2. CHARACTERIZATION, MONITORING, AND MODELING

Characterization, monitoring, and modeling activities have been conducted for the entire sewer system as well as the receiving water bodies for Akron's CSO planning area. The sewer system activities were focused on collecting data to update the hydraulic model to simulate existing conditions, while providing a current awareness of sewer system operation and operational issues. Receiving water quality activities have been used to determine the impacts of overflows from the system on local waterways and to help identify key locations to focus short-term and long-term improvement efforts.

2.1 Combined Sewer System

The City has undertaken a substantial multi-year effort to obtain and verify existing data, collect and generate additional information, and compile data that describe the watersheds and the sewer system. To characterize, evaluate, and document the existing condition of the combined sewer system, the City has performed several historical studies, monitoring and modeling projects, and system evaluations. The information collected during the work was used to characterize the system and to develop, calibrate, and analyze results from the hydraulic model. Information on existing system conditions obtained from the modeling tools, combined with other information sources, such as water quality sampling data and biological measures, was used in several ways:

- To prioritize the City's CSO locations in terms of hydraulic measures (overflow volume, peak overflow rate, overflow frequency, and overflow duration)
- To develop an understanding of the impacts of CSO discharges on the City's receiving water system
- To establish a baseline from which to assess the impact of system abatement alternatives, in terms of both CSO measures and water quality measures

2.1.1 Characterization

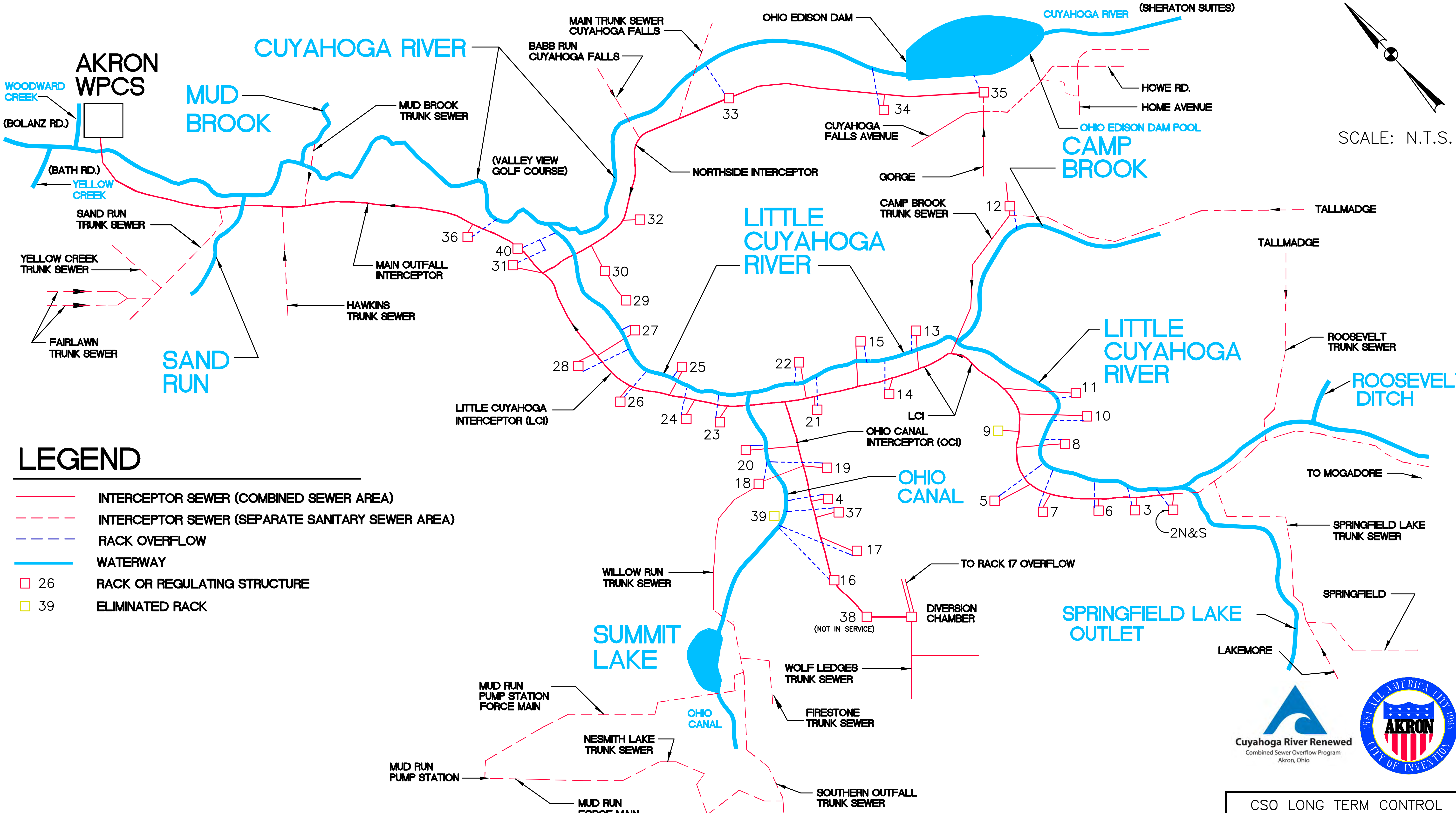
The planning area for the City of Akron covers approximately 167 square miles and includes most of the Akron metropolitan area. The service area includes all or portions of 5 cities, 4 villages, and 7 townships.

The system includes approximately 1,360 miles of sewers consisting of 700 miles of separate sanitary sewers, 490 miles of storm sewer, 170 miles of combined sewers, and 37 pump stations. There are approximately 28,600 manholes in the Akron system.

The City of Akron's combined sewer system contains thirty-four permitted CSOs, shown in Table 1-1, which discharge into four receiving bodies – Ohio Canal, Cuyahoga River, Little Cuyahoga River, and Camp Brook. In addition to the permitted overflows, the sewer system contains some rack structures that are regulator or diversion chambers. These chambers do not overflow to receiving surface waters and, hence, are not regulated under the NPDES permit. A description of all the rack structures, including the regulator chambers, is included below based on the rack descriptions from the City's Combined Sewer System Operations and Maintenance (O&M) Manual (1998) and updated based on infrastructure improvements. The rack drawings, which are also from the O&M Manual, are included in Appendix 2-A. Figure 2-1 contains a schematic of the collection system, and Figure 2-2 is a map of the collection system showing the rack locations.

Rack 2N – This CSO regulator chamber is located on the property of the Goodyear Tire and Rubber Co., and the tributary flow is primarily industrial. The chamber is 4' wide x 3'7'' high and has two racks to screen the flow: a 4'9'' x 3'0'' rack on the upstream side and a 2'5'' x 2'6'' rack on the downstream side of the chamber. The overflow from this rack is controlled by Retention Tank No. 2 located on the Goodyear Tire Co. site serving both Racks 2N and 2S. The overflow pipe from the retention tank to the Little Cuyahoga River is a 78'' conduit.

Rack 2S – This CSO regulator chamber is located on the property of the Goodyear Tire and Rubber Co. and the tributary flows are primarily industrial. The concrete chamber is rectangular in shape and has aluminum access doors which open into two halves. The rack is 2'3'' x 2'3''. The overflow from this rack is controlled by Retention Tank No. 2 located at the Goodyear Tire Co. site serving both Racks 2N and 2S. The overflow pipe from the retention tank to the Little Cuyahoga River is a 78'' conduit.



CSO LONG TERM CONTROL PLAN UPDATE

FIGURE 2-1

SCHEMATIC MAP OF COLLECTION SYSTEM

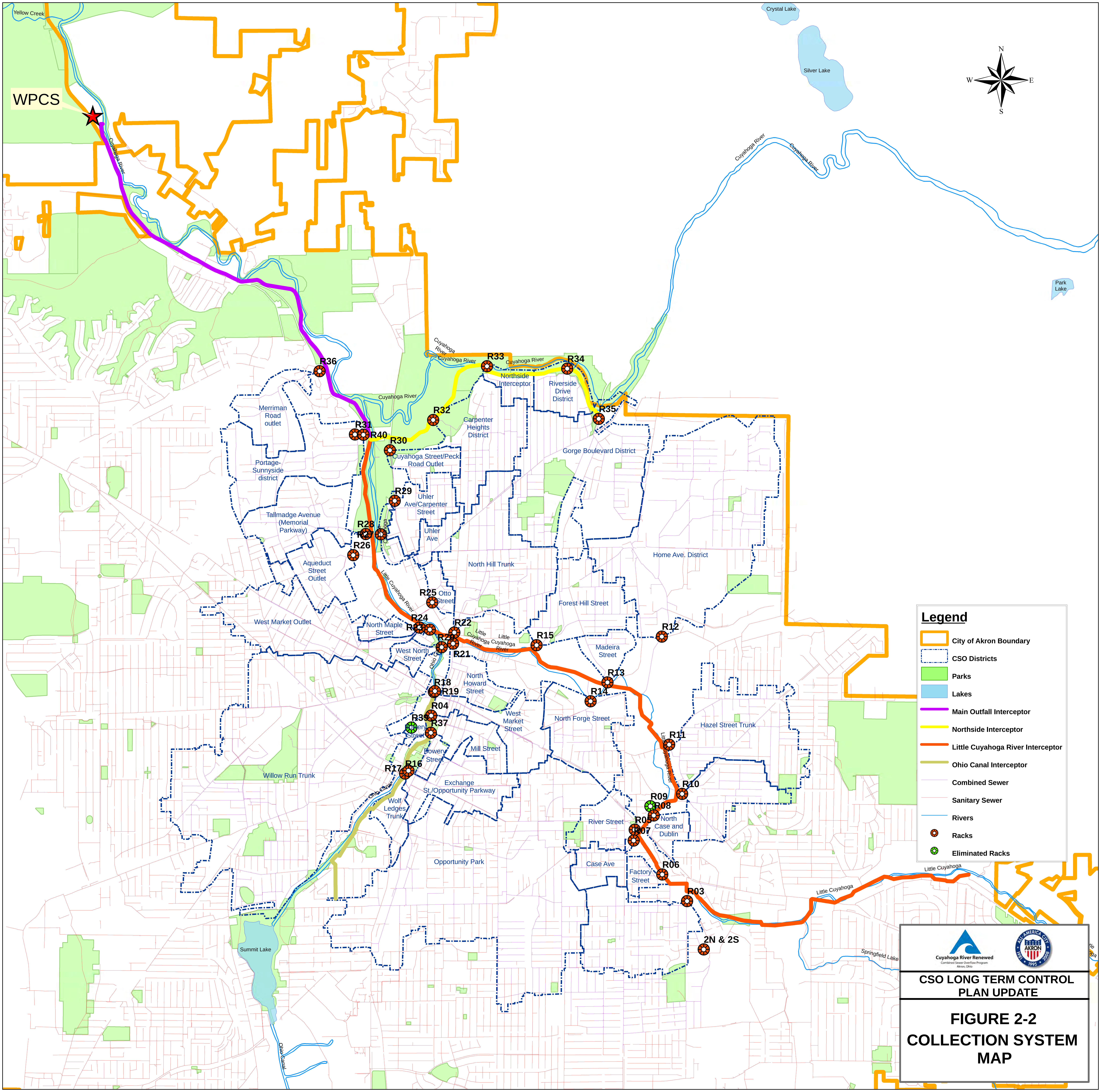


FIGURE 2-2
COLLECTION SYSTEM MAP

Rack 3 – This CSO regulator chamber is located on Kelly Avenue near the expressway exit ramp. The tributary area contributing flow is primarily industrial. A 9'' tall brick wall (weir) was observed 10 feet downstream of the rack. The rack is 3'5'' wide and 4'0'' long. The cross connection pipe is 24'' diameter and is connected to the 60'' diameter Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 4 – Rack 4 is located on the corner of Dart Avenue and West Mill Street. The flows conveyed to Rack 4 pass through a rectangular bar grate, a 15 inch cross connection pipe and into the 36 inch OCI. The tributary area contributing the flow consists of the central business district. Flows in excess of the cross connection pipe or interceptor discharge into the Ohio Canal Enclosure.

Rack 5 – This CSO regulator chamber is located on River Street north of S. Case Avenue. The majority of the tributary basins are contributing flow from commercial areas. The chamber is a straight through type, supported on bricks. The invert is a 48'' diameter pipe and has a staggered structure with bricks and segmented blocks, up to 7 inches downstream of the rack. The invert pipe then becomes a segmented block pipe. The weir is 6'' high and located 10 inches downstream of the rack. The overflow discharges to the Little Cuyahoga River.

