

**General Electric Company  
Albany, New York**

***Sampling and Analysis Plan***

**1997 HIGH FLOW MONITORING PROGRAM  
UPPER HUDSON RIVER**

**March 1997**

**Project No: GE00040**

**HydroQual, Inc.**  
Environmental Engineers and Scientists

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**GENERAL ELECTRIC COMPANY**  
Albany, New York

**Sampling and Analysis Plan**  
**1997 High Flow Monitoring Program**  
**Upper Hudson River**

March, 1997

Prepared by:

**HydroQual**  
Environmental Engineers and Scientists, P.C.  
4914 West Genesee Street  
Camillus, NY 13031

in association with:

**O'Brien and Gere Engineers, Inc.**  
5000 Brittonfield Parkway  
Syracuse, NY 13221

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## SECTION 1

### INTRODUCTION

This sampling and analysis plan (SAP) has been developed by HydroQual Environmental Engineers and Scientists, P.C. (HydroQual) in association with O'Brien & Gere Engineers (O'Brien & Gere) on behalf of the General Electric Company (General Electric). This SAP describes field sampling and analysis activities to be conducted during the 1997 spring high flow event on the upper Hudson River. This study is being conducted to: 1) evaluate the hypothesis that PCBs originating from the Hudson Falls Plant site area which may accumulate within the river adjacent to the site are transported downstream as pulse loadings during high flow events, and 2) develop a solids budget within the Thompson Island Pool (TIP) during a spring high flow event.

#### 1.1 Background

##### TIP Anomaly

Since approximately 1991, summer low flow PCB loadings from the TIP have exceeded estimates of diffusive flux based upon principles of equilibrium partitioning and known PCB concentrations within the TIP sediments (HydroQual, 1995). This mass imbalance may be attributed to a number of possible mechanisms or data inadequacies. The following hypotheses have been developed to account for this mass imbalance:

- 1) The mass and concentrations of PCBs entering the TIP are greater than the mass and concentration measured at the Rogers Island monitoring station due to either pulsed loadings from the plant site area or because they are part of an unquantified bed load.
- 2) The mass and concentration of PCBs passing the Thompson Island Dam (TID) are less than the mass and concentration measured at the TID monitoring station.
- 3) Groundwater inflow within the TIP is causing substantial release of PCBs from the buried sediments into the water column in the TIP.

- 4) There are greater PCB concentrations in the surface sediments of the TIP as result of the Allen Mill failure (O'Brien & Gere, 1994), than reflected in surface sediment data which results in a substantial release of PCBs into the water column of the TIP.
- 5) A substantial mass of PCBs enters the TIP between Rogers Island and the TID from sources outside the Pool such as dredge spoil sites.
- 6) Resuspension of surface sediments introduces a substantial mass of PCB into the waters of the TIP.

These hypotheses are discussed more fully elsewhere (General Electric, 1996). Numerous field sampling and analysis programs have been conducted over the last several years to test one or more of the hypotheses presented above (HydroQual, 1996a, HydroQual, 1996b, O'Brien and Gere, 1996).

One purpose of this SAP is to address the hypothesis that the mass of PCBs entering the TIP is greater than the mass measured at the Rogers Island monitoring station due to pulse loadings which are not quantified by the current monitoring program (no. 1 above). This hypothesis is plausible because of the known PCB dense non-aqueous phase liquid (DNAPL) releases from the Hudson Falls Plant Site area. DNAPL PCB oils are migrating from the plant site to the upper Hudson River. Several oil seeps have been discovered in the river bed at Baker's Falls and one seep is within the plunge pool of the falls. PCB DNAPL may accumulate in the river adjacent to the plant during low flow periods. During periods of high flow, stored PCB DNAPL may be mobilized downstream by the stronger currents. Due to the density of PCB DNAPL, this loading may be associated with the sediment bed load. To the extent that PCB DNAPL escapes detection at Rogers Island because it travels undetected as pulse loadings and sediment bed load to the system, the current monitoring system could be underestimating PCB transport past Rogers Island which may contribute to the TIP anomaly.

