6. Track Down

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6.1 Introduction

Persistent Organic Pollutants (POPs) include polychlorinated biphenyls (PCBs); polychlorinated dibenzo dioxins and furans (PCDD/Fs); chlorinated pesticides DDT and metabolites, dieldrin, chlordanes, mirex (and photomirex); and mercury, particularly methyl mercury. Ambient water quality standards for the protection of people eating fish are, for these substances, extremely low. PCBs and PCDD/Fs occur at concentrations many times above the most restrictive water quality standards in all surface water examined. This includes the open ocean and the Great Lakes. One can safely assume that all the POPs exceed water quality standards in wastewaters. However, it has only been recently that field and laboratory methods have permitted accurate quantitation of these substances in all aqueous samples. Much of the older data show non-detections at levels far above the relevant standards or, in the case of mercury, often show the contamination during sampling or even during laboratory analysis.

Control and reduction of these chemicals is accomplished using multiple approaches, including bans on manufacture and use1 ecosystem mathematical modeling to help identify significant sources, and track down.

Track down is the process of planning, sampling, and interpretation of forensic projects that attempts to locate sources of toxic substances.

This chapter is intended to help managers and field staff in New York's sewer districts plan, carry out, and interpret toxic contaminant track down projects.

6.2 Problem Definition and Background

PCBs, PCDD/Fs, and mercury occur in treated wastewaters at concentration greater than the New York State Ambient Water Quality Standards for the protection of humans eating fish (WQS). Recently data were collected from final wastewater from all 14 New York City treatment plants plus from treatment plants in Rensselaer, Poughkeepsie, Rockland County, and Yonkers. Some of these are very large facilities, some process significant amounts of industrial wastes and many serve residential and commercial customers. The sampling and analytical methods were state-of-the art. Table 4.1 shows average concentrations of PCBs, dissolved mercury, and dioxins (PCDD/F) and the WQS for each.

Parameter units	PCB ng/L	Hg. Dissolved ng/L	PCDD/F pg/L
WQS	0.001	0.7	0.0006
WPCF: 26th Ward	40.7	5.3	0.1
WPCF: Bowery Bay	5.74	2.7	0.067
WPCF: Coney Island	2.25	3.5	0.025
WPCF: Edgewater	6.51		
WPCF: Hunts Point	4.4	2.6	0.29
WPCF: Jamaica	5.5	2.5	
WPCF: Newtown Creek	12.6	6.9	0.14
WPCF: North River	3.77	3.9	
WPCF: Oakwood Beach	9.22	2.5	0.069
WPCF: Owls Head	3.41	10	0.058
WPCF: Port Richmond	137	3.4	0.087
WPCF: Poughkeepsie, City	15.3	4.6	
WPCF: PVSC	334		
WPCF: Red Hook	3.71	2.3	0.043
WPCF: Rensselaer	5.93	5.3	0.1
WPCF: Rockaway	4.44	3.4	0.11
WPCF: Rockland County	4.42	15	
WPCF: Tallman Island	5.33	1.8	0.041
WPCF: Wards Island	2.39	2.5	
WPCF: Yonkers	8.24	4.7	

Table 4.1. Average concentrations of PCB, dissolved mercury, and PCDD/F (as TEQ/BEQ) in treated municipal wastewater immediately prior to discharge. The units are nanograms/l (parts per trillion), and picograms/L (parts per quadrillion)[1].

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[1] TEQ=toxic equivalency; BEQ=bioaccumulative equivalency. See the discussion on PCDD/Fs below.

As shown in Table 4.1, there are ample opportunities to locate and abate toxics sources. Wastewater treatment plants are highly effective at reducing toxic substances but cannot generally meet the most stringent targets.

While it can be safely assumed that any particular area (natural drainage, receiving body, or wastewater effluent) will show exceedances of the most stringent WQC, it is appropriate to actually demonstrate it. Techniques are available to do so and will be discussed.

6.3 Track down - Understanding the Target Chemicals

The most powerful tool for locating toxic chemicals is an understanding of what generates them and where they might be found. The more the investigator knows about the chemical and about the history of the area studied, the greater the chances of locating and ultimately abating sources. The New York Academy of Sciences is in the process of publishing a series of booklets intended to help in contaminant track down and pollution prevention. Volumes are now available for mercury[2] and cadmium[3] and reports are under preparation for PCBs, PCDD/Fs, and polynuclear aromatic hydrocarbons (PAHs).

We will discuss track down strategies and methods for three pollutants, mercury, PCB, and dioxin. Mercury is the easiest from the standpoints of fieldwork and data interpretation. PCBs are more difficult to collect and analysis is very much more expensive. PCBs are complex mixtures that offer the track down specialist the advantage of fingerprints. Fingerprints are patterns of relative abundances of PCB elements that help locate sources. PCDD/Fs are also complex mixtures. They are more difficult to sample in the fie! because the most characteristic elements are extremely dilute. PCDD/Fs also have fingerprints but the relationships between fingerprints and sources are less well known. Toxicological and bioaccumulative weighting factors must be applied.

6.3.1. Mercury

The production of metallic mercury is among the oldest of continuing technological activities. The Almaden mine in Spain has been in operation for more than 2,000 years.

Modern mercury uses fall into five major categories. Knowing these uses and imagining consequences can enhance the success of track down. For example, the use of amalgams in dentistry results in mercury emissions from crematoria. Uses of mercury as a fungicide in shipping raw cotton results in the metal being found in commercial laundries.

1) Mercury is an excellent electrical conductor hence its use in silent switches, thermostats, and other electrical equipment. Positional switches, such as those that tum on lights in automobile trucks when the lid is raised, use mercury. Automotive scrap yards are potential mercury sources.

2) Mercury dissolves into other metals such as gold, silver, and sodium. Mirrors were made by evaporating off the mercury component of a silver amalgam from glass. Amalgam methods were used extensively in the California gold rush and are still used in gold refining in Brazil and Venezuela. ln this case, mercury is contacted with gold bearing sands and poured off to evaporation pans. After boiling off, the gold is left behind. Mercury cell chlor-alkali plants use mercury's amalgamation with sodium and its electrical properties to liberate chlorine from salt. In the process, mercury traps the metal sodium as an amalgam. For example, the Allied Chlor-Alkali plant operated mercury cell and diaphragm cell to make chlorine next to Onondaga Lake in Syracuse. Some 83 tons of mercury were dumped into the Lake from 1946 until 1970. Dental use of amalgams accounts for a major source of anthropogenic mercury in urban settings.

3) Mercury's toxicity has been used as fungicide to protect seed grain, to preserve cotton and wood pulp during shipping, inhibit mildew in latex paint, and to prolong the life of lumber. Mass poisoning events have occurred in Iraq and Guatemala from consumption of grain containing ethyl and phenylmercury fungicides. Its toxic effects have also been

used medicinally. Mercurochrome was a widely used antiseptic as late as the 1960s and 19th century physicians made extensive use of mercuricals in treating a wide variety of ills. The application of mercury for the treatment of syphilis made it the first synthetic pharmaceutical agent.