Rack 6 – This CSO regulator chamber is located on River Street at the intersection of Factory Street. The tributary area contributing flow is primarily industrial and residential. The chamber is supported by brick masonry. The overflow weir is 6'' high and is 1 foot downstream of the chamber. The rack is 1'6'' wide and 5'0'' long. The cross connection pipe is 12'' diameter and is connected to the 60'' diameter RCP Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 7 – This CSO regulator chamber is located on South Case Avenue. The tributary area contributing the flow is commercial. The dimensions of the rack are 57'' x 30''. The overflow weir is 6'' high and is 10 inches downstream of the rack. The invert pipe is 48'' diameter and is a segmented block structure. The overflow discharges to the Little Cuyahoga River.

Rack 8 – This CSO regulator chamber is located in Dublin Street at North Case Avenue. The tributary area contributing flow is industrial. The concrete overflow weir is 7'' high and is located 2 feet downstream of the rack. The rack is 1'3'' wide and 3'0'' long. The cross connection pipe is 8'' diameter and is connected to the 60'' diameter RCP Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 10 – This CSO regulator chamber is located north of the intersection of Eastland Avenue, Newton Street, and Case Avenue. The tributary area is residential. The chamber is 4'0'' x 4'4'', and it is supported by brick masonry structure. The invert is a 5'3'' diameter segmented block pipe. The weir is 9'' high and is located 1 foot 10 inches downstream of the rack. The rack is 2'6'' wide and 3'2'' long. The cross connection pipe is 15'' diameter and is connected to the 60'' diameter Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 11 – This CSO regulator chamber is located on Hazel Street, approximately 100 feet east of the railroad track. The tributary area is primarily commercial. The chamber is supported by brick masonry. The invert pipe has an odd shape; the dimensions of which are 8'-6 ½'' wide x 7'-6'' high. The weir is 9'' high and located 6 inches downstream of the rack. The rack is 2'6'' wide and 2'8'' long. The cross connection pipe is 18'' diameter and is connected to the 60'' diameter Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 12 – This CSO regulator chamber is located off of Evans Avenue in the Home Avenue District. The tributary area contributing flow is commercial/light industrial and residential. The conduit is brick mortar. The weir is 2'6'' high and located at 7'0'' from manhole edge; the structure consists of 3 course brick and mortar with a steel plate. The outfall is approximately 31 feet downstream from the chamber. The rack is 4'0'' wide and 6'6'' long. The cross connection pipe is 24'' diameter and is connected to the 30'' diameter brick Camp Brook Interceptor. The overflow discharges to Camp Brook.

Rack 13 – This CSO regulator chamber is located southeast of the intersection of Arlington Street and North Street. The tributary area contributing the flow is primarily commercial. The chamber is supported by bricks. The invert is a 30'' diameter brick pipe. The weir is 9-1/2'' high and is located 2 feet 4 inches downstream from the rack. The rack is 1'3'' x 3'0''. The outfall is approximately 30 feet downstream of the chamber at the Little Cuyahoga River. The cross connection pipe is 12'' diameter and is connected to the 54'' diameter Little Cuyahoga Interceptor.

Rack 14 – This CSO regulator chamber is located near, but north of N. Forge Street and north of the railway tracks. The tributary area contributing the flow is industrial, commercial, and residential. The outfall is approximately 250 feet north of the chamber. The bottom of the chamber is 6'0'' x 4'4''. The chamber wall is supported by brick masonry. The weir is 7'' high, located 1 foot downstream of the rack. The rack is 3'3'' long and 2'6'' wide. The cross connection pipe is 12'' diameter and is connected to the 54'' diameter Little Cuyahoga Interceptor. The outfall is approximately 30 feet downstream of the chamber at the Little Cuyahoga River.

Rack 15 – This CSO regulator chamber is located in the Forest Hill District. The chamber is supported by brick masonry. This location is in a ravine, northeast of Elizabeth Park Community Center. The tributary area is primarily residential and commercial. The chamber is 20' deep. The invert is a brick pipe. The rack is 3'3'' long and 2'8'' wide. The weir is 10'' high, located 2 feet downstream of the rack. The cross connection pipe is 12'' diameter and is connected to the 54'' diameter sewer. The overflow discharges to the Little Cuyahoga River.

Rack 16 – Rack 16 is located just south of West Exchange Street along the east bank of the Ohio Canal and is adjacent to Lock 1. The tributary area contributing flow is industrial. The flows conveyed to Rack 16 pass down a trough, through a bar grate, and into the 30'' interceptor. Flows in excess of the interceptor overflow a 28'' weir and discharge into the Ohio Canal at the Lock 2 Park.

Rack 17 – Rack 17 is located in the north lane of West Exchange Street along the bridge over the Ohio Canal. The tributary area contributing flow is primarily commercial. The flow conveyed to this area through the diversion line from Subbasin 38 combined with the flows from Subbasin 17 conveyed through a 72'' sewer. Flows conveyed to Rack 17 pass through a bar grate and into a 15 inch cross connection pipe and then into the 36" Ohio Canal Interceptor (OCI). Flows in excess of the cross connection pipe or interceptor overflow a 10'' weir and discharge into the Ohio Canal at the Lock 2 Park.

Rack 18 – Rack 18 is located in the shoulder of State Route 59. The tributary area contributing flow is primarily commercial and residential. The flows conveyed to Rack 18 from Subbasin 18 pass through a rectangular bar grate, a 48'' cross connection pipe, and into the 48'' OCI. Flows in excess of the cross connection pipe or interceptor overflow an 18 inch weir. Flows are then conveyed through an overflow structure consisting of a 144 inch box sewer with a notched weir. The weir was constructed by increasing the conduit floor elevation 3.5 feet over a span of 47 feet. A notch having a width of 2 feet with a grade of 0.2% was constructed down the middle of the reverse spillway. Flows that are conveyed through the notch or crest the reverse spillway, discharge into the Ohio Canal in the junction chamber.

Rack 19 – Rack 19 is located north of the West Market Street Bridge and just east of the Akron Innerbelt. The tributary area contributing flow is commercial. The flows conveyed to Rack 19 pass through a rectangular bar grate, a 15'' cross connection pipe, and into the 48'' OCI. Flows in excess of the cross connection pipe or interceptor overflow a 19 inch weir. Flows are then conveyed through an overflow structure consisting of a 126'' rectangular sewer and a notched reverse spillway, similar to the one found in Rack 18. Flows that are conveyed through the overflow structure discharge into the Ohio Canal in the junction chamber.

Rack 20 – Rack 20 is located in the north lane of North Street along the west bank of the Ohio Canal. The tributary area contributing flow is primarily commercial. The flows conveyed to Rack 20 pass through a rectangular bar grate, an 18'' cross connection pipe, and into the 39'' OCI. Flows in excess of the cross connection pipe or interceptor overflow a 4'' weir and discharge into the Ohio Canal under the North Street Bridge. During storm events, the discharge pipe is submerged.

Rack 21 – This CSO regulator chamber is located on Howard Street, just north of North Street. The tributary area contributing the flow is commercial. The chamber is supported by brick masonry. The rack is 1'3'' wide and 8' long, and it is located 5 feet downstream of the chamber. The outfall is approximately 20 feet downstream of the chamber. The overflow pipe was a brick pipe and discharges to the Little Cuyahoga River. The weir is 10'' high and located 1 foot upstream of the outfall. The cross connection pipe is 12'' diameter and is connected to the 75'' diameter Little Cuyahoga Interceptor.

Rack 22 – This CSO regulator chamber is located on Howard Street, just north of Lods Street. The tributary area contributing flow is commercial. The chamber is supported by brick masonry. The conduit is brick pipe with a horizontal dimension is 5'5''. The outfall is located approximately 100 feet downstream of the chamber. The conduit had an elevated crest neat the outfall. There is a concrete wall 18’’ high and 25 feet long starting from 4’0’’ downstream of the chamber. There is cement concrete bench on one side of the chamber. The rack is 1’3’’ wide and 8 feet long. The cross connection pipe is 20’’ diameter and is connected to the 75’’ diameter brick Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 23 – This CSO regulator chamber is located near N. Maple Street, north of Hickory Street. The tributary area contributing flow is commercial. The chamber is supported by brick masonry. The conduit near the rack is a brick pipe. The rack is 1’4’’ wide and 3’0’’ long. The cross connection pipe is 12’’ diameter and is connected to the 87’’ Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 24 – This CSO regulator chamber is located on Ravine Street north of Hickory Street. The tributary area contributing flow is commercial and residential. The conduit structure is brick masonry. The weir is 4’’ high and is located 5 feet downstream of the rack. The rack is 2’6’’ wide and 5’1’’ long. The cross connection pipe is 15’’ diameter and is connected to the 87’’ brick sewer Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 25 – This CSO regulator chamber is located on Otto Street west of Cuyahoga Street. The tributary area contributing the flow is residential. The chamber wall is supported by brick masonry. The rack is 2’8’’ wide and 4’ 10’’ long. The cross connection pipe is 15’’ diameter and is connected to the 87’’ brick Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 26 – This CSO regulator chamber is located southeast of Hickory Street and Memorial Parkway intersection. The tributary area contributing flow is residential. The manhole support dome is brick masonry. The conduit is a vitreous glazed tile. The rack is 1’3’’ wide and 3’0’’ long. The cross connection pipe is 10’’ diameter and is connected to the 87’’ brick Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 27 – This CSO regulator chamber is located at Memorial Parkway, near the intersection with Uhler Avenue. The tributary area contributing flow is residential. The chamber is supported by brick masonry. The invert is a 3’3’’ diameter brick pipe. The weir is 7'' high and located at 3.25 feet downstream of the rack. The rack is 1'3'' wide and 6'2'' long. The outfall is approximately 116 feet downstream of the rack. The cross connection pipe is 8'' diameter and is connected to the 87'' brick sewer via a 15'' sewer to the Little Cuyahoga Interceptor with a 25' deep manhole on the 8'' pipe. The overflow discharges to the Little Cuyahoga River.

Rack 28 – This CSO regulator chamber is located on west of Memorial Parkway Bridge, approximately 50 feet east of Hickory Street. The tributary area contributing flow is residential. The chamber is supported by brick masonry. The weir is 9'' high and is located 2 feet downstream of the rack. The rack is 2'9'' wide and 4'9'' long. The invert pipe is a 4'4'' diameter brick pipe. The cross connection pipe is 12'' and 20'' diameter and is connected to the 87'' brick sewer Little Cuyahoga Interceptor. The overflow discharges to the Little Cuyahoga River.

Rack 29 – This CSO regulator chamber is located on Cuyahoga Street at Shultz Street. The tributary area is residential. The chamber is supported by brick masonry. The invert pipe is a 4'4'' diameter brick pipe. The rack is 1'6'' wide and 2'0'' long. The weir is 8'' high and is located 1.6 feet downstream of the rack. The cross connection pipe is 12'' diameter and is connected via 12'' pipe to Rack 30 and connected to the 48'' Northside Interceptor after Rack 30. The overflow discharges to the Little Cuyahoga River.

Rack 30 – This CSO regulator chamber is located on Cuyahoga Street south of the Cuyahoga River Bridge and North of Peck Road. The tributary area contributing the flow is residential. The chamber is supported by brick masonry. The chamber is 4'2'' x 6'6''. The rack is 3'1'' long and 1'6'' wide. The invert is a 2'9'' diameter brick pipe. The weir is 6'' high and located next to the rack. The cross connection pipe is 12'' diameter and is connected to the Northside Interceptor by a 12'' sanitary sewer. The overflow is diverted to the Cuyahoga Street Storage Facility and, when full, overflows to the Little Cuyahoga River.

Rack 31 – This CSO regulator chamber is located in the B&O Railroad easement, east of Canyon Trace at Mardon. The tributary area contributing flow is residential. The conduit is a 4'0'' diameter brick pipe. The rack is 2'8'' wide and 4'0'' long. The weir is 10'' high and is located 1.6 feet downstream of the rack. The cross connection pipe is 12'' diameter and is connected to the 90'' x 144'' concrete Main Outfall. The overflow is diverted to the Cuyahoga Street Storage Facility and, when full, overflows to the Little Cuyahoga River.