#### Solids Balance

The fate of PCBs within the upper Hudson River is closely associated with the fate of sediments. As PCBs are hydrophobic, they partition onto river sediments and are, therefore,

subject to the same fate processes including deposition and subsequent burial in bottom sediments as well as resuspension and downstream transport. The importance of these different sediment fate processes can be assessed within a specified region over a particular time frame by development of a solids budget. Solids budgets require an understanding of the upstream and tributary solids loadings over a period of interest. The development of solids budgets for the upper Hudson River have been difficult due to the lack of tributary solids loading data (HydroQual, 1997). While this was remedied, at least in part, by the solids data collected by the USEPA in 1994, uncertainties regarding the solids budget within the TIP still remain (HydroQual, 1997). One of these uncertainties is the lack of tributary flow data for the Moses Kill and Snook Kill. Construction of tributary solids loading for these tributaries using the 1994 USEPA solids concentration data required estimation of tributary flows. This was accomplished by examining the gauged flows from the Kayaderosseras Creek (West Milton, NY) over the period of sampling and estimating flows for the Moses Kill and Snook Kill based on drainage basin proration (HydroQual, 1997). This approach is reasonable due to the similarities between the Kayaderosseras Creek, Moses Kill, and Snook Kill drainage basins. Nonetheless, simultaneous collection of flow and solids data from these tributaries will reduce the uncertainty in solids loading estimates into the TIP.

The tributary solids monitoring described within this SAP will augment existing solids loading data and facilitate the development of a more precise estimate of a solids budget within the TIP.

## **1.2 Program Objectives**

The principal objectives of the High Flow Water Column Monitoring Program are to: 1) evaluate the hypothesis that routine water column monitoring may be underestimating PCB loading into the TIP as a result of upstream pulse loadings activated by flow events in the river, and 2) develop a solids budget for the Thompson Island Pool. Corollary objectives include:

- evaluate PCB bed loading into the TIP during spring high flow,
- evaluate the composition of high flow event PCB loading,
- evaluate the fate of high flow event PCB loading from Hudson Falls,
- quantify TIP tributary solids loading during a spring high flow event,

- verify flow relationships between gauged Kayaderosseras Creek and the tributaries of TIP (HydroQual, 1996), and
- establish flow and TSS relationships for TIP tributaries.

These objectives will be accomplished by collecting and analyzing multiple water column samples per day from numerous stations within the upper Hudson River watershed and the collection and analysis of sediment bed load samples during a high flow event in the spring of 1997.

## **SECTION 2**

### **METHODS**

#### **2.1 Sampling Mobilization**

An event consisting of flow greater than 13,000 cfs at the Fort Edward USGS monitoring station is the target for the high flow monitoring described herein. Because the mechanisms by which PCB DNAPL may be mobilized from the Hudson Falls Plant site area are not fully understood, sampling will target the rising and falling limb of the spring event hydrograph. To facilitate the prediction of the first high flow event and trigger sampling mobilization a number of remote river flow monitoring activities will be conducted. These include:

- 1) The monitoring of weather reports will be used to identify storm events and snow melt potential which can contribute to high flow events in the upper Hudson River.
- 2) The Sacandaga Reservoir water release schedule will be monitored by means of personal communication with operators of the facility. Release of water from the Sacandaga Reservoir significantly contributes to downstream river flow.
- 3) The Internet site of the Northeast River Forecast Center (NERFC) of the National Weather Service will be routinely monitored. NERFC provides river forecast guidance for about 100 river locations throughout New England and New York. Forecast stations that will be monitored include the Hudson River at North Creek, Hadley, and Fort Edward, NY. Current river conditions including stage height (ft), flood stage (ft), flow (cfs) are recorded and posted by NERFC on a daily basis (typically before noon). Stage height forecasts are extended 2 days from 1:00 PM of the day the forecast was generated.