4) The high density and liquidity of mercury have made it useful as bearings for large optical devices like telescope and lighthouse mirrors and as bearings in trickling filter sewage treatment plant rotators. Mercury ballast has been used in submarines. Mercury was used as a bed for pouring molten glass to make windows. Mercury's high density, predictable expansion characteristics, and its inability to "wet" glass have made it a useful component in measuring devices such as manometers, barometers, sphygmomanometers, and thermometers. Mercury filled measuring devices are fragile and often break in use. They have also been manufactured at several locations in New York State. In the mid-20th century, mercury boilers were used in electric power generation.

5) Mercury is a reactive substance that has had many chemical uses. Mercuric nitrate was used to soften animal hair in the felting process. The infamous Minamata mercury poisoning disaster was caused by using mercuric chloride as a catalyst in manufacture of polyvinyl chloride and mercuric sulfate in producing acetic acid, ethyl acetate, acetone, octanol, and vinyl acetate. In the US, however, different metals seem to have been used for the syntheses of these chemicals.

An evaluation of mercury sources to NY/NJ Harbor [2] found:

Sectors	Kg/year
Dental facilities	4,000
Hospitals	1,400
Laboratories	600
Thermometers	500
Utility furnaces	400
Industrial/commercial furnaces	350
Waste	250
Household furnaces	200
Automobile fuel consumption	150

Cremetoria	25
Products	
Vehicle switches	900
Fluorescent lamps	700
Thermostats	600
Batteries	100
Lighting switches	100
Appliance switches	25
Other	
Magico/Religious	400

Mercury occurs naturally in fossil fuels and industrially processed inorganic minerals. The overwhelmingly dominant source of anthropogenic mercury to the global environment comes from combustion of fuels.

Because mercury is so widely distributed, field personnel must be extremely careful to prevent contamination of samples.

6.3.2. PCBs

PCBs are a family of 209 mono- to decachlorinated congeners. They may be treated as individual chemica1s (congeners), as homologues (summation of all congeners having the same molecular weight), as trademarked industrial mixtures of congeners (Aroclors® (Monsanto), Clophens® (Beyer), Kanechlor® (Kanegafuchi)), or as totals. PCBs were intentionally manufactured in the United States from 1930 until 1977. Intentional production of PCBs is now banned but certain chemical processes result in the inadvertent production and release of PCBs. This still occurs. The most thoroughly documented cases of inadvertent PCB production is in the organic pigment industry and in manufacture of titanium dioxide[5].

Notice on Table 4.1 two wastewater treatment plant effluents with outstanding PCB concentrations, PVSC in Newark, NJ, and Port Richmond on Staten Island, NY. Both of these facilities receive wastes from pigment manufacturers and the Port Richmond source has been tracked back to an organic pigment manufacturer. Almost all the PCB at these facilities is waste from pigment manufacture. Diazo pigments based on 3,3'-dischlorobenzidine (pyrazolone red and diarylide yellow) are used in plastics and printing and bas resulted in contaminating recycled waste paper.

Intentionally produced PCBs were made m different grades and have different trademarks. Almost all the PCB in New York State was made by the Monsanto Corporation and sold as blends of different congeners under the name "Aroclor". For example. Aroclor 1242 was made for the capacitor industry and is a light oil with 42% chlorine by weight After epidemiologists linked PCBs with human disease Monsanto reformulated the process and sold a replacement for Aroclor 1242 called Aroclor 1016. Aroclors 1254 and 1260 were frequently used in transformers and have 54% and 60% chlorine. These are more viscous than Aroclor 1242. The PCBs in the upper Hudson River are largely Aroclors 1242 and 1016 from capacitor manufacture. In New York Harbor heavier PCBs are seen that probably come from leaking transformers.

PCBs were also used as hydraulic fluids in mining machinery and in high temperature applications. An automotive parts factory in Syracuse leaked PCBs that had been used as hydraulic fluids. PCBs from hydraulic fluids also turned up in Massena, NY from aluminum and engine manufacturing. PCBs were used as heat exchange fluids. Leaks from heat exchangers in Japan and Taiwan in the 1960s and 1970s provided the first evidence of harm to humans. A heat exchanger leak occurred in Niagara Falls from a company making plastic mesh bags for onions. PCBs were used to make carbonless copy paper and recycling office paper resulted in contamination of much of the paper supply (independently of yellow pigment). Elevated PCB concentrations below a recycle paper factory in Carthage, NY contaminated much of the Black River. PCBs were used as cutting fluids (liquids used to flush out metal chips and to cool the cutting tool) in machining operations and contaminated a portion of the Niagara River below the outfall of an automobile engine manufacturer in Buffalo, NY. Aroclor 1262 is a wax that was used in precision casting. This may have been used at an arsenal in Watervliet, NY. Natural gas compressors used PCB fluids and resulted in the distribution of PCBs to customers on Long Island.

In most cases PCBs found today were made before 1978. They are persistent. The largest use of PCB oil was in the manufacture and maintenance of electrical transformers, capacitors, fluorescent ballasts, and switching gear. PCBs can be found where these items were manufactured (if before 1978), deployed, repaired, or discarded. PCB capacitor filling was performed in General Electric at sites located in Hudson Falls and Fort Edward. PCBs were lost from transformer maintenance facilities in Buffalo. Transformers on electrically powered locomotives leaked in use and during servicing resulting in PCBs along railroad tracks and in maintenance yards. This may have occurred around the Selkirk and Croton Harmon yards. Not all transformers were intentionally filled with PCB oil but some "non-PCB" transformers may contain relatively high PCB concentrations from cross contamination. Almost all installed transformers that had contained PCB oils have been drained and now have non-PCB oil (meaning less than 50 parts per million) but there may be PCBs around the site from previous spills and leaks. PCBs were lost from a transformer fire at the State Office Building in Binghamton, NY (2/5/1981), from a fire at Coykendall Science Building at SUNY New Paltz (12/29/1992), from a failure at the Arthur Kill Generating Station, Unit #2 (9/7/1998)[1], and from the residual amounts in the transformers at the World Trade Center following its destruction on 9/11/2001. The World Trade Center main transformer held 100,000 gallons of "non-PCB" fluid perhaps containing l0 parts per million PCB. The total amount of PCB was about one gallon.

Scrap metal yards are often PCB sources. Salvagers may spill fluids from PCB-containing devices (transformers, capacitors, hydraulic equipment) to recover valuable metals. Scrap paper containing carbonless-recycle may be PCB contaminated. Waste oils were often contaminated with PCBs and in some cases waste oils were donated to fire fighter training facilities as practice flammables. This occurred outside of Oswego, NY at a utility-owned fire training facility. Waste oils, sometimes contaminated with PCBs, were also used to suppress dust on dirt roads and racetracks.

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[1] The Arthur Kill transformer was "non-PCB" (less than 50 ppm) but the unit was surrounded with box beams that had been loaded with Chlorextol©, a PCB containing product trademarked by the Allis-Chalmers Corp. for noise suppression. Other trademarked PCB containing products are Dykanol© (Federal Pacific Energy of Newark, NJ); Noflamol© (Wagner Electric of Newark, NJ); Inerteen© (Westinghouse); Pyralene© (General Electric); and Therminol© (Monsanto). Therminol is still an active trademark but no longer contains PCBs.