Rack 32 – This CSO regulator chamber is located slightly east of Peck Road and Cuyahoga Street intersection. The tributary area contributing flow is residential. The chamber cover and frame is supported by brick masonry. The conduit is brick masonry. The weir is 13'' high and is 17 feet to the manhole. The rack is 3'1'' wide and 2'9'' long. The cross connection pipe is 15'' diameter and is connected to the 48'' Northside Interceptor. The overflow discharges to the Cuyahoga River.

Rack 33 – This CSO regulator chamber is located near the Northside Interceptor near Cuyahoga River and Main Street (west of the Main Street bridge). This rack has a weir-splash plate that is 21'' high. The rack is 3'0'' wide and 5'0'' long. The cross connection pipe is 12'' diameter and is connected to the 36'' Northside Interceptor. The overflow discharges to the Cuyahoga River.

Rack 34 – This CSO regulator chamber is located near the Riverside Drive District along the MetroParks Easement Road. The tributary area is residential and highly developed. The chamber is supported by brick masonry. The rack is 1'4'' wide and 3'0'' long. The invert is a 2'6'' diameter brick pipe. The weir is 8'' high and is located 8 inches downstream of the rack. The cross connection pipe is 8'' diameter and is connected to the 24'' Northside Interceptor. The overflow discharges to the Cuyahoga River.

Rack 35 – This CSO regulator chamber is located southwest of Front Street Bridge as it crosses the Cuyahoga River. The tributary area contributing flow is primarily commercial and residential. The chamber wall is brick masonry. The overflow pipe is a brick pipe. The dimensions of which are 5'5'' high x 4'10'' wide. The chamber is 4'3'' high x 3'8'' wide. The rack is 2'8'' wide and 2'8' long. The weir is 20'' high and is located 3 feet downstream of the rack. The outfall is approximately 360 feet downstream of the chamber. The cross connection pipe is 24'' diameter, and this connection is the beginning of the 24'' Northside Interceptor. The overflow discharges to the Cuyahoga River.

Rack 36 – This CSO regulator chamber is located off Poulson Street, east of the railroad track and north of Rocky Hollow Drive. The tributary area is residential. The weir is 11'' high and is located 1 foot downstream of the rack. The invert is a 3'2'' diameter brick pipe. The rack is 1’3’’ wide and 4’7’’ long. The cross connection pipe is 12’’ diameter and is connected to the 90’’ x 144’’ concrete Main Outfall. The overflow discharges to the Cuyahoga River.

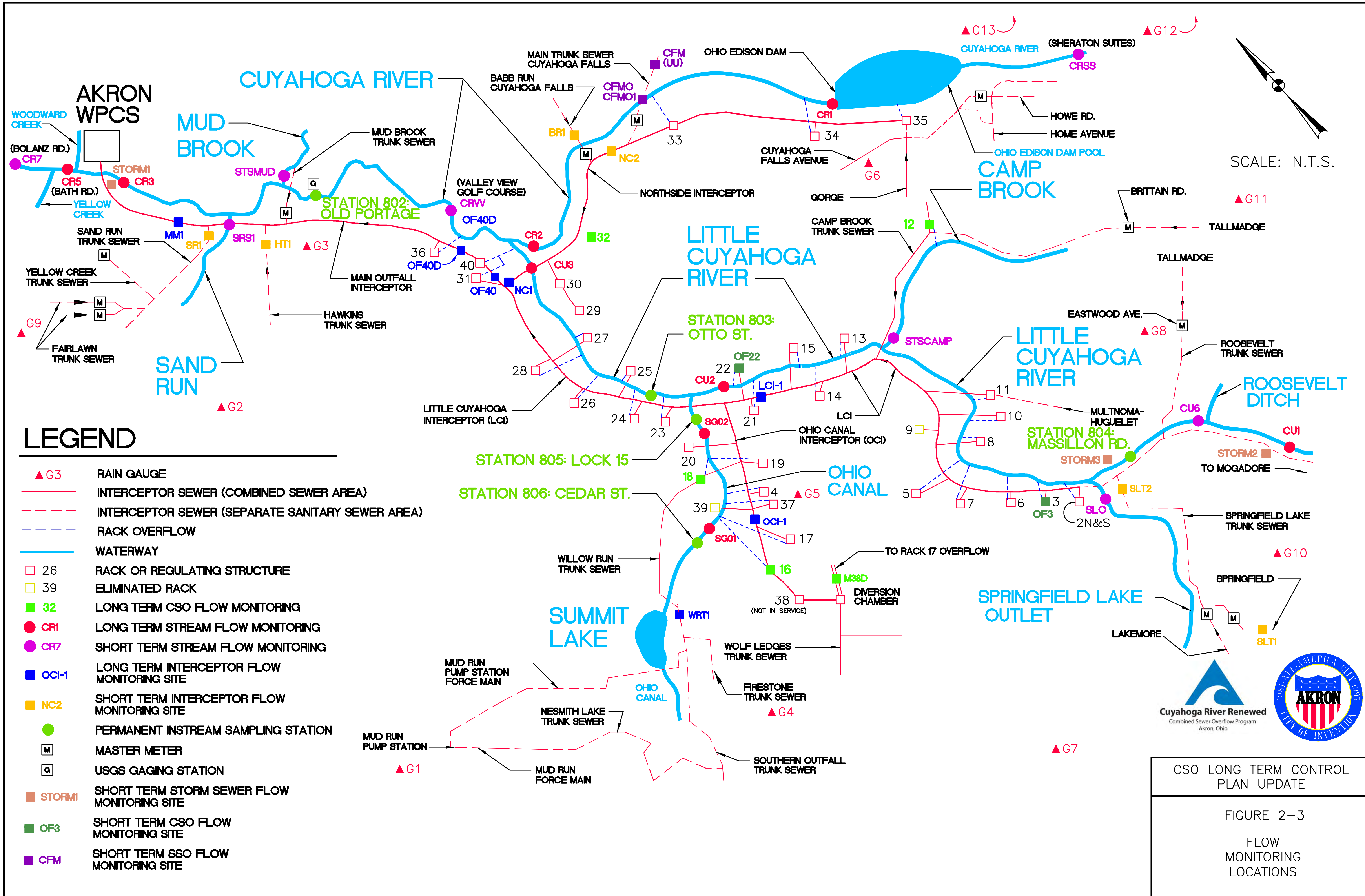
Rack 37 – Rack 37 is located inside the Cascade Parking Garage on level 3. The tributary area contributing flow is commercial. The flows are conveyed to Rack 37 from Subbasin 37 pass through a rectangular bar grate, a 12’’ cross connection, and into the 36’’ OCI. Flows in excess of the cross connection pipe or interceptor overflow an 8 inch weir and discharge into the Ohio Canal Enclosure.

Rack 40 – Rack 40 is located on the west bank of the Little Cuyahoga River, and it is west from the power sub-station on Cuyahoga Street. The overflow is diverted to the Cuyahoga Street Storage Facility (CSSF). If the CSSF is full and the Little Cuyahoga River water level is too high to allow discharge from the CSSF, then Rack 40 overflows to the Little Cuyahoga River.

2.1.2 Monitoring

The City of Akron has developed and incorporated historical monitoring results as well as a current system monitoring program to help determine the prioritization of overflow locations for improvements as well as the scope and magnitude of the selected projects. The monitoring activities have focused both on the in-system flows as well as the receiving streams, and the purpose of the flow-monitoring work is to analyze the rainfall and flow monitoring data so that the flow in the combined collection system and the receiving waters can be characterized during dry and wet weather conditions. The monitoring program included the following, and a map showing the monitoring sites is shown in Figure 2-3:

- Rainfall Monitoring
- Flow Monitoring
- Cuyahoga Street Storage Facility Monitoring
- SCADA Data Collection
- Instream Sampling



CSO LONG TERM CONTROL PLAN UPDATE

FIGURE 2–3

FLOW MONITORING LOCATIONS

Rainfall Monitoring

The City has installed 13 permanent rain gauges throughout the sewer system area to collect and record rainfall data for use in system analysis. These gauges have been in operation for 10-15 years depending on the location, and are listed in Table 2-1. These gauges have provided the City with a valuable historical record of the observed rainfall conditions throughout the system and have helped to establish typical rainfall conditions and events that impact the collection system. The rain gauges are managed by ADS Environmental Services, who oversees the collection of the rainfall data with wireless technology.

Table 2-1 City of Akron Rain Gauge Network

Rain Gauge	Address	Location
G1	2644 Cordelia Avenue	Mud Run Pump Station
G2	1532 Peckham Street	Akron School – Practical Nursing
G3	1668 Merriman Road	Valley Center
G4	1200 Firestone Parkway	Bridgestone Americas Holdings
G5	177 S. Broadway Street	Morley Health Center
G6	574 E. Cuyahoga Falls Avenue	U.S. Post Office
G7	1436 Triplett Boulevard	Akron Public Works Bureau - Municipal Service Center
G8	2100 Eastwood Avenue	East Ohio Gas Company
G9	3487 S. Smith Road	Fairlawn City Hall
G10	3061 Albrecht Avenue	Jenkin's Garage
G11	89 E. Howe Road	Weaver School
G12	1100 Graham Circle	County/Summit Health
G13	10 Ascot Parkway	Figgie International

Following initial data collection, statistics for each rain gauge are summarized in a monthly flow monitoring report that is submitted to the City. This helps provide information for wet weather studies, such as CSO studies, NPDES monitoring, and WPCS service area storm water monitoring, as well as enhanced understanding of how the system performs under different storm events and seasonal conditions.

Flow Monitoring

Historical flow monitoring has been conducted at locations throughout the system to provide information about the overall performance of the system. The monitors included 21 long-term and 22 short-term flow monitors, as shown in Figure 2-3 and Tables 2-2 and 2-3. Of the 21 long-term flow monitors, nine were located on receiving streams, eight were located in interceptor or trunk sewers and four were located in CSO racks. Of the 22 temporary flow monitors, eight were located on receiving streams, six were located in interceptor or trunk sewers, three were located on storm sewers, two were located on CSO racks, and three were located on separate sanitary sewer overflows (SSOs) in the City of Cuyahoga Falls. These locations monitored depth, velocity, and flow and were used for the calibration of the system-wide model as well as to provide information regarding capacity limitations and bottlenecks within the collection system. The flow monitoring activities occurred from September 1997 through December 1997. Results of the 1997 Flow Monitoring Program are reported in the Akron Facilities Plan '98 - Sampling, Flow Monitoring and Analysis Report, dated March 1998, and the Flow Monitoring Supplement, Volumes 1 and 2.

A stream bed cross-section survey was conducted using ten of the sixteen stream sites as part of the flow monitoring portion of the 1997 Flow Monitoring Program, as denoted in Tables 2-2 and 2-3. The remaining stream sites had been surveyed under previous projects and, therefore, were not surveyed as part of this program. The stream sites were surveyed to reference the cross-sections and depth readings to the City of Akron geodetic datum. The cross-section surveys were performed on the stream sites at five (5) foot intervals, perpendicular to the flow. The recorded elevations were used to determine the depth of flow. The survey data was reduced and the stream cross-sections were generated. The stream bed cross-sections are included in the Appendix 11-A in the Facilities Plan '98 Appendices (1999).

Table 2-2 Long Term Flow Monitoring Locations

No.	Site Name	Collection Method	Site Type	Location	Receiving Stream / Sewer
1	CR1*	Phone	Stream	Ohio Edison Dam	Cuyahoga River
2	CR2	Manual	Stream	1021 Cuyahoga Street Bridge	Cuyahoga River
3	CR3	Phone	Stream	Akron WPCS	Cuyahoga River
4	CR5	Phone	Stream	Bath Road Bridge at Riverview Road	Cuyahoga River
5	CU1	Phone	Stream	25 Skelton Road	Little Cuyahoga River
6	CU2	Phone	Stream	Cuyahoga Street Bridge	Little Cuyahoga River
7	CU3*	Phone	Stream	Cuyahoga Street/Akron Corrections Facility	Little Cuyahoga River
8	LCI1	Phone	Manhole	Cuyahoga Street Bridge near Howard Street	Little Cuyahoga Interceptor
9	M38D	Manual	Overflow	Opportunity Parking Garage	Ohio Canal Interceptor
10	MM1	Manual	Manhole	1852 Merriman Road	Main Outfall Sewer
11	NC1	Phone	Manhole	Cuyahoga Street/Akron Corrections Facility	Northside Interceptor
12	OCI1	Phone	Manhole	State Street Bridge	Ohio Canal Interceptor
13	OF12	Phone	Manhole	South of Evans Avenue	Rack 12
14	OF16	Phone	Manhole	North of Lock 1	Rack 16
15	OF18	Phone	Manhole	Route 59	Rack 18
16	OF32	Phone	Manhole	Peck Road	Rack 32
17	OF40	Manual	Siphon	Main Outfall Sewer Siphon	Upstream Rack 40
18	OF40D	Manual	Manhole	Main Outfall Sewer Siphon	Downstream Rack 40
19	SG01	Phone	Stream	48 West Exchange	Ohio Canal
20	SG02	Phone	Stream	234 Ferndale Street	Ohio Canal
21	WRT1	Phone	Manhole	South Street West of W. Bowery Street	Lakeshore Trunk Sewer

Note: An asterisk (*) denotes that the site was surveyed to develop stream bed cross-sections.