## 2.2 Sampling Locations and Frequency

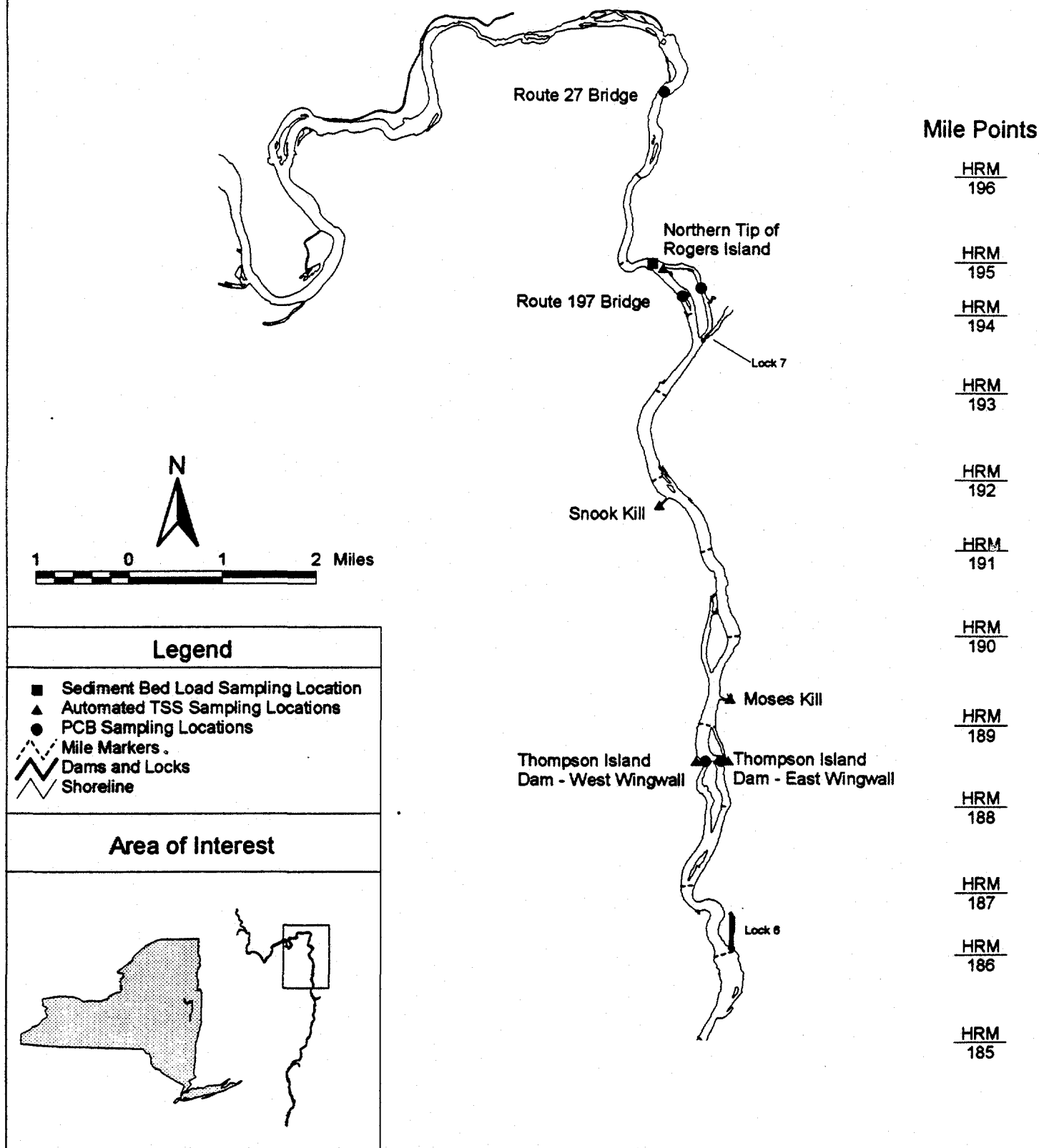
### Sampling Locations

Sampling locations for this 1997 High Flow Water Column Monitoring Program will include 5 river sampling and 2 tributary sampling stations as described in Table 1 and illustrated on Figure 1.

<b>Table 1. Hudson River Sampling Locations</b>		
<b>Sampling Site</b>	<b>Location Description</b>	<b>Approximate Hudson River Mile<sup>1</sup></b>
Hudson Falls	Route 27 Bridge, upstream of Hudson Falls plant site	197.0
Rogers Island	Northern tip of Rogers Island at headwaters of TIP	194.6
Fort Edward, East Channel & West Channel	Route 197 Bridges, Fort Edward, NY	194.2
Snook Kill	West River Road Bridge, Moreau, NY, immediately upstream of confluence with Hudson River	191.8
Moses Kill	Route 4 Bridge, Fort Edward, NY, immediately upstream of confluence with Hudson River	189.3
Thompson Island Dam Eastern Wing Wall and Western Wing Wall	Two locations at the Dam located downstream of the Thompson Island Pool	188.5

<sup>1</sup> Tributary river miles represent the approximate river mile of their confluence with the Hudson River.