PCBs were used as bridge-bearing lubricants, as adhesives and in waterproofing compounds, synthetic rubber, waxes, sealants, paints and varnishes. Immersion fluid for high-power optical microscopy was PCB.

Due to their volatility and widespread usage, PCBs occur in all surface waters and in all surface soils. Background concentrations of PCB in the ocean are around 10 picograms/L. The NYS Ambient Water Quality Standard for the protection of humans eating fish is 1 picogram/L.

While intentiona1 manufacture of PCBs is ceased, pools of PCB remain in soils, sediments, and wastes. PCBs bound to soil or sediment particles are mobilized during mechanical stress and PCBs may be desorbed by other processes.

Because PCBs are complex mixtures of many congeners, the data may contain a great deal of fingerprint information.

6.4 Project Task/Description

A track down project has three parts; preliminary planning and surveys, execution of sampling, and data manipulation storage, and interpretation.

Preliminary planning and surveys is where the relevant information about known and potential sources is assembled. The more that is known at a project's outset, the greater the likelihood of success and the more efficient track down will be.

It is recommended that track down be initiated when data show the occurrence of the targeted analyte at a downstream location in concentrations exceeding some criterion. This may pose challenges in that the downstream or receiving body concentrations may simultaneously exceed WQS and be undetectable by conventional sampling and analytical methods. Fortunately, non-conventional methods are available, but they are expensive, slow, and non-standard.

Once the occurrence of the targets is established, a search can be initiated to discover sources. The search may be directed by knowledge of potential sources or it may be a fishing expedition where multiple possibilities are investigated iteratively.

Investigators need to remember the potential of historical sources. ln some instances long extinct facilities are responsible for long-lived pollutants. Historical research came be done using old maps, old phone books, old business directories, and old fire insurance maps. As an example, the pesticide/flame retardant Mirex (so termed when marketed as a pesticide to kill fire ants; "myrmex" is Latin for ant. The same substance was marketed as a flame retardant and trademarked Dechlorane®) was discovered in Eighteenmile Creek in Niagara County. Searches of old Labor Department Records and old Dunn and Bradstreet reports revealed a defunct facility on the upper creek that had manufactured fire-proofed theatrical curtains and fabric wire insulation. It seemed logical that a business making flame-proofed material might have been interested in Dechlorane. Sediment samples at the former outfall showed Mirex present but sediments taken a little upstream showed no Mirex.

Another example of paper track down was an investigation into potential mercury sources in NYC from magico-religious practices. Metallic mercury is sold to practitioners through stores called "botanicas". This practice is now restricted by new legislation. Working with people knowledgeable about botanicas, NYC telephone books, and mapping software, a botanica map was created to identify neighborhoods with high concentrations of the stores. As it turned out, these places were so numerous and so widely distributed that the track down was abandoned.

A valuable source of information about known sites in New York State is the NYSDEC Division of Environmental Remediation's series of Inactive Hazardous Waste Disposal Sites. These are available for each of the nine regions in the state and contain information about the sites, history, known chemicals present, the status, and the locations of the sites.

The sampling component includes evaluating available sampling technologies, understanding the relationships of potential sampling sites, and dealing with analytical laboratories. This component also includes collection of sampling data and inputting them into a data management system.

Data manipulation, storage, and interpretation involve the jobs of choosing data quality objectives and criteria, database design, database quality control (ensuring that entered data are complete, accurate, and safely stored), and data interpretation.

6.5. Quality Objectives and Criteria

Track down data are usually not used for direct enforcement and often do not need to withstand legal scrutiny. That means that project planners have the freedom to use non-standard methods. Unusual methods that generate semi-quantitative data can be used or entirely new techniques can be developed. It does not mean that poor quality data are acceptable. Elements of data quality include detectability, reproducibility, freedom from interferences, freedom from field or lab contamination and accuracy.

Detectability is the function of measuring the targeted analyte. ln almost all cases POPs are present at concentrations very much greater than the most stringent water quality standard. Non-detections of persistent pollutants are due to inadequate field or lab technique.

Reproducibility is the function of getting the same number from an identical sample. Since the environment is highly variable, the only way to measure reproducibility is through replicate samples. There are two kinds of reproducibility; reproducibility of concentrations, and, for multi-element substances like PCB or PCDD/F congeners, reproducibility of fingerprints. Both kinds are quantifiable and can be treated statistically, however fingerprints are often more stable (repeatable with time) than concentration.

Interferences can be very significant problems in analysis of complex mixtures like sewage. This has been a serious defect in measure PCBs in wastewater by gas chromatography/electron capture (GCIEC) methods. NYSDEC recommends using the more sensitive high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) methods for PCBs. The standard method for PCDD/Fs is HRGC/HRMS.

Field and laboratory contamination has been a long-standing problem in mercury analysis. The solution is a great deal of vigilance and numerous field and lab blanks.

6.6 Special Training/Certification

There are neither certifications nor courses in track down. Those facing the tasks of track down project design and interpretation need to be familiar with the possible sources of the target substances and the current and former sites in their area of interest that may have generated them.

Field personnel require extensive training and close supervision to perform the methods properly.

6.7 Documents and records

Extensive record keeping is essential. The details of what needs to be recorded are to be found in the discussions of each sampling method and in the Data Management section. Preprinted forms are useful for field recording. The forms serve as reminders as to what needs to be noted and are to be retained for keypunching and for reference. Entering field notes on a laptop computer saves time and possible errors in transcription but often screens are impossible to read in bright sunlight, they are more prone to failure than paper, and they do not easily accommodate unanticipated notes.

6.8 Tools For Track Down

The objective of track down is a convincing discovery of continuing sources. Since abatement will cost money, time, effort, and possibly good will, the strength of the argument setting these things in motion must bear considerable scrutiny.

Design of the track down takes both these needs into account. The elements of the track down are:

Field sampling design
Field sampling methods
Laboratory analysis
Data storage and manipulation
Data interpretation

6.9 Field Sampling Methods- Overview

In this section field methods are briefly compared and discussed. More detail is provided in Section 6. 10, *Field Sampling Methods – Details.*

Sampler Type	Analyte	Cost per unit	Max samples/day	Sensitivity	Temporally Integrating
Grab, water	H	$5	~30	Low	Low
Bottom sediment	P,D,T,H	$5	~30	Medium	High
Suspended sediments	P,D,T	$1,000	5	Medium	Medium
Automatic composite samplers	P,T,H	$4,000	24	Low	Medium
PISCES	P,T	$30	~30	Medium	High
TOPS	P,D,T	$10,000	1	Very High	High

Table 4.2. Selected sampling methods along with their target analY1es (P= PCB. D=PCOO/F; T=chlorinated pesticides; H=mercury), relative costs. rapidity, ability to detect low concentrations (Sensitivity), and ability to collect a temporally integrated sample (Temporally Integrating).