Table 2-3 1997 Short Term Flow Monitoring Locations

No.	Site Name	Collection Method	Site Type	Location	Receiving Stream / Sewer
1	STORM2	Manual	Manhole	Skelton Road / Mogadore Road	Storm2 Sewer
2	STORM1	Manual	Manhole	Akron Compost Facility	Storm1 Sewer
3	BR1	Manual	Manhole	Babb Run Park	Babb Run
4	CFM(UU)	Manual	Overflow	Trail at 1728 Highbridge Street	Cuyahoga Falls Main
5	CFM0	Manual	Overflow	Highbridge Street and 17th Street	Cuyahoga Falls Main
6	CFM01	Manual	Overflow	Highbridge Street and 17th Street	Cuyahoga Falls Main
7	CR7*	Manual	Stream	Bolanz Road Bridge	Cuyahoga River
8	CRSS*	Manual	Stream	Sheraton Suites Hotel Deck	Cuyahoga River
9	CRVV*	Manual	Stream	Valley View Golf Course	Cuyahoga River
10	CU6*	Manual	Stream	Massillon Road Bridge / E. Market Street	Little Cuyahoga River
11	HT1	Manual	Manhole	Merriman Road / Weathervane Lane	Hawkins Trunk Sewer
12	NC2	Manual	Manhole	Cascade Valley Park	Northside Interceptor
13	OF22	Manual	Manhole	Howard Road and Lods Road	Rack 22
14	OF3	Manual	Manhole	Kelly Street South of Martin Avenue	Rack 3
15	SLO*	Manual	Stream	Massillon Road Bridge / Fremont Avenue	Springfield Lake Outlet
16	SLT1	Manual	Manhole	741 Abington Road	Springfield Lake Trunk
17	SLT2	Manual	Manhole	184 Massillon Road	Springfield Lake Trunk
18	SR1	Manual	Manhole	Sand Run Parkway	Sand Run Trunk Sewer
19	SRS1*	Manual	Manhole	Riverview Road / Merriman Road	Sand Run Culvert Pipe
20	STORM3	Manual	Manhole	Seiberling Street South of E. Market Street	Storm3 Sewer
21	STSCAMP*	Manual	Stream	Eastwood Avenue Bridge	Camp Brook
22	STSMUD*	Manual	Stream	Akron-Peninsula Road / Sycamore Lane	Mud Brook

Note: An asterisk (*) denotes that the site was surveyed to develop stream bed cross-sections.

Instream Sampling

The City monitors 5 instream locations as a requirement of their existing, 2010 NPDES permit. Two stations are on the Ohio Canal, two stations are on the Little Cuyahoga River, and one station is on the Cuyahoga River. The existing sample locations consist of the following:

- Station 806 upstream of overflows at Cedar Street on the Ohio Canal
- Station 805 at Lock No. 15 on the Ohio Canal
- Station 804 upstream of overflows on the Little Cuyahoga River at Massillon Road
- Station 803 at Otto Street on the Little Cuyahoga River
- Station 802 downstream of all CSOs at the Old Portage Gauging Station on the Cuyahoga River

Samples are collected at frequencies governed by the current NPDES permit. Wet weather events that cause overflows at Rack 16 trigger sample collection activities at Stations 806, 805, and 803. These sampling stations help determine pollutant loads from upstream Little Cuyahoga River and Ohio Canal locations as well as water quality parameters during CSO discharge.

Cuyahoga Street Storage Facility Monitoring

Upon the completion of the construction of the Cuyahoga Street Storage Facility, which captures overflow from Racks 30, 31, and 40, a continuous monitoring system was put in place to track the activation and operation of the storage facility. This system tracks the influent and effluent flows, as well as the depth in each of the three cells within the facility. This data has been collected for several years and has provided insight on the usage frequency of the tank as well as tracking the overflow activations and volume when the facility discharges into the Cuyahoga River.

SCADA Data Collection

Throughout the years, the City of Akron has worked to upgrade their SCADA system to capture and organize system monitoring data. The combined sewer overflow monitoring system (1993-1997) was updated to improve the existing monitoring systems from the “Autocon” CSO monitoring system to the Motorola “Moscad” radio telemetered unit monitoring system. The Motorola system allows for the data to be directly sent to the Sewer Maintenance Facility on Home Avenue. The Motorola CSO radio telemetered monitor systems are comprised of ultrasonic level and flow indicating transmitters that calculate the flow rates using a pre-programmed depth to discharge relationship. Whenever the combined sewage rises to a pre-established set point, an alarm is sent to dispatchers at the Sewer Maintenance Facility. A PC-based operator interface computer station located at the Sewer Maintenance Facility provides for centralized monitoring and control. This computer monitoring station digitally logs the corresponding volume associated with each overflow event. The data accumulated can be used for calibrating the sewer system model and for use in NPDES monitoring and reporting.

2.1.3 Hydraulic Modeling

The City of Akron has devoted significant resources to modeling both the collection system and the major receiving waters (Ohio Canal, Little Cuyahoga River, Cuyahoga River, and Camp Brook) within the CSO system. The hydraulic model was developed as part of the original LTCP development in the 1990s and has been updated as new system conditions have been implemented, such as the construction of the Cuyahoga Street Storage Facility. The water quality model of the receiving waters was also developed as part of the original LTCP evaluation; that model served as the basis for the water quality modeling conducted recently as part of the LTCP update process.

Model Software and Calculations

The model of the collection system was developed using the XPSWMM software platform in the 1990s. The model has since been upgraded to different versions during the long-term planning process to keep current with the latest software and operating systems. The model network was originally developed using the SWMM TRANSPORT module within XPSWMM, which is utilized to simulate non-surcharged flow routing through sewer systems. This system does not require vertical detail and does not calculate heads and depth of surcharge. This module does not model backwater effects and downstream conditions (regulator structures, pump stations, etc.) are assumed not to impact upstream conditions. For a combined system model with very little surcharge within the network occurring during storms during the typical year, this module provides sufficient confidence for developing planning level sizes and costs. The majority of the City of Akron system is not surcharged in those storm events which are typically found to control CSO activations, since the system trunk sewer network was constructed to transport much larger storms to the rack structures.

As part of the LTCP update process, the XPSWMM model in the TRANSPORT module was converted to the InfoWorks CS model platform. The InfoWorks platform overcomes some of the limitations of the TRANSPORT module and can be used to evaluate surcharged conditions and backwater impacts. Conversion to this platform will provide additional details on system performance and will provide a more advanced modeling platform for analyzing the planned improvements and developing final design sizing. The goal of converting the model was to provide a tool for the City of Akron to utilize moving forward that has increased flexibility and accuracy in prediction of system conditions.

For both the XPSWMM TRANSPORT and InfoWorks models, the wet weather inputs were developed using SWMM runoff calculations, which generate inflow hydrographs that represent the overland runoff from the impervious and pervious areas tributary to the combined system. The hydrographs that are generated are then input into the network to route the wet weather flows through the sewer system and evaluate performance.

Existing Model Description

The model network represents the backbone of the CSO collection system and consists of approximately 33 miles of sewer, representing the interceptor system, including the Ohio Canal Interceptor, Little Cuyahoga Interceptor, Northside Interceptor, and the Main Outfall Interceptor. The model represents approximately 9,000 acres, included in 67 subcatchments, ranging from 9.5 acres up to 946 acres. Impervious area percentages in the subcatchments are as high as 80% in the most developed portions of the combined system. The original development and calibration of the model is detailed in the Facilities Plan ’98 Alternatives (1999). The Facilities Plan ‘98 project collected calibration data through several data collection programs, summarized within Section 2.1.2. A flow monitoring program was conducted that consisted of 27 flow monitoring locations within the collection system. Locations that were included in the collection system are referenced in Tables 2-2 and 2-3. These flow monitoring locations were located throughout the system and were concentrated heavily along the interceptor system and near the significant overflow locations within the combined network. Four wet weather events were captured:

- Wet-Weather Event #1: October 26/27, 1997, with a two-day total rainfall at Gauge G6 of 1.10 inches
- Wet-Weather Event #2: November 13/14, 1997, with a two-day total rainfall at Gauge G6 of 0.57 inches
- Wet-Weather Event #3: November 28, 1997, with a one-day total rainfall at Gauge G6 of 1.07 inches
- Wet-Weather Event #4: December 10, 1997, with a one-day total rainfall at Gauge G6 of 0.67 inches

Since the original development of the model, system updates have been constructed and have been represented in the version used to support the development of the LTCP Update. This includes representing the Cuyahoga Street Storage Facility, which provides control for Racks 40, 31 and 30. This 9.5 MG storage facility was added to the model to simulate the impact of the storage on the CSO reduction.

The CSO projected activations and overflow volume during existing conditions developed in the previous LTCP (2002) using the 1994 typical year rainfall are presented in Table 2-4. At this time, the Rack 39 Sewer Separation Project had been completed. However, the Cuyahoga Street Storage Facility was not yet constructed, and Rack 9 had not yet been separated. In comparison, the updated model representing the existing conditions for 2010 was also used to simulate flows using the adjusted 1994 rainfall as specified within the Consent Decree, and the projected activations and total volume are shown in the Table 2-5. Because the overflow from the Cuyahoga Street Storage Facility is dependent on operating procedures, the overflow reported in this table is based on 2008 and 2009 monitored data and annual report volume.

Table 2-4 2002 Existing Conditions CSO Activation and Volume, 1994 Typical Year

Rack	Estimated Typical Year Activations	Estimated Typical Year Overflow Volume (MG)
2	0	0.0
3	38	16.0
4	22	8.5
5	19	2.5
6	0	0.0
7	23	3.7
8	38	2.9
9	6	0.2
10	33	8.0
11	15	6.7
12	34	44.2
13	10	0.6
14	55	27.5
15	44	14.9
16	39	119.7
17	44	143.4
18	26	213.9
19	16	5.2
20	44	6.7
21	9	1.3
22	19	11.3
23	3	0.0
24	46	23.9
25	13	1.2
26	52	10.7
27	21	2.3
28	40	13.1
29	45	11.5
32	39	15.3
33	26	1.5
34	46	5.9
35	49	44.5
36	34	7.8
37	6	0.3
30/31/40	90	465.2
Total	**1044**	**1240.4**

Adapted from: Table 2-4 of the LTCP (2002)

Table 2-5 2010 Existing Conditions CSO Activation and Volume, Adjusted 1994 Typical Year

Rack	Estimated Typical Year Activations	Estimated Typical Year Overflow Volume (MG)
2	0	0.0
3	38	16.1
4	18	7.0
5	20	2.6
6	0	0.0
7	26	3.9
8	38	2.9
10	32	7.9
11	17	15.3
12	36	45.5
13	10	0.6
14	52	25.9
15	45	14.7
16	36	96.5
17	42	130.2
18	27	167.6
19	13	4.3
20	33	5.0
21	9	1.3
22	20	12.2
23	4	0.1
24	50	39.6
25	13	1.2
26	48	10.5
27	24	2.4
28	41	13.2
29	44	10.2
32	37	15.3
33	3	0.0
34	28	2.8
35	49	46.7
36	36	7.9
37	5	0.3
30/31/40	8*	49.5*
Total	**832**	**753.2**

* Cuyahoga Street Storage Facility (Racks 30/31/40) is based on 2008 and 2009 monitored data and annual report volume.