Figure 1



# **GENERAL ELECTRIC COMPANY - HUDSON RIVER PROJECT** **1997 High Flow Water Column Monitoring Program** **Sampling Locations**

Three of the five PCB sampling locations are situated on bridges. These bridge locations include the Route 27 Bridge located upstream of Bakers Falls and upstream of the Hudson Falls Plant site, and the Route 197 Bridges (east and west channels) in Fort Edward. The two remaining PCB sampling stations are located at the eastern and western wing walls of the Thompson Island Dam at the downstream extreme of the TIP.

Automated TSS sampling locations include the northern tip of Rogers Island at the headwaters of the TIP, the eastern and western wing walls of TID at the downstream end of the TIP, as well as Moses Kill and Snook Kill, tributaries to the TIP. These locations are being sampled to facilitate development of a solids budget for TIP. The two tributaries will be sampled at locations near their confluences with the Hudson River (Figure 1).

Sediment bed load samples will be collected from the river near the northern tip of Rogers Island. These samples will be used to evaluate flow event driven PCB bed loading from the Hudson Falls Plant site region into the TIP.

#### Water Column PCB Sampling Frequency

During the high flow event, PCB sampling will occur around the clock through the rising and falling limbs of the hydrograph from the PCB sampling locations. A typical spring flood event occurs over a several day period. For the purposes of this SAP, a 3-day high flow event has been assumed. Samples will be collected every 1-2 hours at the Fort Edward station and the east and west wing wall stations at the Thompson Island Dam. Samples will be collected four times daily from the upstream station located at the Route 27 Bridge in Hudson Falls, NY. For health and safety reasons, samples will be collected from the west channel of the river only during daylight hours at the Fort Edward station. The bridge there does not afford safe access at night.

#### Water Column TSS Sampling Frequency

TSS samples will be collected once every three hours using automated samplers installed at the northern tip of Rogers Island, the eastern and western wing walls of the TID, and along the shore of the two tributaries near their confluence with the Hudson River. The automated samplers will begin operating upon installation (as soon as ice cover dissipates), and will continue

operating through the spring high flow event. Samplers will be serviced every two days to collect samples and verify proper sampler performance. In the event that a flow event has not occurred during the 72 hour sampling period, the TSS samples will be combined to form separate daily composites for each of the stations. Individual samples collected from each of the five TSS sampling stations during a tributary flow event will be analyzed for TSS only. The decision to submit individual samples for analysis will be based upon visual inspection of TSS sample turbidity and tributary flow measurements (see Section 2.3).

Additionally, paired TSS and congener-specific PCBs samples will be collected from each of the river sampling locations. Only TSS samples will be collected at the tributary sampling locations. Two large volume water samples (~20 L) will also be collected from each tributary sampling location during the high flow event. One of these samples will be collected during the rising and one during the falling limb of the tributary hydrograph and will be used to determine the composition of tributary solids. Sampling will be terminated along the falling limb of the hydrograph as determined in the field from inspection of river conditions.

#### Sediment Bed Load Sampling Frequency

Two sediment bed load samples per day will be collected during the initial three days of the high flow event. Six bed load samplers will be deployed in late March when moderate river flows allow safe access to the river. Two samplers per day will be activated by removing the faceplate across the sampler opening (see Section 2.4). Figure 2 diagrams a passive bed load sampler. Activated samplers will collect sediment bed load for an approximate 24 hour period after which they will be retrieved from the river for sample collection and analysis.

### **2.3 Tributary Flow Monitoring**

Continuous flow measurements will be obtained in Moses Kill and Snook Kill using a battery powered Sigma 950 flow velocity meter located near the center of the channel of each tributary. Velocity meters will be secured on shore and connected via cable to a submerged probe which uses the Doppler principle to measure average velocity throughout the depth of flow. Water depth will be continuously recorded via a submerged pressure transducer. Data collected using these devices will be stored in an on-site data recorder and routinely downloaded to a

portable personal computer in the field. Relationships between tributary cross sectional area and stage will be established prior to installation of the flow monitoring stations by confirmation of previously measured bathymetric profiles constructed on these tributaries (O'Brien & Gere, 1993b). Bathymetric profiles will consist of manual depth measurements at five foot intervals across each tributary. An elevation benchmark will be established at each of the tributary sampling locations to serve as a reference point for measurement of relative surface water elevations. To facilitate evaluation of center channel flow measurements, instantaneous flow velocity measurements will be collected manually at three locations along the cross section of tributary flow each time the automated samplers are serviced. These measurements will be made using a Marsh McBirney Model 201 flow velocity meter.