TOPS – Trace Organics Platform Sampler. TOPS was invented at NYSDEC and is intended for quantifying extremely dilute organic chemicals in water. It is slow, complicated, and very expensive. While not conventionally considered a track down tool, TOPS can provide accurate measurements of trace contaminants such as PCDD/Fs, PCBs, and chlorinated pesticides in final effluents and ambient sites. It can be configured to operate over periods ranging from hours to weeks. TOPS samples are lightweight and physically robust making them easy to ship to distant analytical labs. It collects suspended sediments and the dissolved phase separately. TOPS can be used as a device for filtering water if only suspended solids are required. The TOPS setup may be used to obtain mercury samples **but** as a side train.

Grab Water – Easy and cheap to take, grab samples are often disappointing in that they may collect insufficient analyte masses to overcome blanks or to adequately distinguish congener/homologue fingerprints. Grab sampling may also fail to find intermittent loads driven by storm events or production cycles. The costs of shipping water to distant labs may be high and there are risks of breakage in transit. Where source concentrations are very high and are consistent, grab sampling is completely adequate. Mercury is obtained from grab water samples but the extreme care that must be exercised for proper sampling often precludes simultaneous sampling for other analytes.

Automatic Composite Samplers - The problems and advantages (except initial cost) for automatic water samplers are similar to those of water grabs except that they provide temporal integration. The high cost of the units makes it difficult to use them at many sites in a network. When it is desirable to have round the clock discrete sample, they are mandatory. Mercury may *be* collected with automatic samplers, but care needs to be exercised to avoid contamination.

Bottom sediments – Bottom sediments provide an historical record but a record that is not always easy to interpret. The composition of sedimenting materials change with time, the rates of deposition change with time, the age of sediments at the surface of a sample may not be recent, and sediments may be unavailable at desired locations, and sediment sampling usually requires a boat. Some of the interpretive problems of sediments may be addressed, at a cost, by radio dating – measurement of radioactive isotopes of differing sources and half-lives. Physical and biological forces often scramble sediments confusing the stratigraphy. Bottom sediments vary greatly in quality from gravel to organic oozes. Sediments are frequently not available from high-energy locations such as sewer pipes. The affinity of PCBs to sediments is a function of the nature of the sediment. Highly organic sediments (measured as total organic carbon) have greater affinity for PCBs than inorganic and coarse materials. Samples are compact and easily shipped but may require post-processing in a laboratory.

Suspended sediments - are materials currently in motion. Since they are in the water column, they are likely to be finer than the particles in the bottom sediment. WQS for organic contaminants do not distinguish between particulate and dissolved phases so contaminants on suspended sediments, if expressed as mass/L, are interpretable under the WQS. This is not true for bottom sediments. Collection of suspended sediments can be difficult and, if working with raw wastewater, unpleasant and possibly dangerous. Field concentration techniques are centrifugation or filtration. Centrifugation is complicated and very expensive – small continuous centrifuges cost approximately $25,000. Field filtration using peristaltic pumps or compressed nitrogen is cheaper but much slower and more prone to contamination.

PISCES – Passive In-Situ Chemical Extraction Samplers. PISCES is another shop- made device but unlike TOPS, it is relatively cheap. PISCES is integrative over one or two weeks, quickly deployed, and moderately sensitive. PISCES is fairly good at seeing PCB congener patterns, less suited to accurate PCB or pesticide quantitation, and unsuitable for PCDD/Fs or mercury. There is a considerable literature on SPMDs – Semi-Permeable Membrane Devices. These are very similar to PISCES except that they have a greater surface area, use the lipid triolein instead of hexane, and require greater field handling[6]. They can also be purchased ready-made. All passive samplers suffer from imprecision. Sampling rates are affected by turbulence, water temperature, and the condition of the membrane surface.

6.10 Field Sampling Methods -Details

6.10.1 TOPS

TOPS is a highly adaptable system than can be configured in different ways for different applications. Its main peristaltic pump pulls water from the source and pushes it through one or more glass fiber filters to capture suspended particles. A pressure sensor shuts it down when the filter clogs. The shut-off pressure is user-defined but is usually set at 15 psi. The filtered water passes a tee. Some of it is usually wasted and exits through a flow totalizer. The remaining water is pulled through columns containing the synthetic resin XAD-2 and exits through a second flow totalizer. The filter and the XAD columns are sent to a lab for analysis. The total amount of water filtered is the sum of the two flow totalizers and the amount of water passed through the XAD columns are known by the output of the second totalizer. A number of modifications to the basic TOPS allow sampling for suspended sediment, particulate organic carbon, dissolved organic carbon, conductivity, and metals. Extra quality control devices have also been incorporated. Modifications to the system remove large zooplankton and permit shipboard operation.

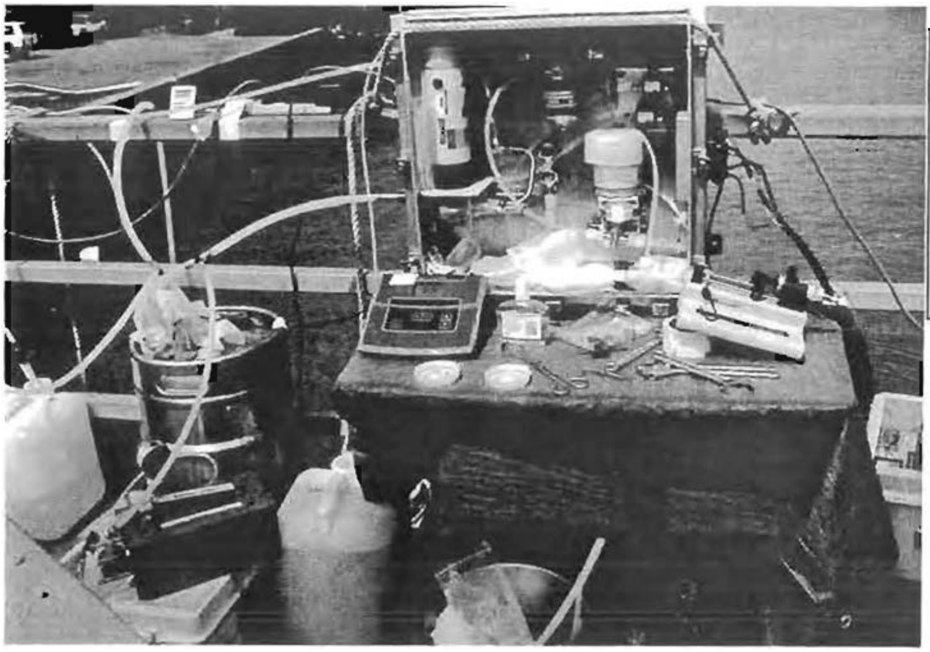

Figure 6.1. TOPS deployed on a bridge over the Passaic River. Once set up, numerous modifications permit sampling additional parameters and the inclusion of numerous quality control components.

The amount of water processed by TOPS for a sample can be very large. Typically, final effluent samples from a wastewater treatment plant are 100 – 200 L. Open ocean samples are 5,000 to 10,000 L. TOPS concentrates the analytes so that there are no limits to detection. By using large samples, detection of ultra-trace chemicals can be assured. TOPS can be run as a totally enclosed system so that it can be operated in very dirty environments such as on ships, on busy highways, or in sewage treatment plants.

TOPS is not commercially available and requires at least two operators, one of whom must be experienced.