The total overflow volume, when including the 2008-2009 monitoring data for Rack 40/31 overflow, is estimated at approximately 750 MG/year. This has decreased from the estimated 1,240 MG/year of overflow from the 2002 existing conditions. The decrease is primarily attributed to the Cuyahoga Street Storage Facility which controls what was the largest overflow in the system. However, part of the decrease is due to changing the rainfall data from the 1994 typical year to the adjusted 1994 typical year. It should be noted that the overflow volume from the Cuyahoga Street Storage Facility is dependent on the conditions of the interceptor and the flow conveyed to the WPCS. Flow enters the storage facility when it overflows a weir along the main interceptor. The exact conditions when the storage facility is activated rely heavily on the condition of the interceptor and the flows that are being treated at the WPCS. Given the variability of the conditions and the difficulty in representing those transient conditions accurately within the model, the actual reported data for 2008-2009 was used to establish an estimate of the conditions observed at the facility. The remaining three largest overflows, Rack 17, 18, and 16, account for over 50% of the existing 2010 predicted overflow volume within the typical year.

2.2 Receiving Water Quality

This section briefly describes the characteristics of the main receiving waters in the Akron CSO area and their water quality characteristics, based on water quality analyses, instream monitoring, water quality modeling, and outfall sampling that have taken place over the years. These programs have been coordinated with flow monitoring, rainfall monitoring, and hydraulic modeling to provide information on the entire system characterization efforts. The section also describes a water quality model that was developed to assess wet weather impacts on the receiving waters. The basics of the model are described, as well as its calibration and application to quantify the impacts of CSOs and upstream sources.

2.2.1 Characterization

The receiving streams in the area are shown in Figure 2-1. The main river flowing through Akron is the Cuyahoga River, which has a drainage basin of about 400 square miles above Akron. Upstream of the city are several small impoundments. Farther upstream, at River Mile 58, is Lake Rockwell, a major impoundment used for Akron's water supply. The Little Cuyahoga River discharges into the Cuyahoga River at River Mile 43.3. The Ohio Canal and Camp Brook are tributary to the Little Cuyahoga River.

At Cuyahoga River Mile 40.18 is USGS Gauging Station (No. 04206000). Flow statistics for this station are presented in Table 2-6.

Table 2-6 Cuyahoga River Flow Statistics

Daily discharge statistics, in cfs, based on 85 years of record					
Min (1934)	**20th percentile**	**Median**	**Mean**	**80th percentile**	**Max (1990)**
37	79	125	225	282	1480

Akron's Water Pollution Control Station (WPCS) is located downstream of Akron, at Cuyahoga River Mile 37.45.

Pollutants associated with CSOs include floatables, suspended solids, BOD, pathogens, nutrients and toxic chemicals. Pathogens are most frequently used to quantify CSO impacts, either as pathogens, relative to recreation, or as indicators of CSO discharge. The section of the Ohio Water Use Designation and Statewide Criteria (Chapter 3745-1 of the Ohio Administrative Code [OAC]) dealing with recreation is reproduced below for convenience:

(4) Recreation

These use designations are in effect only during the recreation season, which is the period from May first to October thirty-first. The director may require effluent disinfection during the months outside the recreation season if necessary to protect an unusually high level of water based recreation activity such as, but not limited to, canoeing, kayaking, scuba diving, or sport fishing during spawning runs and, in the normal pursuit of the recreation activity, there is a strong likelihood of exposure to water borne pathogens through ingestion of water or from dermal exposure through fresh cuts or abrasions.

(a) "Bathing waters" - these are waters that, during the recreation season, are heavily used for swimming. The bathing water use applies to all waters in areas where a lifeguard and/or or bathhouse facilities are present, and to any additional water bodies designated bathing waters in rules 3745-1-08 to 3745-1-30 3745-1-32 of the Administrative Code

(b) "Primary contact" - these are waters that, during the recreation season, are suitable for one or more full-body contact recreation activities such as, but not

limited to, wading, swimming, boating, water skiing, canoeing, kayaking, and scuba diving. Three classes of primary contact recreation use are defined to reflect differences in the observed and potential frequency and intensity of usage.

(i) Class A primary contact recreation. These are waters that support, or potentially support, frequent primary contact recreation activities. The following water bodies are designated as class A primary contact recreation waters:

(a) All lakes having publicly or privately improved access points; and

(b) All water bodies listed in Table 7-16 of this rule. [Comment: The streams and rivers listed in Table 7-16 of this rule are popular paddling streams with public access points developed, maintained, and publicized by governmental entities.]

(ii) Class B primary contact recreation. These are waters that support, or potentially support, occasional primary contact recreation activities. All surface waters of the state are designated as class B primary contact recreation unless otherwise designated as bathing waters, class A primary contact recreation, class C primary contact recreation or secondary contact recreation.

(iii) Class C primary contact recreation. These are water bodies that support, or potentially support, infrequent primary contact recreation activities such as, but not limited to, wading. The following water bodies are designated class C primary contact recreation:

(a) All water body segments with drainage areas less than 3.1 square miles and meeting the definition in 6111.01 of the Revised Code of historically channelized watercourse, unless they are specifically designated a different recreational use in rules 3745-1-08 to 3745-1-30 of the Administrative Code; and

(b) All water bodies specifically designated class C primary contact recreation in rules 3745-1-08 to 3745-1-30 of the Administrative Code.

(c) "Secondary contact" - these are waters that, result in minimal exposure potential to water borne pathogens because the waters are: rarely used for water based recreation such as, but not limited to, wading; situated in remote, sparsely populated areas; have restricted access points; and have insufficient depth to provide full body immersion, thereby greatly limiting the potential for water based recreation activities. Waters designated secondary contact recreation are identified in rules 3745-1-08 to 3745-1-30 of the Administrative Code.

Table 7-13. Statewide numerical criteria for the protection of recreation uses. These criteria apply inside and outside the mixing zone at all times during the recreation season.

Recreation Use	*E. coli (colony counts per 100 ml)*	
	Seasonal geometric mean	*Single sample maximum*[1]
Bathing water	*126*	*235*[a]
Class A primary contact recreation	*126*	*298*
Class B primary contact recreation	*161*	*523*
Class C Primary Contact Recreation	*206*	*940*
Secondary Contact Recreation	*1030*	*1030*

[1] Except as noted in footnote a, these criteria shall not be exceeded in more than ten per cent of the samples taken during any thirty-day period.
[a] This criterion shall be used for the issuance of beach and bathing water advisories.

2.2.2 Monitoring

Historically, the water quality monitoring program included the following:

- Flow Monitoring
- Instream Sampling
- Water Quality Sampling Program

The flow monitoring activities that were performed for the receiving waters are discussed above in Section 2.1.2 with the collection system monitoring. The other water quality activities are described below.

Instream Sampling

Historically, three instream sampling stations were installed in CSOs on the Ohio Canal to fulfill NPDES water quality reporting and monitoring requirements (1988-1990). These automatic sampling stations helped determine pollutant loads from upstream Little Cuyahoga River locations as well as water quality parameters during CSO discharge. A sampling station at Massillon Road on the Little Cuyahoga River and a station in the Merriman Valley near the USGS Old Portage gauging station on the Cuyahoga River were also installed with sampling, monitoring, and communication equipment (1995-1999) to provide NPDES monitoring/reporting that was directly sent to the WPCS.

To keep the instream sampling stations operational and to provide quality data for water quality modeling the existing instream sampling stations were rehabilitated to provide additional instream sampling data (1994-1996). The existing CSO instream sampling stations that were rehabilitated are located on the Little Cuyahoga River and the Ohio Canal. These automatic stations bracket CSOs on the Ohio Canal and the data helped to quantify pollution loads from upstream Little Cuyahoga River locations.

Water Quality Sampling Program (1997)

The guidance set forth by the National CSO Control Policy encourages that CSO permittees assess water quality impacts on a watershed basis. To that effect, the City developed a comprehensive water quality sampling program that incorporates sampling from both CSO points of discharge and receiving water bodies.

In conjunction with the City of Akron and the CSO consulting team, a three (3) phase Water Quality Sampling Program was developed for the Combined Sewer Overflow Study. The first phase of the study was discrete grab sampling. This program was implemented to assess the impact of wet weather overflows on the receiving streams. The second phase of the sampling program involved the determination of site specific decay rates of 5-day carbonaceous biochemical oxygen demand ($CBOD_5$), nitrogenous biochemical oxygen demand (NBOD), total Kjeldahl nitrogen (TKN), and ammonia. By establishing Akron-specific decay rates, the accuracy of the water quality model's predicted dissolved oxygen cycle would be improved. The third phase of the study was DO monitoring of the receiving streams to provide data for the water quality model.

Water quality sampling and monitoring was performed from June 1997 through January 1998. Analytical results from the water sampling were reported in the Akron Facilities Plan '98 - Sampling, Flow Monitoring and Analysis Report, dated March 1998. Results indicated considerable wet weather influence, particularly in the bacterial counts. In contrast, however, the other parameters did not exhibit very high levels of contamination. An important observation from this sampling is that water coming from upstream of the

CSO area contained high bacteria levels, considerably in excess of the ambient water quality standards.

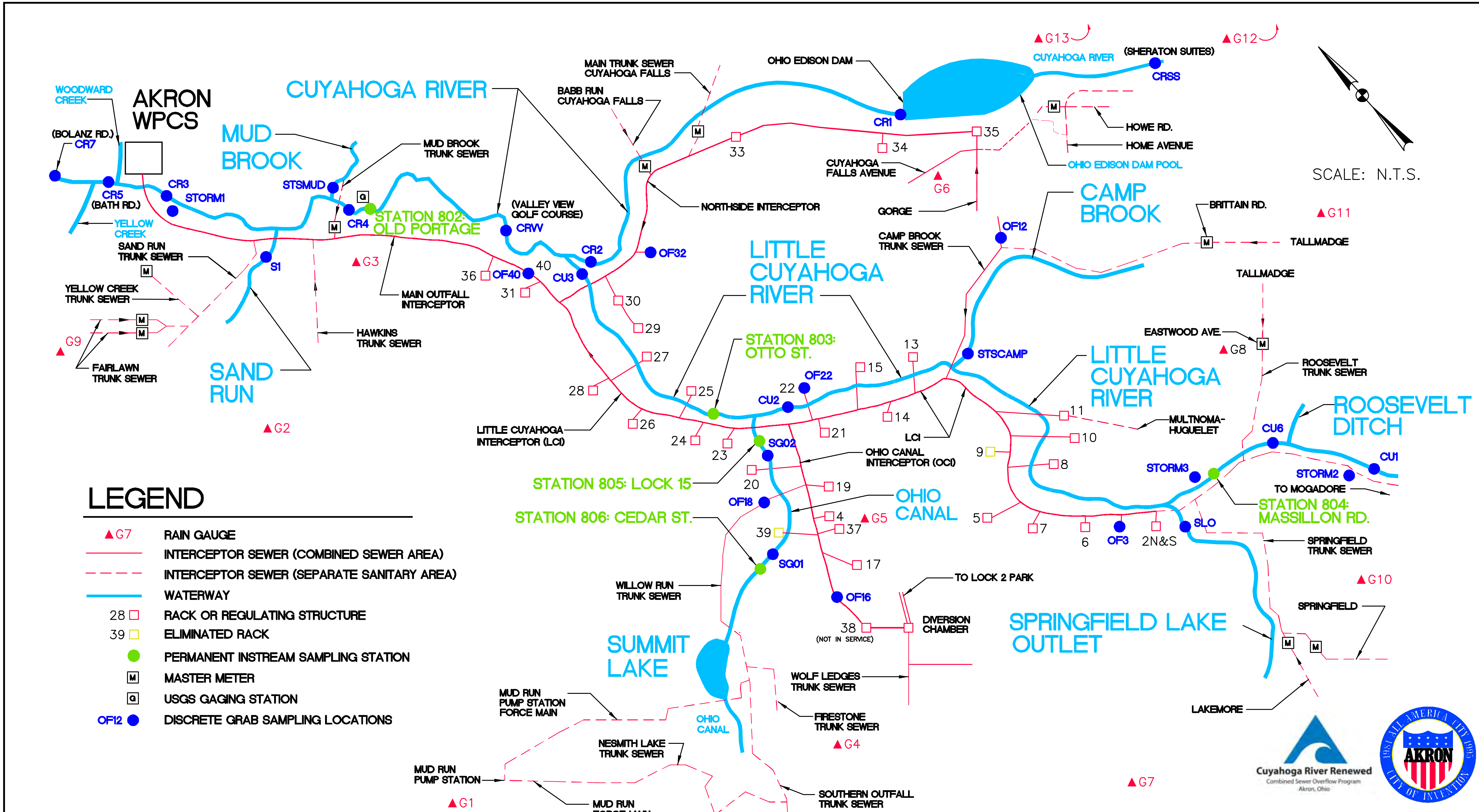
Additional grab sampling was conducted in 2008 and 2009 at rack outfalls and instream to test for fecal coliform and E. coli.