## **2.4 Sample Collection Procedures**

Sample collection procedures for this High Flow Water Column Monitoring Program are consistent with those employed for previous upper Hudson River sampling and are defined in the Quality Assurance Project Plan developed for the site (QAPP; O'Brien & Gere, 1993a).

### Water Column PCB Sampling Stations

At bridge sampling stations, PCB samples will be collected from the center channel of the river using a Kemmerer Bottle sampler. These samples will consist of vertically stratified composites made up of discrete aliquots collected at three intervals within the water column including 0.8, 0.5, and 0.2 times the total depth. The Kemmerer Bottle sampler is a 1.2 liter stainless steel cylinder equipped with a triggering device and closeable teflon stoppers. The Kemmerer Bottle will be lowered to the desired depth in the water column in the open position, followed by the release of a mechanical messenger which triggers the closure of teflon stoppers. The sampler is then retrieved and an aliquot discharged directly into sample containers.

Samples collected from the eastern and western wing wall of the Thompson Island Dam will consist of surface water grab samples collected in a stainless steel beaker and transferred to a sample container.

### Water Column TSS Sampling Stations

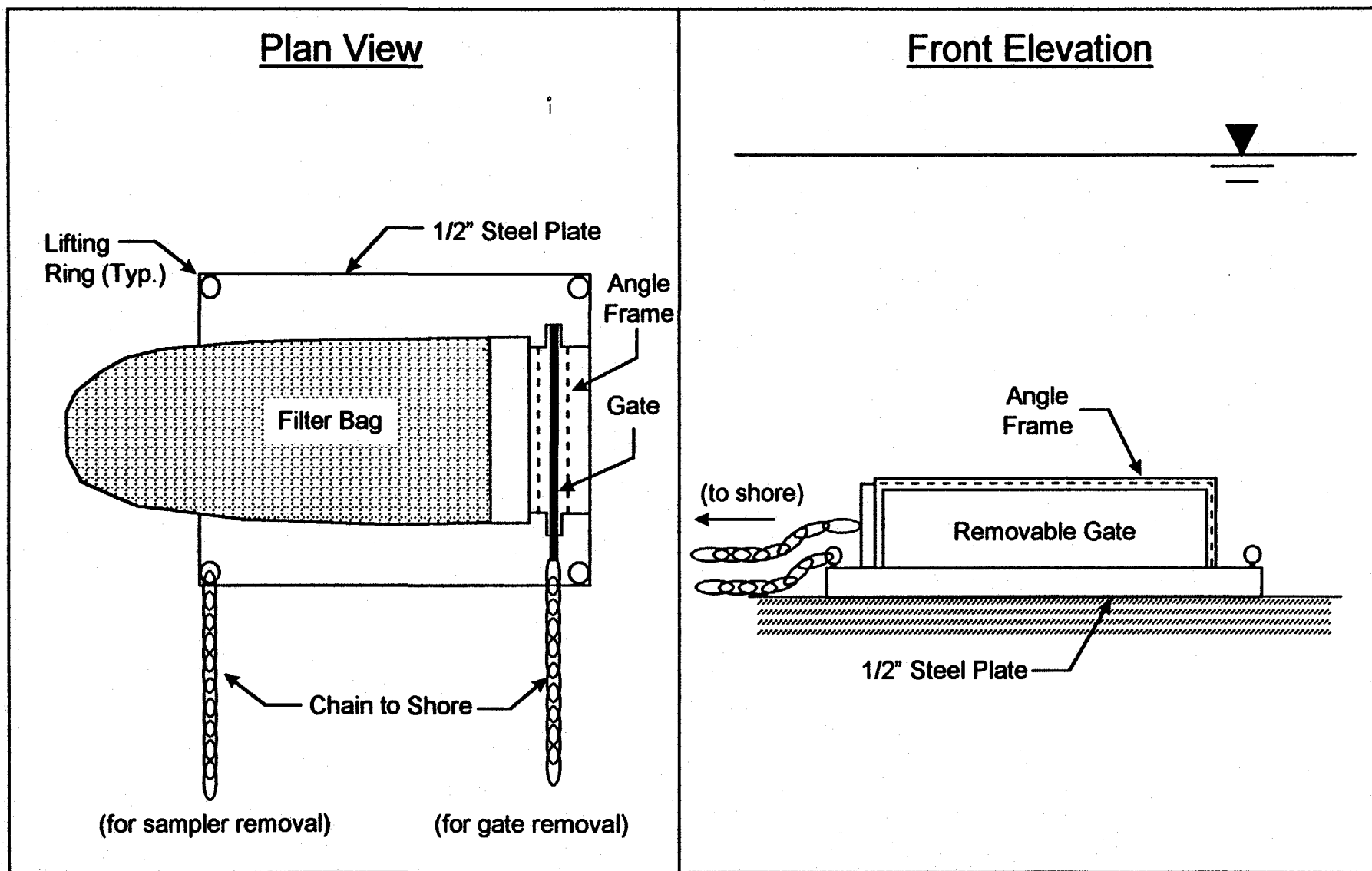
TSS samples from the Rogers Island, TID, and tributaries will consist of grab samples collected using a Sigma Model 900 automated sampler. Sample intake hoses will be situated so as to collect a sample from approximately mid depth along the center channel of tributary flow. Sample hoses will be supported using weighted PVC pipe and will discharge samples into 1 L plastic containers.