6.10.2 Grab Water Samples

This method is recommended for mercury track down. Mercury is a very difficult analyte to sample because it is so widespread in the environment and in many analytical labs. It has been determined that a great deal of historical mercury data are compromised by sampling and analytical contamination. USEPA Method 1669[7] details a safe way to sample for mercury. Specially cleaned Teflon® bottles are brought into the field double bagged in Ziplocks®. All work surfaces are covered with clean plastic sheeting. Samplers are designated "Dirty Hands" and "Clean Hands". An unsuited third helper takes notes. Dirty Hands, fully gloved and garbed in plastic, assists Clean Hands. Dirty Hands puts plastic outer garments and class 100 gloves on Clean Hands. Dirty Hands is permitted to touch the outer surfaces of the outer Ziplock®. Clean Hands removes the bottle from the inner Ziplock® and fills it. While filling, Clean Hands takes extreme care not to unnecessarily expose the bottle to airborne contaminants and avoids breathing on the bottle to minimize contamination from dental work. After filling, Clean Hands replaces the bottle in the inner Ziplock® and Dirty Hands seals the outer Ziplock®. Frequent blanks (five blanks per sample) are taken to demonstrate cleanliness. As the team develops proficiency (measured by the blanks) fewer blanks are required. The method also allows a peristaltic pump to be used if the tubing has all been appropriately cleaned. It is advised to have the tubing cleaned by the analytical lab. It too is shipped double bagged and is handled in the same way as the bottles by Dirty Hands and Clean Hands.

These methods are difficult to perform when the water surface is not readily reachable, for example when sampling off ships, bridges, or in manholes. Modifications use a submersible magnetic impeller pump to bring water to the TOPS. A tee on the intake line (always use new tubing) is attached to a clean tubing offshoot. The offshoot is taped to a rail giving a convenient fixed sampling point (see Figure 4.1). Samples are not taken until a large volume of water (500 L) thoroughly flush the lines. The actual sample is taken with Clean Hands, Dirty Hands, and the note taker.

The TOPS procedure is well suited to collecting dissolved mercury samples. A 3/8-inch ID plastic tube is inserted into the 1-inch ID offshoot. This set-up is permitted to thoroughly flush. The 3/8-inch ID closely fits over the intake end of a pre-cleaned (and double bagged) 0.45 micron Gelman Scientific High Capacity In-Line Groundwater Sampling Capsule®. The Sampling Capsule has an intake end (rounded) and an outlet side (a cap). An arrow on the body shows the proper flow path. Clean Hands attaches the Sampling Capsule to the 3/8-inch ID line immediately before sampling. A pre-cleaned short flexible tube from the end of the Sampling Capsule helps direct water into the bottle. Filtration for dissolved mercury should be done in the field to avoid phase changes.

Researchers at Environment Canada have recently built and field-tested two devices (ISOMET) that promise to make clean mercury sampling by a single individual easier and safer[8]. Both hold a bottle that had been pre-cleaned in a mercury lab. The bottle may be remotely opened and closed under water. One model is suitable for working short distances and the other is designed to work off high bridges or from a ship. NYSDEC has built its own copy of the short distance sampler and is having it field-tested at wastewater treatment plants.

Once collected samples are kept dark and cold and are shipped by courier within 24 hours to a laboratory capable of performing USEPA Method 1631 (or a similar method). Ensure that there are sufficient blue ice packs in the cooler to keep cold during transit.

6.10.3 Bottom Sediments

Sediments serve as sorption sites for hydrophobic chemicals. Sediments are used only occasionally for track down. A notable instance was the discovery of the pesticide/flame retardant Mirex in Lake Ontario and a source from the Oswego River[9]. Sometimes a few sediment samples can assist in track down.

There are two general ways to collect sediments; surface grab samples and cores. Surface grab samples are typically taken with a mini-Ponar. This hand-held device is lowered down opened. When it comes to rest on the bottom and the tension is released from the cable, the jaws are freed and they close biting off some sediment when the cable is pulled up. In soft sediments the mini-Ponar takes up a sediment section that is about four inches thick. On the surface the contents are spilled into a tray or bucket. Sub samples may be taken after thorough stirring or, if the sample is compact, an upper surface may be taken.

Sediment cores, taken with a Vibracorer or a piston corer, help in determining the chronological order of contaminant deposition, particularly when coupled with radio-dating. Deployment of these devices requires a boat and usually a power winch. They are not often used in projects specifically designed for track down but data from any kind of project may be used for source identification.

6.10.4 Suspended Sediments

Suspended sediments may be field-concentrated with a TOPS. An alternative to TOPS is a pressure filter device costing around $1,300 and requiring compressed gas (such as high-purity nitrogen), a pressure gauge, and a regulator. Water can be poured into the reservoir over a flat glass fiber filter. The reservoir is closed and pressurized. The process is repeated until a sufficient mass of sediment is collected. The glass fiber filters (for TOPS or for the pressure filter device) should be ashed for 4 hours at 450° C, wrapped, while still warm, in aluminum foil and kept frozen in Ziplocks® prior to use. Take care not to touch the filter and prevent the filters from being bent before use. After use remove the filter with acetone-rinsed tongs and fold over covering the collected sediment. Replace the filter in the aluminum wrapping, which has been kept in the Ziplock®. Keep the filters frozen before sending out for analysis. This method is much slower and more prone to contamination than TOPS but is much less expensive to set up.

6.10.5 PISCES

PISCES is a short brass 2-inch diameter brass nipple closed off at the top with a disk of Teflon and a slip nut seated on a Viton O-ring. The bottom is sealed with a 4x4 inch single layer of Soxhlet-extracted 1 mil polyethylene. The Teflon and Viton are specifically ordered but the other parts are available from hardware stores. The polyethylene is held in place with a slip nut and another Viton O-ring. A hose clamp secures a wire loop that allows the device to be deployed vertically with the polyethylene side down. The cost of each unit is about $30 and they are, excepting the polyethylene, infinitely reusable. Immediately prior to deployment the unit is rinsed twice and then filled with high-grade hexane from the top (Figure 6.2).

Figure 6.2. Preparing PISCES for deployment. PISCES are usually set out in pairs. They are thoroughly rinsed and the filled with hexane immediately prior to placement. Never transport PISCES loaded with hexane.

The hexane saturates the polyethylene and creates a solvent/water interface. Chemicals like DDT or PCB dissolved into the hexane, pass through the membrane, and are trapped in the bulk phase solvent inside. Some solvent dissolves off the bottom but the analytes should remain in the bulk phase. Losses will occur if tears or leaks develop.

Polypropylene rope is used to secure the units inside a manhole to the rungs of a ladder or, through holes in the top of the manhole. A typical surface water deployment uses an anchor and float. The anchor is a cinder block and the float is an empty ½ gallon plastic jug. The units should be positioned such that they are mostly vertical and the polyethylene is always covered by sample water. We used deploy them in pairs. Record the water temperature and placement and at recovery. The units are usually deployed for about two weeks except if the water temperature is greater than 20° C or the water is very turbulent. In the cases of high temperature or turbulence, reduce expose times to no more than one week. Record times of placement and recovery and temperatures of deployment at recovery.