Discrete Grab Sampling Program (DGSP)

The DGSP consisted of wet weather sampling that utilized grab sampling at the twenty-eight (28) sampling locations shown on Figure 2-4. During the DGSP, three (3) rainfall events occurred that resulted in significant overflows from the CSO points of discharge:

- 10-26-97 through 10-29-97, 1.16 inches of rainfall (monitored at gauge G6)
- 11-14-97 through 11-16-98, 0.57 inches of rainfall (monitored at gauge G6)
- 12-10-97 through 12-13-97, 0.80 inches of rainfall (monitored at gauge G6)

The purpose of the discrete grab sampling program was to obtain a sufficient number of discrete grab samples during a rainfall event so that pollutant concentration curves could be developed for both the discharges from the CSOs and for the flows in the receiving water bodies. Specifically, discrete grab samples were collected for fecal coliform, E. coli, $CBOD_5$, TKN, total suspended solids (TSS), and ammonia at the twenty-eight (28) sampling locations. Each grab sample was tested in the field for temperature, DO, pH, and conductivity. Grab sampling was initiated when precipitation caused the CSOs to overflow. Table 2-7 lists the sites that were sampled and the intervals at which each sample was collected.



CSO LONG TERM CONTROL PLAN UPDATE

FIGURE 2–4

1997
DISCRETE GRAB
SAMPLING LOCATIONS

Table 2-7 Sampling Program Sites and Collection Intervals

Receiving Streams	Site Locations	Collection Intervals
Cuyahoga River	CRSS, CR1, CR2, CR3, CR4, CR5, CR7, CRVV	Interval 1 (1)
Little Cuyahoga River	CU1, CU2, CU3, CU6	Interval 1 (1)
Ohio Canal	SG01, SG02	Interval 1 (1)
Mud Brook	STSMUD	Interval 1 (1)
Camp Brook	STSCAMP	Interval 1 (1)
Sand Run	S1	Interval 1 (1)
Springfield Lake	SLO	Interval 1 (1)
CSO Racks	OF3, OF12, OF16, OF18, OF22, OF32, OF40	Interval 2 (2)
Storm Sewers	STORM 1(425), STORM 2 (115), STORM 3	Interval 2 (2)

Notes:
(1) Interval 1: All stream sites were sampled at the following intervals (hours from the start of the sampling event): 1, 2, 3, 6, 9, 12, 18, 24, 36, 48 and 72.
(2) Interval 2: All racks and storm sewers were sampled on an hourly basis up to eight hours or until the flow ceased, whichever occurred first.

The DGSP resulted in the collection of 4,014 individual samples. Appendix 11-C of the Facilities Plan '98 Appendices (1999) presents data summary tables with the sample analytical results broken down by sampling site. This data was used in the modeling calibration process.

Decay Rate Sampling Program (DRSP)

The second sampling methodology was the DRSP. The DRSP consisted of tracking a slug of water through a designated stream segment. The DRSP procedure collects instream water quality samples to measure the $CBOD_5$, NBOD, ammonia, and TKN decay rates in the receiving waters. These site specific decay rates are critical coefficients for modeling instream DO.

To determine the rate of instream decay, a slug of water was sampled as it moved downstream. The change in concentration in the water over time as it traveled downstream was used to determine the decay rate. Rhodamine dye was used as a tracer. After the dye was injected into the stream, it was followed and sampled at downstream locations to determine the Time of Travel (TOT), which is the time it took for the water to move from one site to the next. Water quality grab samples were collected at each sampling location after the visible dye peak. In this manner, the same water was sampled as it traveled downstream and the rate of change in its concentration was determined.

The DRSP was performed at five (5) stream segments for one (1) dry weather event and two (2) wet weather events. The dry weather event was chosen such that there was no precipitation preceding the sampling for a period of 72 hours. The stream segments were as follows:

> *Segment 1:* Located on the Cuyahoga River, this segment is between river mile (RM) 32.99 at Bolanz Road and RM 37.45 at the effluent outfall at the Akron WPCS. The total distance of Segment 1 is 4.46 river miles.
>
> *Segment 2:* Located on the Cuyahoga River, this segment is between the effluent outfall at the Akron WPCS RM 37.45 and the confluence of the Cuyahoga River RM 42.40 and the Little Cuyahoga River RM 0.00. The total distance of Segment 2 is 4.95 river miles.
>
> *Segment 3:* Located on the Little Cuyahoga River, this segment is between the confluence of the Little Cuyahoga RM 0.00 and the Cuyahoga River RM 42.40 and the confluence of the Ohio Canal and the Little Cuyahoga River RM 1.98. The total distance of Segment 3 is 1.98 river miles.
>
> *Segment 4:* Located on the Ohio Canal, this segment is between sampling location SGO1 (Ohio Canal RM 1.36) and sampling location SGO2 (Ohio Canal RM 0.13). The total distance of Segment 4 is 1.23 river miles.
>
> *Segment 5*: Located on the Little Cuyahoga River, this segment is between the confluence of the Ohio Canal and Little Cuyahoga River RM 1.98 and the confluence of the Springfield Lake Outlet and the Little Cuyahoga River RM 7.15. The total distance of Segment 5 is 5.17 river miles.

The sampling of these segments proceeded in an upstream direction. Figure 2-5 shows the locations of the segments for the DRSP. Appendix 11-D of the Facilities Plan '98 Appendices (1999) presents data summary tables with the analytical results of the decay rate sampling events and a table listing the instream calculated decay rates for each parameter.

Dissolved Oxygen Monitoring Program

DO monitoring was performed on the Cuyahoga River between July 24, 1996 and September 20, 1996. The results of that study showed that instream, continuous DO monitoring for extended time periods was a very effective mechanism for identifying locations of low dissolved oxygen. The study also suggested the following:

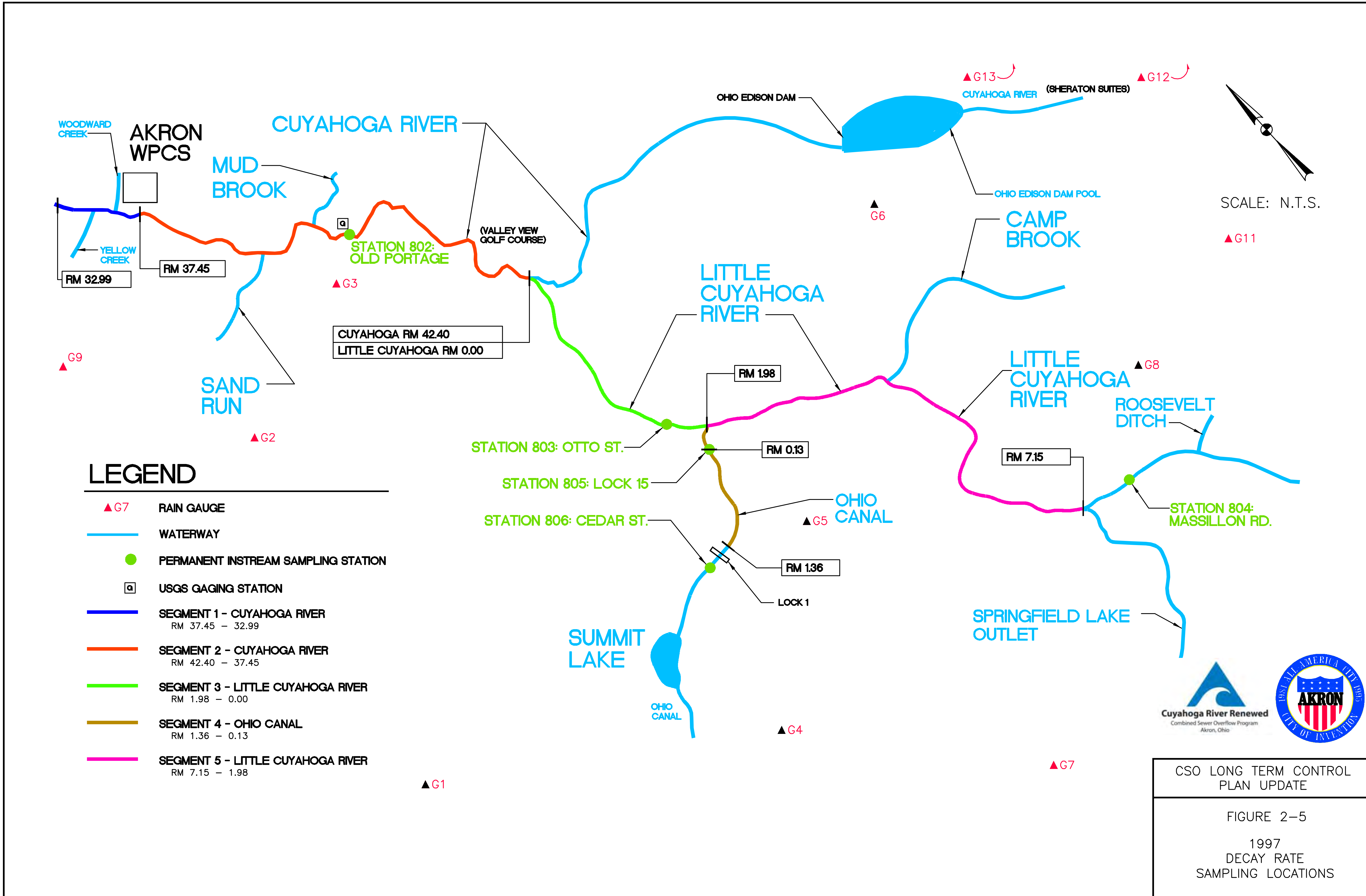
- Further analysis of sources of oxygen demand upstream of the Akron WPCS was needed to determine the necessary measures that would address the periodic episodes of low dissolved oxygen.
- A study of dissolved oxygen should include monitoring of Mud Brook and Yellow Creek to determine the effects of these tributaries on the receiving stream.

As part of the 1997 Water Quality Sampling Program, continuous DO monitoring was conducted at 16 long-term sites and 8 temporary sites (2 week periods). Between June 23, 1997 and December 16, 1997, monitoring occurred on sections of the following waterways: Little Cuyahoga River, Cuyahoga River, Ohio Canal, Camp Brook, Yellow Creek, Sand Run, and Springfield Lake Outlet. The monitoring sites are shown on Figure 2-6 and listed in Table 2-8. Sites were chosen based on identification of potential oxygen demanding sources and water quality modeling needs.