### Sediment Bed Load Sampling

Sediment bed load PCB samples will be collected using the sampling device presented in Figure 2. The sediment bed load sampler is similar in design to the in-situ particle filtration devices employed during the PCB DNAPL transport study conducted on the river in the fall of 1996 (HydroQual, 1996a). The device consists of a 100  $\mu$ m nylon mesh bag secured to a steel frame and mounted on a ½ inch thick steel plate. The steel plate should provide stability under the shear stresses expected during high flow. The sampler will be rigged with a removable face plate over the sampler opening. Tether lines will be attached to both the faceplate and the sampler base and run to shore. This configuration allows the samplers to be deployed in an inactive state prior to high flow. The sampler will be activated from shore by removing the faceplate. After the 24 hour sampling period, the sampler will be removed from the river and the associated bed load sample will be collected.

### Sample Handling, Storage, and Transport

Once a sample has been collected it will be stored at approximately 4 degrees Celsius in coolers and transported to the analytical laboratory. Samples will be assigned a unique sample designation, identifying sample location, date, and time. Standard chain of custody procedures will be followed. Sample handling procedures are specified in the QAPP (O'Brien & Gere, 1993a). Field logs will be maintained by sampling personnel.



**FIGURE 2. SCHEMATIC OF  
PASSIVE BED LOAD SAMPLER**

*Not to  
Scale*

HydroQual  
Engineers and Scientists, P.C.

March, 1997

## **2.5 Laboratory Analysis**

Laboratory analyses will be performed by Northeast Analytical, Inc. (NEA) located in Schenectady, New York. Table 2 summarizes analytical methods. Analytical protocols are described in the QAPP (O'Brien & Gere, 1993a). The congener PCB analysis has been modified to include an independent separation and quantification of congeners contained in NEA peaks 5, 8, and 14 (BZ4 and BZ10, BZ5 and BZ8, and BZ18 and BZ15, respectively) on a CP-SIL5-C18 capillary column.

### **Water Column PCB Samples**

Select samples collected from the PCB sampling locations will be submitted for congener-specific PCB and total suspended solids (TSS) analyses. Sample selection will be based upon timing along the flow event hydrograph. Samples collected along the rising limb of the hydrograph will be preferentially analyzed in an attempt to capture the "first flush" of PCBs from the plant site area. Remaining samples will be archived. Congener-specific PCB analysis will be performed by the DB-1 capillary column method with separate quantification of individual congeners coeluting in NEA peaks 5, 8, and 14. Table 3 outlines the sampling and analysis design for the river sampling stations.

### **Water Column TSS Samples**

Samples collected by the automated samplers will be submitted for TSS analysis only. Analysis of TSS will be performed according to U.S. EPA Method 160.2 (U.S. EPA, 1983). Table 4 outlines the sampling and analysis design for the tributary sampling locations.

