to remove PCBs-containing oils and electrical equipment from active service across the Bay Area. The results of the desktop analysis will inform identifying new or improved control measures to avoid/reduce the release of PCBs from this source. This information may also be used to update the estimated PCBs loads to stormwater from this source, and inform development of a load reduction accounting methodology. This project will request the assistance and support of the SF Bay Water Board to gather the information needed from electrical utility companies to conduct the desktop analysis. Based on the outcomes of the desktop analysis, this project will then propose a framework for addressing PCBs from electrical utility equipment. The framework may include a recommendation to designate electrical utilities as a *Categorical Source* of PCBs to stormwater in order to facilitate the development of a comprehensive, regional control measure program to address this source.

This SSID Project is a BASMAA Regional Project. The BASMAA Monitoring and Pollutants of Concern Committee (BASMAA MPC) will oversee implementation of the project. Implementation of this work plan will contribute to fulfillment of MRP Provision C.8.e requirements for all BASMAA co-permittees.

4.1 Task 1: Desktop Analysis

The desktop analysis is designed to gather and evaluate information on electrical utility equipment in the Bay Area to determine if a *Categorical Source* referral is warranted, and to provide the foundation for development of a comprehensive regional control measure program to reduce PCBs loads from this source. The desktop analysis will include the following five sub-tasks:

- **Subtask 1.1 Request information from electrical utility companies.**
  This task will seek the assistance and support of the SF Bay Water Board to: obtain information from private utility companies that is not publicly available but is needed to better understand the extent and magnitude of PCBs releases from OFEE; identify the most appropriate actions to prevent or reduce releases from this source; and develop and implement effective reporting and control measures. For this task, the SF Bay Water Board will be asked to assist BASMAA in compelling electrical utility companies (e.g., PG&E) to provide the necessary information. A preliminary list of information that will be requested includes the following:
    - Spill reporting and notification procedures (both company-wide and location-specific);
    - Spill records NOT reported in Cal OES;
    - SOPs and other documentation used by electrical utilities and their contractors to guide spill response and cleanup actions when releases from OFEE occur;
    - SOPs and documentation, including analytical methods for PCBs used by electrical utilities and their contractors to identify and clean up regular leaks from OFEE during regular maintenance activities

- Measurement data on concentrations of PCBs in OFEE;
- Maintenance records that document when and where PCBs-containing OFEE are removed from the system and how often PCBs containing equipment is inspected for leaks or spills;
- Documentation of past programs to voluntarily remove PCBs-containing oils or OFEE – including what equipment was removed, and the locations from which it was removed; and
- Documentation of where PCBs-containing OFEE were located in the past, and where they are currently located across the Bay Area.

This list will be reviewed prior to making any data requests. Additional data gaps may also be identified and added to the data request based on discussions with SF Bay Water Board staff and/or preliminary information provided by utility companies.

- **Subtask 1.2 Assess current electrical utility data.**
  This task will review, tabulate and analyze the information provided by electrical utility companies as a result of the SF Bay Water Board's request for information, in order to document the following:
  - Measurement data on PCBs concentrations and/or mass in OFEE;
  - Locations of PCBs-containing OFEE;
  - Quantity of PCBs-containing OFEE removed from service annually;
  - Occurrences of spills or releases from OFEE;
  - Current PCBs spill and cleanup reporting requirements; and
  - Current PCBs cleanup protocols.
- **Subtask 1.3 Improve estimates of PCBs loadings.**
  This task will combine the information provided in Subtask 1.2 with all existing data in order to develop improved estimates of current PCBs loadings from electrical utility equipment to MS4s in the study area. The quality of these estimates will partly depend on the quality of the data received from the utility companies.
- **Subtask 1.4 Refine PCBs reporting requirements**
  This task will review all current reporting and notification requirements to identify any improvements or clarifications that the SF Bay Water Board could require of electrical utilities to provide the type of data needed to better quantify the amount of PCBs released from OFEE spills, and to help ensure that adequate cleanup actions are being implemented.
- **Subtask 1.5 Evaluate PCBs cleanup protocols**
  This task will review all documented cleanup protocols that are currently used by electrical utility companies in order to identify any changes or improvements that could be recommended to further reduce the discharge of PCBs to the MS4 when releases occur.