2.2.3 Modeling

1998 LTCP

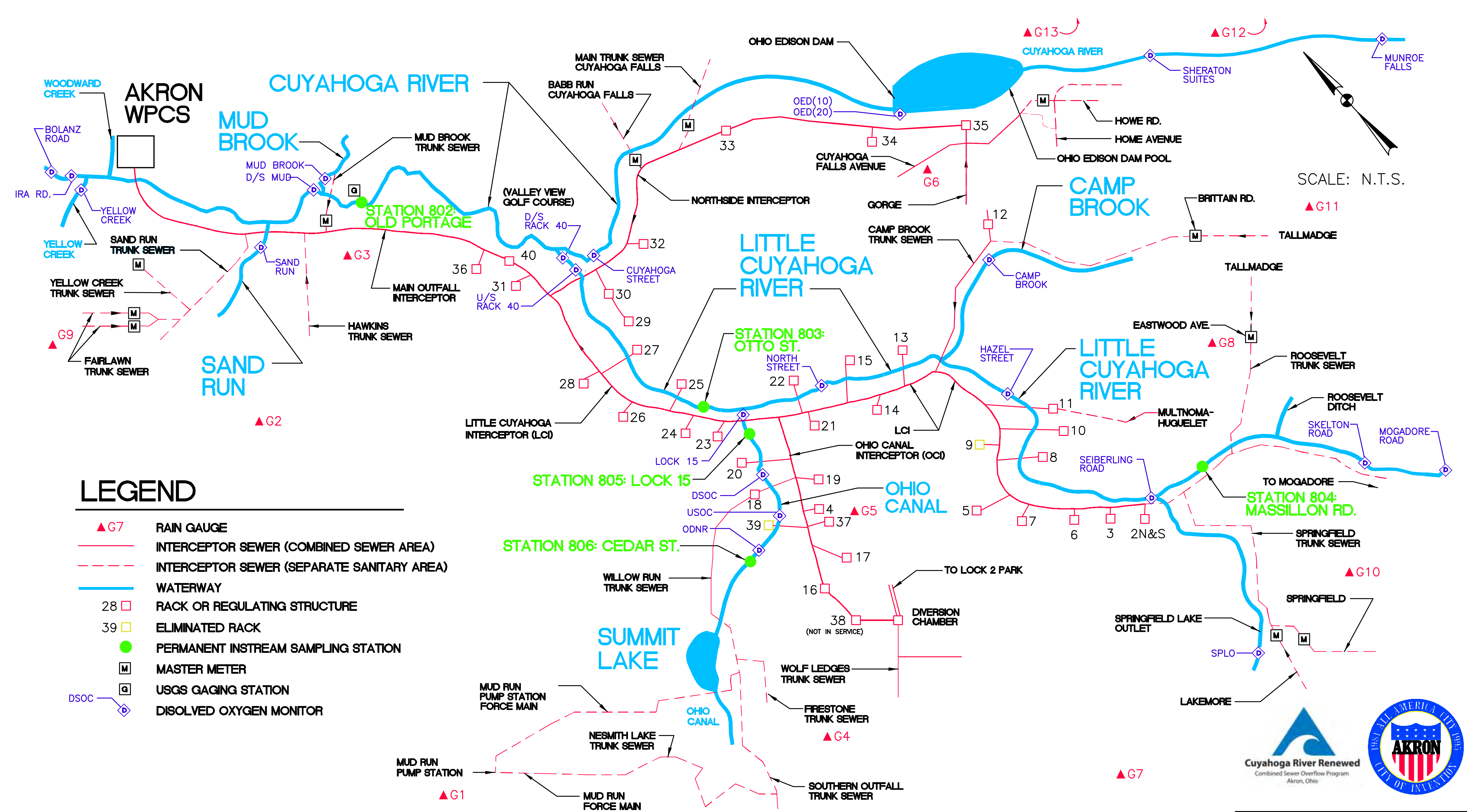
Receiving water quality modeling was done as part of the 1998 LTCP using the WASP model with flow inputs from an XPSWMM model that covered both the collection system and the streams. The model simulated dissolved oxygen and fecal coliform and was calibrated using the events of October 26 and December 10, 1997. Following calibration, the model was used to simulate the October 26, 1997 event (0.91 inches



CSO LONG TERM CONTROL PLAN UPDATE

FIGURE 2–5

1997 DECAY RATE SAMPLING LOCATIONS



CSO LONG TERM CONTROL PLAN UPDATE

FIGURE 2–6

1997
DO MONITORING LOCATIONS

Table 2-8 1997 Dissolved Oxygen Monitoring Locations

Site Designation	Site ID	Location Description	Approximate River Mile	Remark
DLCR 0.17	D/S Rack 40	Little Cuyahoga River, downstream of Rack 40	0.17	permanent location
DLCR 0.25	U/S Rack 40	Little Cuyahoga River, upstream of Rack 40	0.25	permanent location
DLCR 3.15	North Street	Little Cuyahoga River, underneath Route 8 overpass	3.15	permanent location
DLCR 4.7	Hazel Street	Little Cuyahoga River, upstream of Hazel Street bridge	4.7	permanent location
DLCR 6.65	Seiberling Road	Little Cuyahoga River, upstream of Seiberling Road Bridge	6.65	permanent location
DLCR 8.67	Skelton Road	Little Cuyahoga River, downstream of Skelton Rd. Bridge	8.67	permanent location
DLCR 10.4	Mogadore Road	Little Cuyahoga River, upstream of Mogadore Industrial Parkway bridge	10.4	permanent location
DOC 0.05	Lock 15	Ohio Canal, downstream of Lock 15 and upstream of confluence with Little Cuyahoga River	0.05	permanent location
DOC 0.43	DSOC	Ohio Canal, downstream of abandoned power plant	0.43	temporary location
DOC 1.25	USOC	Ohio Canal, downstream of former O'Neil's building	1.25	temporary location
DOC 1.35	ODNR	Ohio Canal, downstream of ODNR facility and upstream of Exchange Street underpass	1.35	permanent location
DCR 33.60	Bolanz Road	Cuyahoga River, Bolanz Road bridge	33.60	permanent location
DCR 35.55	Ira Road	Cuyahoga River, upstream of Ira Road bridge	35.55	permanent location
DCR 39.95	D/S Mud	Cuyahoga River, downstream of Mud Brook	39.95	permanent location
DCR 42.75	Cuyahoga Street	Cuyahoga River, upstream of Cuyahoga Street bridge	42.75	permanent location
DCR 45.21 (10)	OED (10)	Ohio Edison dam pool, monitor located at 10 feet depth	45.21	temporary location.
DCR 45.21 (20)	OED (20)	Ohio Edison dam pool, monitor located at 20 feet depth	45.21	temporary location.
DCR 46.35	Sheraton Suites	Cuyahoga River, upstream of dam behind Sheraton Suites Hotel	46.35	permanent location

Table 2-8 1997 Dissolved Oxygen Monitoring Locations (Continued)

Site Designation	Site ID	Location Description	Approximate River Mile	Remark
DCR 49.80	Munroe Falls	Cuyahoga River, downstream of Munroe Falls	49.80	permanent location
DSLO 0.05	SPLO	Springfield Lake Outlet, upstream of General Tire driveway	0.05	permanent location
DSR 0.28	Sand Run	Sand Run, downstream of Cuyahoga Valley Line railroad bridge	0.28	temporary location
DYC 0.1	Yellow Creek	Yellow Creek, downstream of Riverview Road bridge	0.1	temporary location
DCB 0.1	Camp Brook	Camp Brook, downstream of Rack 12	0.1	temporary location
DMB 0.1	Mud Brook	Mud Brook, downstream of Akron-Peninsula Road	0.1	temporary location

over 22 hours, approximately 1-month return period), and a six-month (May – October) recreational period. Conclusions of the modeling are reproduced below[1].

The single event simulation indicated the following DO and bacteria impacts:

- The Ohio Canal does not experience a local DO drop under this simulation.
- The Little Cuyahoga River downstream of the Ohio Canal is affected directly by the Ohio Canal $CBOD_5$ load.
- The Cuyahoga River has a long continuous reach of relatively depressed DO from the confluence with the Little Cuyahoga River downstream to the Akron WPCS. The downstream portion of the Ohio Canal has fecal coliform levels elevated above ambient conditions for the longest periods of time in the system (at least 17 hours and up to 96 hours in all model reaches).
- All modeled reaches of the Cuyahoga River in the CSO area upstream of the confluence with the Little Cuyahoga River show fecal coliform concentrations remain elevated above ambient conditions for a relatively long period. The occurrence of the long-duration elevated concentrations extends upstream of the Northside Interceptor CSO inflows, thus implicating boundary conditions and non-point sources.

[1] *http://www.epa.gov/athens/wwqtsc/html/wasp.html*

The six-month recreational simulation indicated the following:

- Model-predicted DO is never below the 5.0 mg/l water quality standard in any of the receiving waters. The model did not account for diurnal variations due to photosynthesis and respiration, which could depress the average DO values into a limited number of periods of noncompliance.

- The Cuyahoga River, within and downstream of the CSO area, has difficulties achieving compliance with the bacteriological standard for five to six months of the six-month recreational period.

- The Little Cuyahoga River, within the CSO area, has difficulties achieving compliance with the bacteriological standard for five months of the six-month recreational period.

- The Ohio Canal, within the CSO area, has difficulties achieving compliance with the bacteriological standard for six months of the six-month recreational period simulated.

Data from the stream segments entirely upstream of the CSO area (boundary conditions) demonstrates noncompliance with applicable water quality standards. Therefore, the modeling is not conclusive with regard to the reason for inability to meet applicable water quality standards in the receiving streams in the CSO area. Specifically, data collected in the CSO area indicates:

- Upstream boundary conditions on the Cuyahoga River near Broad St in Cuyahoga Falls demonstrate noncompliance with the bacteriological standard for every month in the six-month recreational period simulated.

- Upstream boundary conditions on the Little Cuyahoga River near Skelton Road demonstrate noncompliance with the bacteriological standard for three months out of the six-month recreational period.

- Upstream boundary conditions on the Ohio Canal near Exchange St demonstrate noncompliance with the bacteriological standards for five of the six-month recreational period simulated.

New Modeling

For this LTCP update, additional receiving water quality modeling was conducted. The XPSWMM model of the collection system and streams that was developed for the 1998 LTCP was used as the basis of the new model. The collection system part was removed and the model was ported to SWMM5, whose water quality modeling capabilities were used to simulate E. coli. The model extent covers the Cuyahoga River, Little Cuyahoga River and Ohio Canal, as shown in Figure 2-7

It was previously noted that the upstream boundary conditions had a significant influence on water quality in the CSO area. Therefore, the model was configured to simulate these boundary conditions as a function of rainfall, to allow simulation of any period of time. Catchments were assumed to discharge at each of the upstream boundaries and their characteristics were adjusted to match flow and water quality measurements.

For flow, the only data that were available for a long period of time were those from the Akron USGS gauge. Those were used to adjust the parameters that control the catchment flows, i.e. percent impervious, width, slope and Manning's n. The larger catchment by far was that of the Cuyahoga River, with an area of more than 400 square miles. The intent was to reproduce measured flows as well as possible, using upstream catchments simulated in SWMM - RUNOFF. Measured and calculated flows for the period of October to December 1997 are shown in Figure 2-8. The match is not as good as can be obtained for smaller catchments. The difference is attributed to the fact that rainfall data from a single gauge was used. Therefore, some storms are over predicted, while others are under predicted, probably because of the different rainfall distribution. Therefore, the receiving water quality model must be considered as representative rather than exactly predictive.

For water quality, the build-up / wash-off model included in SWMM - RUNOFF was used. In this model, pollutants are assumed to build up in the catchment during dry weather and washed off during wet weather. Different options for the build-up and wash-off are available. An exponential build-up with an asymptotic maximum was assumed, together with a power function wash-off in which the wash-off is proportional to the runoff intensity raised to a user-specified power (a value of 1.5 was used). The parameters were calibrated using the three monitoring events in October, November and December, 1997. Measured and calculated E. coli counts are plotted in Figures 2-9 and 2-10.