The large volume tributary samples will be analyzed for Total Organic Carbon (TOC) and particle size distribution. The samples will be cooled to approximately 4 degrees Celsius and transported to the NEA laboratory where they will be allowed to settle for 3 days. After settling, the supernatant will be siphoned from the sample and the remaining settled solids will be centrifuged to yield a 50 ml solids sample. An aliquot of each solid sample will be analyzed for TOC. The remainder of the sample (a minimum of 200 mg dry weight) will be transferred into a



plastic sample container and shipped to the University of Minnesota Limnological Research Center for laser-based particle size analysis.

### Sediment Bed Load Samples

Sediment bed load samples will be analyzed for TOC, total solids, and congener-specific PCBs.

<b>Table 2. Surface Water Analytical Methods Summary</b>	
<b>Parameter</b>	<b>Analytical Method</b>
Congener-specific PCB	NEA-608CAP, Rev. 3.0 (NEA, 1990) by the DB-1 capillary column method with separate quantification of NEA peaks 5, 8, and 14 on a CP-SIL5-C18 capillary column.
TSS	USEPA Method 160.2 (USEPA, 1983)
TOC	USEPA Method 415.1 (USEPA, 1983)

<b>Table 3. Sampling Summary of River Sampling Locations</b>			
<b>Sampling Site</b>	<b>Sample Frequency</b>	<b>Laboratory Analyses</b>	<b>Sampling Method</b>
Route 27 Bridge	4 per day	CS PCB, TSS	Kemmerer Bottle
Fort Edward	1 per 1-2 hours	CS PCB, TSS	Kemmerer Bottle
Northern tip of Rogers Island	1 per 1-2 hours	CS PCB, TSS	Grab
	1 per 3 hours during a tributary flow event	TSS	Grab
Thompson Island Dam Eastern Wing Wall	1 per 1-2 hours	CS PCB, TSS	Grab
	1 per 3 hours during a tributary flow event	TSS	Grab
Thompson Island Dam Western Wing Wall	1 per 1-2 hours	CS PCB, TSS	Grab
	1 per 3 hours during a tributary flow event	TSS	Grab

<b>Table 4. Sampling Summary of Tributary Sampling Locations</b>			
<b>Sampling Site</b>	<b>Sample Frequency</b>	<b>Laboratory Analyses</b>	<b>Sampling Method</b>
Snook Kill	1 per 3 hours during flow event	TSS	Automated Grab
	2 per event	TOC & Particle Size	20 L Grab
Moses Kill	1 per 3 hours during flow event	TSS	Automated Grab
	2 per event	TOC & Particle Size	20 L Grab

## 2.6 Quality Assurance/Quality Control Sample Collection

Quality assurance/quality control (QA/QC) samples will be collected in accordance with the QAPP (O'Brien & Gere, 1993a). These samples include the collection and analysis of matrix spike, blind duplicate, and equipment blank samples at a rate of 5% of total sample numbers. The locations of the matrix spike, blind duplicate, and equipment blank samples will be selected on a rotational basis from the sampling locations. Matrix spike samples are duplicate samples which are collected in the field, submitted to the laboratory, spiked with a known quantity of analyte, and then analyzed for percent recovery. Blind duplicate samples consist of duplicate water samples submitted to the laboratory without indication of sampling location. Equipment blank samples are prepared in the field by rinsing the Kemmerer Bottle sampler or sampling beaker with organic free water. The rinse water is collected and submitted to the laboratory for analysis.

The results of the QA/QC sample analyses will be used to evaluate the quality of the data generated for this program. Results of QA/QC analyses will be reported with results of the high flow monitoring event.

## **SECTION 3**

### **PROJECT ORGANIZATION, SCHEDULE, AND DELIVERABLES**

#### **3.1 Project Organization**

A project organization chart is presented in Figure 2. HydroQual will be responsible for project oversight and will assist in field sampling efforts. O'Brien & Gere will be responsible for overall project coordination and staffing. Personnel from O'Brien & Gere will routinely monitor river flow data as described in Section 2.1 and prepare daily reports to be faxed to General Electric and HydroQual. The decision to mobilize will be determined jointly between General Electric, HydroQual, and O'Brien & Gere. However, as they are supplying a majority of the field sampling personnel, the ultimate responsibility to initiate sampling will be O'Brien & Gere's.

#### **3.2 Project Schedule**

A project schedule is contained in Figure 3. Tributary bathymetry will be conducted in mid-March immediately following ice out. The automated sampling stations on Rogers Island, TID-East, TID-West, Moses Kill and Snook Kill will be established and tested immediately following ice out. PCB sampling will be initiated based upon river flow predictions, but is expected to occur during mid-April.