After deployment., the PISCES are disassembled for cleaning with hot soapy water. The metal parts may be baked in a muffle furnace. The Teflon and Viton pieces are solvent rinsed. Fresh polyethylene is used after Soxhlet extraction.

After deployment (usually one or two weeks) the PISCES are pulled, wiped dry, and immediately decanted into amber pre-cleaned glass bottles with Tefon lid liners. These are stored frozen until shipping to minimize contamination. The labs are instructed to report total analyte mass recovered. This mass can be converted to a very rough approximation of concentration by the formula:

sampling rate S (L/cm/day) = $\exp((-6591/T)+19.269)$

where T is absolute temp (K). The effective sample volume (V) is:
$V=S$ x membrane area in cm^2 x days of exposure. The unit of V is liters. Temperature is most conveniently measured at deployment and at retrieval. More elaborate temperature measurements may be used but they are of doubtful value. The qualitative aspects of PISCES results expressed as relative homologue abundances is probably more valuable than the quantitative. PISCES results are affected by turbulence but there are no techniques for quantitatively dealing with turbulence.

To calculate a rough concentration, divide the total analyte mass recovered from a PISCES by V.

Successful PISCES track down projects have been conducted in the Black River where PCBs were found entering at Carthage[10], a source to the Arthur Kill was found to be a facility recovering precious metals from obsolete electronic circuitry, and DDT was discovered in onion fields on the upper Wallkill River.

6.11 Field Sampling Methods - Strategy

Track down projects start with a need to know where a chemical is coming from. The impetus may be an ecosystem model or a previous investigation where the substance was seen but where its source is still in doubt. The investigator needs to proceed as quickly as an inexpensively as possible. Two different strategies are available, directed searches and fishing expeditions.

In initiating a track down, remember that the concentrations of the target analytes will usually greatly exceed the WQS but even so may not have an identifiable source. Many POPs are primarily transported by atmospheric processes and will not be significantly abated on a regional or larger scale by track down and remediation. The project managers will often have to choose between attempting to identify sources that contribute to high concentrations or to high loads.

We have had most experience in attempting to track down PCB sources. As a rule of thumb, we rarely pursue source identification from initiating samples having less than 10 ng/L total PCB.

6.11.1 Directed Searches

Directed searches are much preferable to fishing expeditions. Through an understanding of potential sources and knowledge of the facilities (past as well as present) in a drainage area, a small number of likely sites can be investigated.

An example of a directed track down occurred when NYSDEC investigators discovered an unusual PCB congener in the effluent of a wastewater treatment plant on Staten lsland.[4] The original sampling was done with TOPS. Through a literature search it was discovered that the PCB congener in question was inadvertently produced along with certain commercial organic pigments. A pigment manufacturer in the drainage was visited and acknowledged producing the congener. Concurrent fieldwork using PISCES placed in sanitary sewer manholes confirmed the pigment plant source and ruled out other sources. Besides the congener in question, the fieldwork showed the presence of other, more toxic PCB congeners.

The manufacturer told investigators that their products were made in batches. This information led to the choice of using PISCES so that samples would represent two weeks.

An intermediate used in the pigment production and the precursor of the unusual congener is listed in EPA's Toxic Release Inventory (http://www.epa.gov/triexplorer/). Searching the TRI database revealed other pigment manufacturers in the region that used

the intermediate and limited sampling data suggests that they too are generating the PCB. This will help in further directed searches.

6.11.2 Fishing Expeditions

Often the investigators do not have enough information to perform a directed search and begin by surveying multiple sites that represent stream segments or, in the case of sewer systems, trunks. An example of a successful fishing expedition occurred in a track down in the Wallkill River. In the spring of 1997 PISCES were deployed in downstream areas of streams tributary to the Hudson River. Hexane extracts were analyzed for PAHs, PCBs, and pesticides. The resulting data were difficult to interpret for PAHs, no significant PCB sources were encountered, but DDT turned out to be very abundant in the Wallkill River.

The Wallkill River was then revisited with PISCES deployed from bridges at roughly 10-mile intervals. The most upstream site, at the NY/NJ border, showed the least DDT but the next site showed the most. The interval is a rich bottomland agricultural area called the Black Dirt Area.

Sediment cores taken near the mouth of the Wallkill River showed that the highest DDT concentrations occurred in the most recently deposited strata. TOPS samples taken immediately below the Black Dirt Area showed that most of the DDT was associated with suspended sediment. Sediment samples taken within the Black Dirt Area showed very high DDT concentrations.

Fishing expeditions have been undertaken in sewer lines. The strategy has been to begin at the raw water intake at the sewage treatment plant. Some plants have multiple entry points and some have significant amounts of recycle water entering at physically convenient sampling locations. Avoid recycle water. If influent samples indicate elevated concentrations (more than 10 ng/L for PCBs or dissolved mercury), the next step is sampling the major trunks.

A PCB track down in New York City (26th Ward in Brooklyn) found very high PCB levels in two separate trunks. They both were from Aroclor 1260. It seems that the plant drains a former industrial area and much of the sewer system is contaminated.

In Rochester, five major trunks were sampled for PCB after seeing high concentrations in the influent. One of the trunks showed both high concentrations and a homologue pattern similar with that of the combined influent. That trunk was explored with another six samples and again, one line stood out. Another round of six samples identified a facility.

6.12 Laboratory Analysis

New York State Approved Labs for mercury by EPA 1631:

10121
MICROBAC LABS INC ERIE TEST LAB DIV

(814)825-8533
1962 WAGER RD
ERIE, PA 16509
10975
STL NORTH CANTON
(330)497-9396
4101 SHUFFEL DRIVE NW
NORTH CANTON, OH 44720 **11109**
ACCREDITED LABORATORIES INC
(732)541-2025
20 PERSHING AVENUE
CARTERET, NJ 07008
11121
KATAHDIN ANALYTICAL SERVICES INC
(207)874-2400
PO BOX 720 - 340 COUNTY RD #5
WESTBROOK, ME 04092
11436
EN CHEM INC
(920)469-1436
1090 KENNEDY AVENUE
KIMBERLY, Wl 54136
11501
GENERAL ENGINEERING LABORATORIES INC
(843)556-8171
2040 SAVAGE ROAD
CHARLESTON, SC 29407
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11662
FRONTIER GEOSCIENCES INC
(206)622-6960
414 PONTIUS AVENUE NORTH
SEATTLE, WA 98109
11688
BROOKS RAND LLC
(206)632-6206
3958 SIXTH AVENUE NW
SEATTLE, WA 98107
11775
COLUMBIA ANALYTICAL SERVICES - KELSO
(360)577- 7222
1317 SOUTH 13TH AVENUE
KELSO, WA 98626

PCBs can be analyzed using GC/EC (gas chromatography/electron capture) or HRGC/HRMS. Results can be expressed as Aroclor determination or congeners. USEPA Method 1668A provides GC/MS data for all 209 PCB congeners.

GC/EC is cheaper and more widely available. Aroclor estimations fit into some regulatory programs. We prefer to use HRGC/HRMS because it is much less affected by co-elutants (substances that are incorrectly identified as PCBs). We also prefer congener data because it makes fewer assumptions than Aroclor estimations. However, few labs

are capable to doing a good job with 1668A and it very much more expensive. Dioxin is analyzed using Method 1613B. This is widely available.