4.2 Task 2: Develop Source Control Framework

Based on the results of the desktop analysis, this task will propose an appropriate framework for managing and implementing control measures to reduce PCBs from electrical utility equipment. The framework should include prescribed methods and procedures for unplanned spills and

releases from OFEE, as well as a plan for continued reduction of PCBs from in-use OFEE, and potentially further identification and cleanup of historic release sites. The framework will likely include the following elements:

- Summary of the outcomes of the desktop analysis results, including:
    a. Summary of information provided by electrical utility companies as a result of the SF Bay Water Board's request for information from electrical utilities;
    b. Improved estimates of current PCBs loadings from electrical utility equipment based on information received;
    c. Documentation of current spill clean-up and reporting actions, and existing programs for proactive removal of PCBs-containing oils and equipment conducted by electrical utility companies;
    d. Recommended PCBs spill and cleanup reporting requirements that the SF Bay Water Board could require of electrical utilities;
    e. Recommended improvements to PCBs spill cleanup protocol(s) that would reduce the discharge of PCBs to MS4s that the SF Bay Water Board could require of electrical utilities.
- A recommendation (based on the results of the Task 1 desktop analysis) about designation of electrical utility equipment as a *Categorical Source*.
- Recommended approach to manage and control releases of PCBs from electrical utility companies. For example, if a *Categorical Source* referral is submitted, the recommended approach will focus on development of a comprehensive regional control measure program. The program would include requirements the SF Bay Water Board could impose on electrical utility companies in the Bay Area, such as new spill reporting and cleanup protocols.

4.3 Task 3: Develop methodologies to account for PCB load reductions from new source control measures

BASMAA will further apply the results of the desktop analysis to develop methodologies to account for the PCBs load reductions that can be achieved via the new clean-up and reporting protocols identified above in Task 2.

4.4 Task 3: Develop SSID Project Report

BASMAA will prepare a report describing the desktop analysis and outcomes. The report will summarize the information provided by electrical utility companies and identify recommendations to modify or improve current control measures or management actions that will reduce PCBs released to MS4s. The Management Questions described in Section 2.3 will be addressed:

1. What is the current magnitude and extent of PCBs stormwater loadings from electrical utility equipment and operations in the San Francisco Bay Area region?
2. Are there aspects of equipment or operational procedures that electrical utilities should be required to report to the SF Bay Water Board?
3. Are there additional spill and clean-up controls needed to reduce water quality impacts from the release of PCBs in electrical utility equipment?

4. Are there additional proactive activities needed to avoid releases of PCBs from electrical utility equipment?
5. What are the PCBs load reductions that can be achieved through implementation of a regional reporting and control measure program?

4.5 Project Schedule

Table 2 summarizes the tasks and anticipated outcomes described in this work plan, and the proposed schedule for each task. This is an approximately one-year effort to be conducted primarily in Fiscal Year 2019-2020. However, Task 1 (information request) will likely be made before the end of Fiscal Year 2018-2019. It is anticipated that the SSID project report will be completed in June 2020. The schedule in Table 2 is dependent upon the timing, extent, and format of the data that are received from electrical utility companies based on the SF Bay Water Board's request for information.

Table 2. Tasks, Anticipated Outcomes, and Schedule.

Task Description		Anticipated Outcome(s)	Anticipated Completion Date
Task 1: Desktop Analysis			
1.1	***Request information from electrical utility companies***	Language for information request provided to SF Bay Water Board.	Apr-2019
1.2	***Assess current electrical utility data***	Summary tables of information and analyses of the data received from electrical utility companies.	Oct-2019
1.3	***Improve estimates of PCBs loadings***	Tables with estimated annual PCBs loads to MS4s from electrical utility equipment.	Nov-2019
1.4	***Refine PCBs reporting requirements***	Recommended improved PCBs spill and cleanup reporting requirements for electrical utility companies.	Dec-2019
1.5	***Evaluate PCBs clean-up protocols***	Recommended improved PCBs cleanup protocols for electrical utilities companies.	Dec-2019
Task 2: Develop Source Control Framework		Recommended source control framework for electrical utility equipment.	Jan-2020
Task 3: Develop PCBs Load Reduction Accounting Methodology		Recommended methodology to account for PCBs load reductions achieved through implementation of new source controls.	Jan-2020
Task 4: Reporting		Regional SSID Project Report	Jun-2020

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