#### **3.3 Project Deliverables**

Project deliverables for the high flow water column sampling event will include a non-interpretive data summary report containing a description of the objectives, methods, and raw data results.

Figure 3.

**GENERAL ELECTRIC COMPANY**  
**Hudson River Project**

**1997 High Flow Monitoring**  
**Organizational Chart**

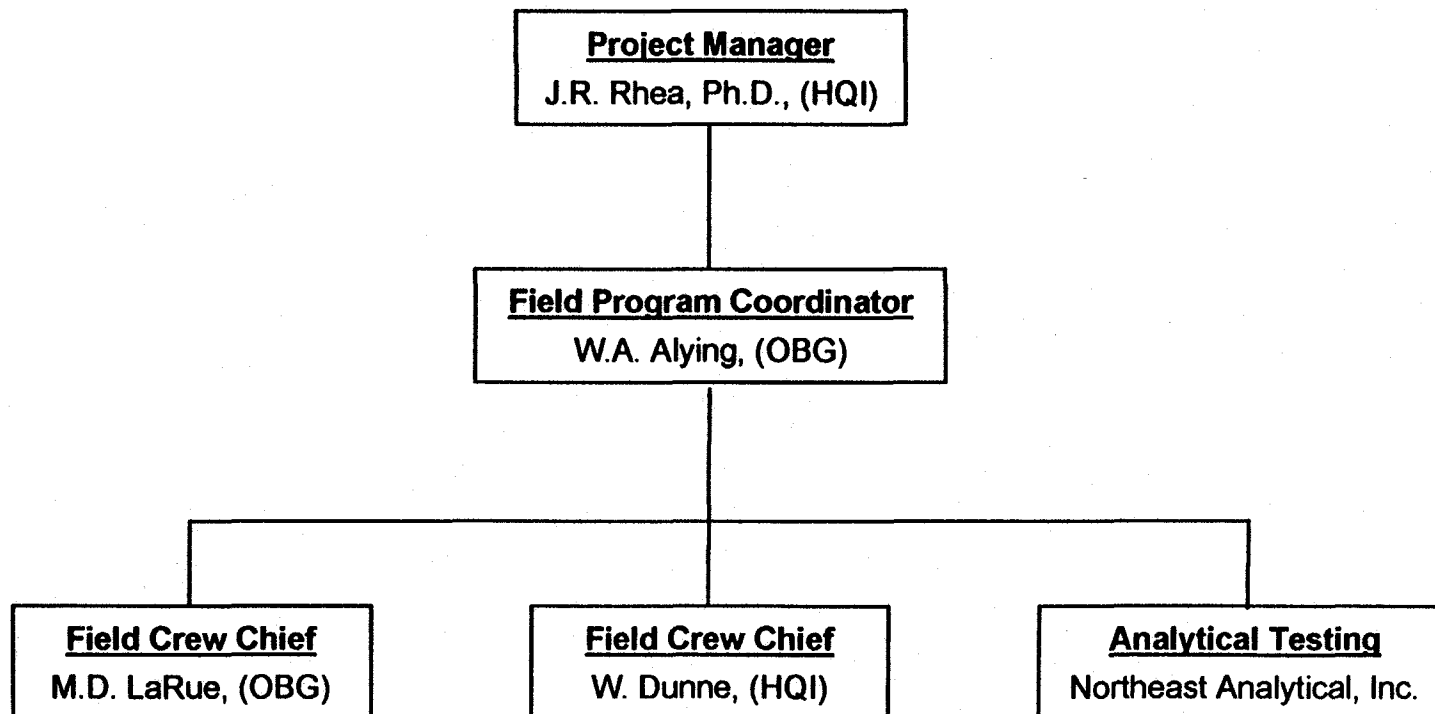


Figure 4.

**GENERAL ELECTRIC COMPANY**  
Hudson River Project - 1997 High Flow Monitoring Program

Project Schedule

	MARCH				APRIL				MAY				JUNE			
BATHYMETRIC PROFILING AND AUTOMATED SAMPLER SETUP																
FIELD SAMPLING																
ANALYTICAL TESTING																
PREPARATION OF PROJECT SUMMARY REPORT																

## SECTION 4

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