6.13 **Data** Storage **and Manipulation**

Electronic data are stored in linked tables. The columns are called “fields” and the rows are called "records". Each table has at least one field that links it to another table.

NYSDEC project managers are required to follow the National Water Quality Monitoring Council's Data Elements. These are a lengthy list of fields that will sufficiently describe each sample. The list can be seen at: http://wi.water.usgs.gov/methods/

The database should contain a minimum of four tables: *tblSamples*, *tblStations*, *tblAnalytes*, and *tblResults*.

tblSamples holds all the information relating to sample collection. This includes SAMPLE_ID (a unique identifier for each physical sample links to *tblResults)*, STATION_ID (links to *tblStations)*, date, time, matrix (sediment, water, glass fiber filter, XAD-2 resin, etc.), team leader (record initials. More information such as full name, phone number, email, institutional affiliation etc. may be stored in a separate table), volume, field QC code (is sample a duplicate, a field blank, a regular sample?) and so forth.

tblStations includes STATION_ID (links to *tblSamples)*, station name, station type (surface water, ground water, treated effluent, raw wastewater, and so forth), geographical coordinates (latitude, longitude), and any other information relating to the sampling site. This is also a convenient place to store abbreviations of station names for use in making tables and graphics where the full name may be too long and the STATION_ID too cryptic.

All information relating to the analytes is contained in *tblAnalytes*. Fields include CHEM_CODE (links to *tblResults)*, full chemical name, chemical class (for example, PCB, PCDD/F, PAH, pesticide, metal), and any other information about the substance. Information supplied by laboratories is stored in *tblResults*. Linking fields are SAMPLE_ID and CHEM_CODE. Other fields should be lab name, analytical method, detection limit, lab qualifiers, units, and lab QC code (is the value a method blank, a lab duplicate, a sample, a lab spike). Additional information might be dates of analysis, instrument ID, analyst name, clean-up method and so forth.

Other tables might be helpful in holding more information about project personnel, other environmenta1 data such as weather, stream discharge, or field observations that are not associated with a SAMPLE ID.

Planners should carefully think out the design of a data management system so the correct information is gathered. Field sheets should be prepared for the field teams to record the required data. These sheets a very helpful in reminding the teams of what they must do; field Standard Operating Procedures (SOPs) are often bulky documents not easily read in the field. At the conclusion of surveys, the field sheets are used to input data and are paper records of field activities. They should be kept and, in cases where litigation is possible, signed by the field team leader. The laboratories should thoroughly understand and adhere to the reporting conventions so that proper and consistent terminology is followed. For example, the CAS code might be chosen as the CHEM CODE. The CAS for the PAH perylene is "198-55-0". The lab should know not to report perylene as "198550” or "198 55 0". Values for units and lab qualifiers must also be consistent and precisely defined.

6.14 References

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7. Developing a PMP (Generic)

7.1 Summary of the Process

Summary Description of the Process for Developing a Pollutant Minimization Plan		
Phase of PMP Development	Description of the Phase	Steps of the Process Involved in the Phase
Phase 1	Plan of Study	1. Target the pollutant
		2. Lay the Groundwork
		3. Identify stakeholders and Develop Partnerships
Phase 2	Data Gathering, Data Analyses, Plan of Action	4. Gather Information
		5. Locate and Quantify Sources
Phase 3	Actions and Reporting	6. Pollutant(s) Minimization Actions

7.2 Generic Process for Developing a PMP for any Targeted Pollutant

Note: - The PMP is prepared, submitted and reviewed in three phases, each documented in a Report. The process delineated here embodies all three Phases.

Phase 1 - Shortly following establishment of the requirement for a Pollutant Minimization Program plan, a study plan is to be prepared and submitted. This serves as the "Plan of Study" for the Pollutant Minimization Program. The Phase 1 Report includes Steps 1, 2, and 3 below addressing targeting the pollutant and developing partnerships for follow-up action.

Phase 2 - the second phase report is to present data, analyses, conclusions and statements of intended actions. (TOGS 1.3.3 calls for this report - identified as the PMP - to be submitted within six months after the date of the permit establishing the requirement for the PMP.) The Part 2 Report includes Steps 4 and 5 below. Following approval of the Part 2 Report, approved actions are taken.

Phase 3 - this third phase report documents action implementation and the results obtained; it specifies aspects begun during the process of establishing the P which are to be kept ongoing and recommends any further actions. The Phase 3 Report includes Step 6 below. Approval of this report documents the conclusion of the PMP.

Step 1 (PMP Phase la) - Target the pollutant or pollutants to be addressed - i.e., identify the problem pollutants.

A. Establish the basis for targeting specific pollutants (per regulatory requirements).

The target pollutants for which a PMP is needed will be identified in the SPDES permit. This is consistent with 40 CFR 132, Appendix F, Procedure 8, tributary to the Great Lakes. The permittee is required to conduct a Pollutant Minimization Program (PMP) for WQBELs set at the PQL. The goal of the PMP is to achieve the calculated WQBEL

B. Additionally, a discharger may seek to develop a PMP for one or more pollutants on its own initiative, based on cost or other elements identified below in Part A of Step 2.

C. There should be a separate PMP for each target pollutant identified, however...

1. Related components of separate PMP's could be conducted together, and
2. Separate PMP's should be integrated into a comprehensive Program.

Step 2 (PMP Phase 1b) - Lay the groundwork for the PMP

A. Obtain Top Management support and establish Management direction

1. Document for management the need to establish a PMP:
    a. When it is a regulatory requirement, prepare a basic fact sheet documenting the need.

       (See above, plus use the SPDES Fact sheet for the facility.)

    b. There are also other factors that may establish the need to minimize discharge of targeted pollutant. These may include the following.

1) Capital and O&M cost of additional treatment that would otherwise be required;
2) Treatment and removal of the pollutant once in the waste stream puts the pollutant someplace else where it still needs to be dealt with;
3) Removal at the treatment plant, particularly to the low levels that are necessary, is often not feasible.

2. Present to management the benefits that can accrue from establishing a PMP.
   a. Environmental - (Much of the information that was prepared for informing the public about the Great Lakes Initiative would also be helpful to use in informing management);
   b. Generation of Community good will;
   c. Permit compliance;
   d. A PMP is usually a cost-effective means of reducing the discharge – PMP is less costly than treatment
3. Estimate costs of developing the PMP. Consider both...
   a. internal costs such as staff time – include both personnel and non-personal service items, and
   b. the potential or projected need for consultants, lab support, etc.
4. Prepare a Mission Statement for the PMP.
   a. The Mission Statement must be brief, clear, easily understood and communicated;
   b. It needs to establish a common sense of purpose and direction;
   c. Its focus must be on maximum reduction of the target pollutant in the facility's discharge.
5. Policy Direction - Solicit or prepare for management review a statement of the facility's commitment to the PMP.
6. Scope and Impact – Define the breadth of the PMP (e.g. Will it include non-regulated contributors? How direct will the control on use of the targeted pollutant be?)
7. The Necessary Legal Authority needs to be defined (or obtained if necessary).
8. Establish internal reporting procedures - both routine progress reports and those that will

be needed to address issues and problems encountered.

B. Form the Project Team –

1. . The Team develops a plan and takes the actions necessary to fulfill the plan's goals

    a. The plan must include a timeline for accomplishing significant milestones. TOGS 1.3.3 states that the SPDES permit should require the permittee to propose a PMP within six months of the effective date of the permit and identifies certain items that should have been accomplished by the time of that submission (pollutant mass balance, source track down, and analysis of potential significant sources). It also identifies items that would ensue, most notably actual pollutant reduction.

    b. The Team should build the plan from the Mission, Goal sand Policy Direction set by Management.

    c. The time-line should include points for regulatory review, comment, and approval.

    d. A laboratory component should be a significant part of the overall PMP plan.

        1. The lab component should consider which methods will be employed, quality assurance/quality control, detection levels and even which laboratories might he used for various analyses.

        2. Laboratory requirements should be considered in terms of their impact on budget, schedule and other practical aspects of the PMP

2. Team members should be key people from the utility with knowledge and expertise to develop the PMP and put it into effect.

3. Team Leader (Project Manager) -This person needs good organizational, interpersonal, communication and team-building skills. The Team Leader has a number of responsibilities:

    a. Functions as primary team link with management and other organizations;

    b. Arranges team meetings, agendas;

    c. Assures team remains focused on the Mission and progresses with PMP development in accordance with the plan;

    d. Assures team members and others who may be involved in PMP development clearly understand their responsibilities and have the necessary capabilities

4. Assure the existence of satisfactory communication procedures among those who will be working on PMP development

C. Establish preliminary goals and consider what forms of interim and final evaluation will be used. TOGS 1.3.3 provides some guidance regarding goals and objectives. It establishes the goal of a PMP as achieving the calculated WQBEL. It also states that the PMP should include a schedule to reduce controllable amounts of the pollutant to the maximum extent practicable.

Step 3 (PMP Phase 1c) - Develop partnerships, identify stakeholders and consult with partners and stakeholders

A. Meet with appropriate people in NYS DEC - water pollution control personnel and others with cross-media responsibilities

B. Develop a support/contact network – Consider people from various levels of government, from industry, professional and industry trade groups, academia, providers of technical assistance. Such a network will be a resource for information needed throughout the development of the PMP.

C. Form an Advisory Group
   1. Membership should be comprised particularly from among people in the facility's service area who are knowledgeable about the target pollutant(s). Include both users of the target pollutant(s) and others with differing legitimate interests
   2. Functions of the Advisory Group include:
      a. Identify potential sources of information;
      b. Review information gathered by the Team/Project Group;
      c. Suggest alternative project approaches;
      d. Support PMP initiatives.

D. Take additional measures to secure stakeholder support. (A stakeholder is defined as someone with a vested interest in the PMP, but not directly involved in its production. Some stakeholders should be on the Advisory Group; others will not have the time or interest it will take to participate. However, it is critical to assure effective communication with ALL stakeholders, using newsletters, media, and actively outreaching to both inform and listen to them.

Step 4 (PMP Phase 2a) - Gather information

A. Gather existing information. Consider all appropriate sources, including:

1. Facility operating and reported data, especially on sludge; sewer monitoring data;
2. Industrial user permits and monitoring data;
3. Toxic Release Inventory;
4. NYS Hazardous Site Registry;
5. Historical records of industrial sites (which may indicate use of the target substance[s] in the past, while current site use may not suggest that)
6. If the targeted substance is PCB's. Local fire companies maintain an inventory of PCB-containing transformers.

B. Establish baseline information

1. Research the origins and uses of the target pollutant(s) and develop a list of chemicals/materials which have the target pollutant(s) in them
   a. Uses of the target pollutants may not be obvious
   b. Knowledge of the various chemicals, processes and materials employing the target pollutant(s) will help with tracking down unknown sources. (See Chapter 5 for detailed information on Trackdown.)
2. Survey users of the target pollutant.
   a. This could begin by using a questionnaire

b. Progressively more direct contact could follow as needed.

3. Document Cooperative Arrangements that may exist with external entities to provide treatment services to determine the pollutant load being contributed.
4. Develop a Pollutant Mass Balance. (See the EPA Guidance Manual on Development and Implementation of Local Discharge Limitations Under the Pretreatment Program, December 1987.)
5. Conduct a Headworks Analysis.
6. Audit your own wastewater treatment plant internal processes (Contaminants or incidental components of chemicals used for treatment may contribute pollutants to the system.)

Step 5 (PMP Phase 2b) - Locate and Quantify Sources

A. The actions taken in Step 4 above may identify the sources to a sufficient degree that a meaningful source reduction action plan can be developed. Otherwise additional source location measures are needed.

B. Assess whether an internal sampling program (system assessment) is appropriate - Consider whether sampling throughout the collection system is needed to determine the loading pattern of the target pollutant in the system.

C. Assess whether additional Significant Industrial User sampling is needed and institute if it is.

D. Track down unknown sources - The preceding steps should provide an indication of at least the likely area(s) where the target pollutant is introduced by unknown sources. A focused program of sampling and analysis of the wastewater in those areas should identify the unknown source(s). Again, refer to Chapter 6 for detailed information on Trackdown.

E. Evaluate data to determine relative contributions from among the various sources and project ranges of feasible reductions that might be anticipated from individual contributors and/or from various categories.

Step 6 (PMP Phase 3) - Act to Minimize the Pollutant(s)

A. Evaluate Tools and Options

   1. Audit/inspect users to enable you to understand their processes and to work collaboratively with those who are the process experts. You will be much better off if you can convince users that it is in their own best interest to minimize contribution of the pollutant rather than approach them confrontationally.
   2. Understand and overcome "myths of the trade" - seek new ways to do things rather than existing, institutionalized approaches.
   3. Contact sources and develop options <u>with</u> them - the most effective pollutant reduction is likely to come from those most knowledgeable about the processes employed. Seek to establish voluntary source reduction programs.
      a. Enlist people to use their creativity to find ways of doing what must be done.
      b. Reasons for pollutant minimization are not merely regulatory in nature, but also are ethical, environmental and economic. Human health risk is a major concern. In many instances, voluntary source reduction produces net economic benefit to the discharger.
      c. When working with industry's environmental managers, offer to assist them by explaining the importance of pollutant minimization to their management and the employees who will be actually doing the work to reduce the pollution. (See Chapter 6 for more information on this subject.)
      d. Ask companies th.at have already implemented effective source reduction programs to offer source reduction assistance to companies that could do better.
   4. Highlight Sectors/Sources that are apt to achieve the most cost-effective results. Members of the Advisory Group can be very useful at this phase in helping to formulate the most effective approaches to individual sources and attesting to the credibility of the PMP process thus far.

B. Set specific Goals and Objectives

C. Implement the Program

    1. Establish a Publicity Campaign to promote knowledge about and support for the PMP.
    2. Document success stories.
    3. Communicate, communicate and communicate!

D. Measure/Evaluate

    1. Assure appropriate recognition and rewards for successful efforts.
    2. Evaluate and assess the need for and feasibility of further action.