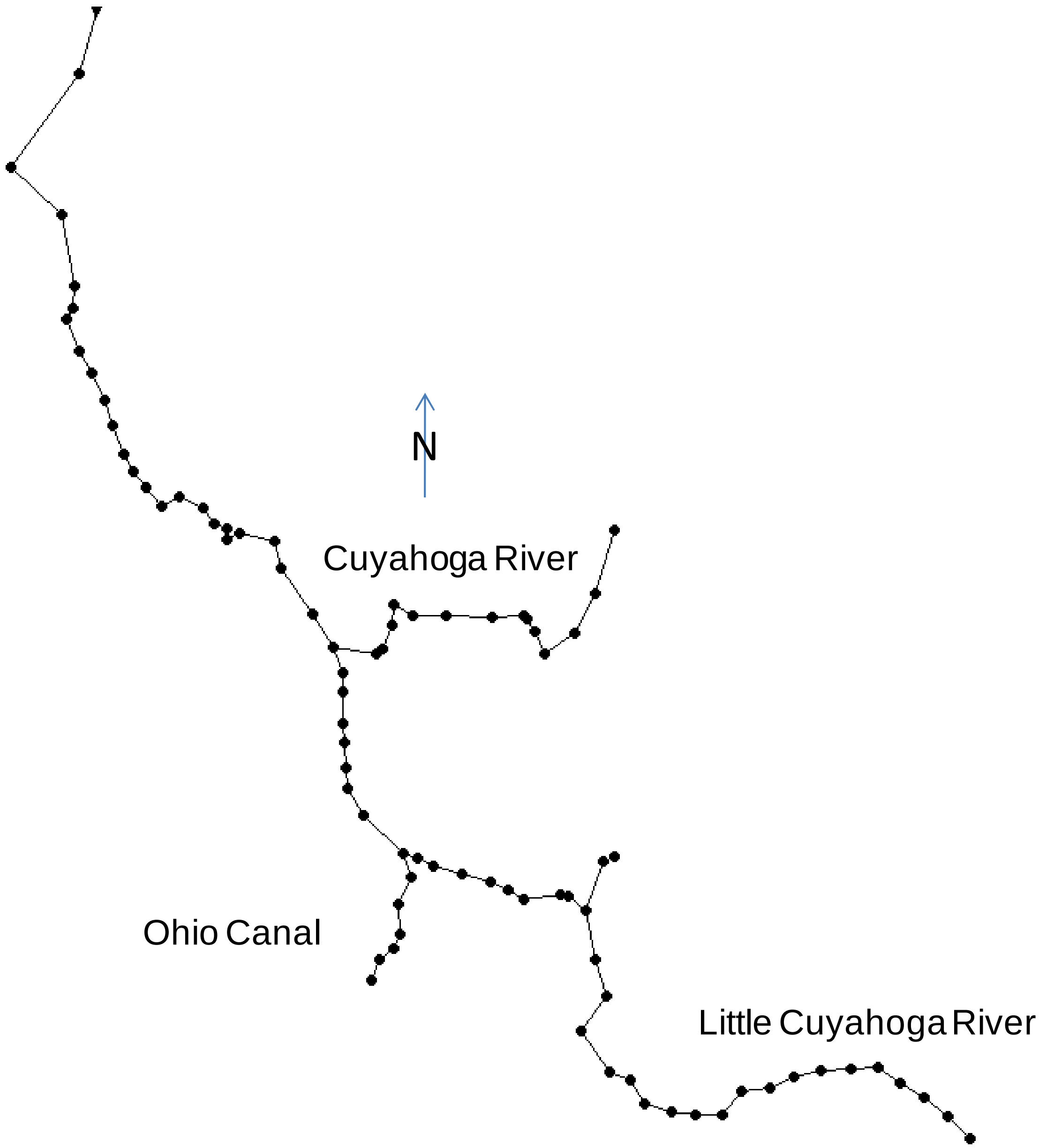


Figure 2-7 Receiving Water Model Schematic

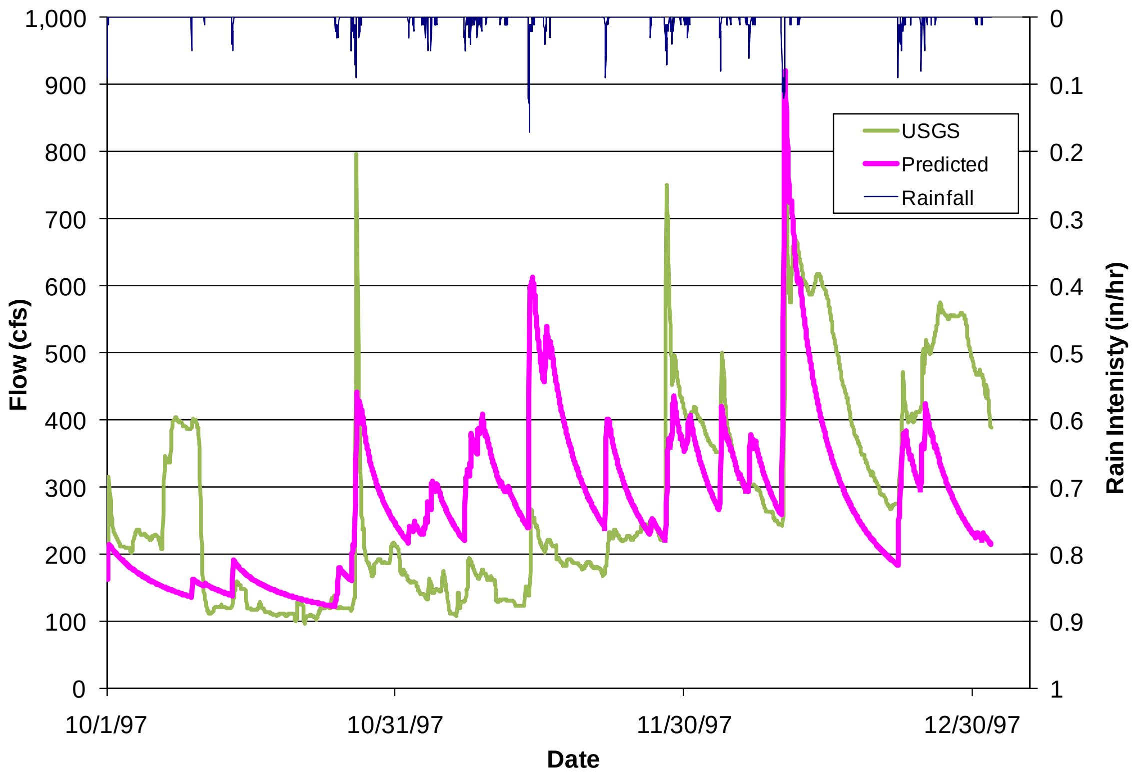
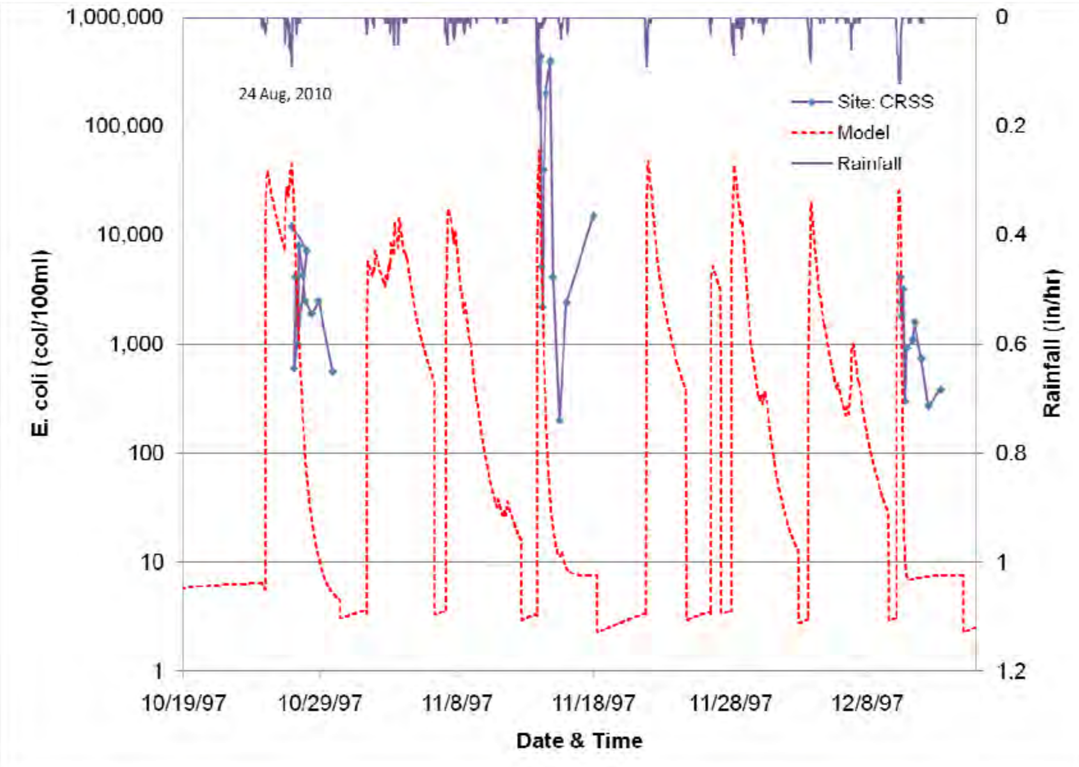


Figure 2-8 Upstream Boundary Flow Calibration



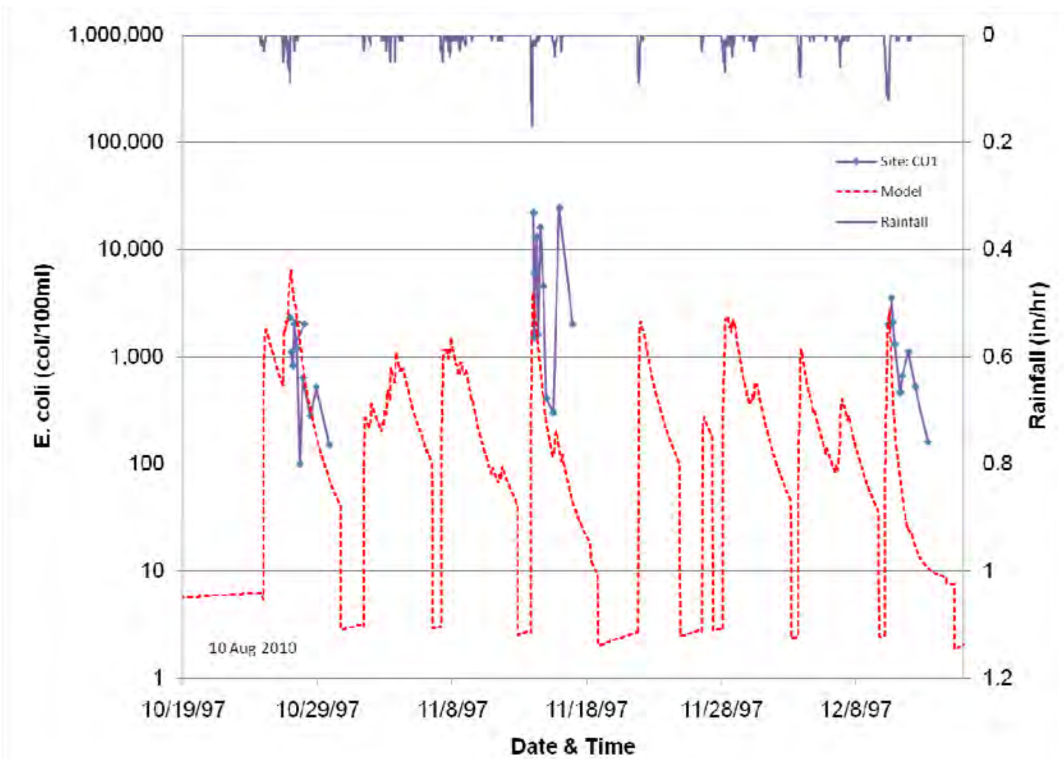


Figure 2-9 Upstream Boundary Conditions Calibration

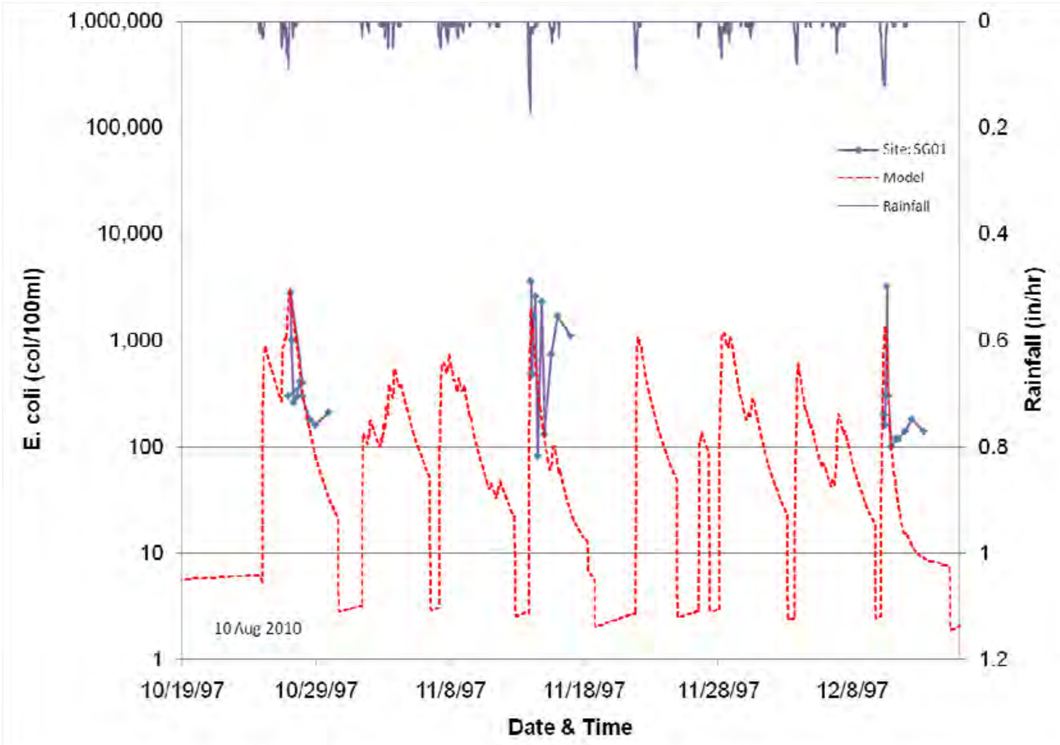


Figure 2-9 Upstream Boundary Conditions Calibration (Continued)

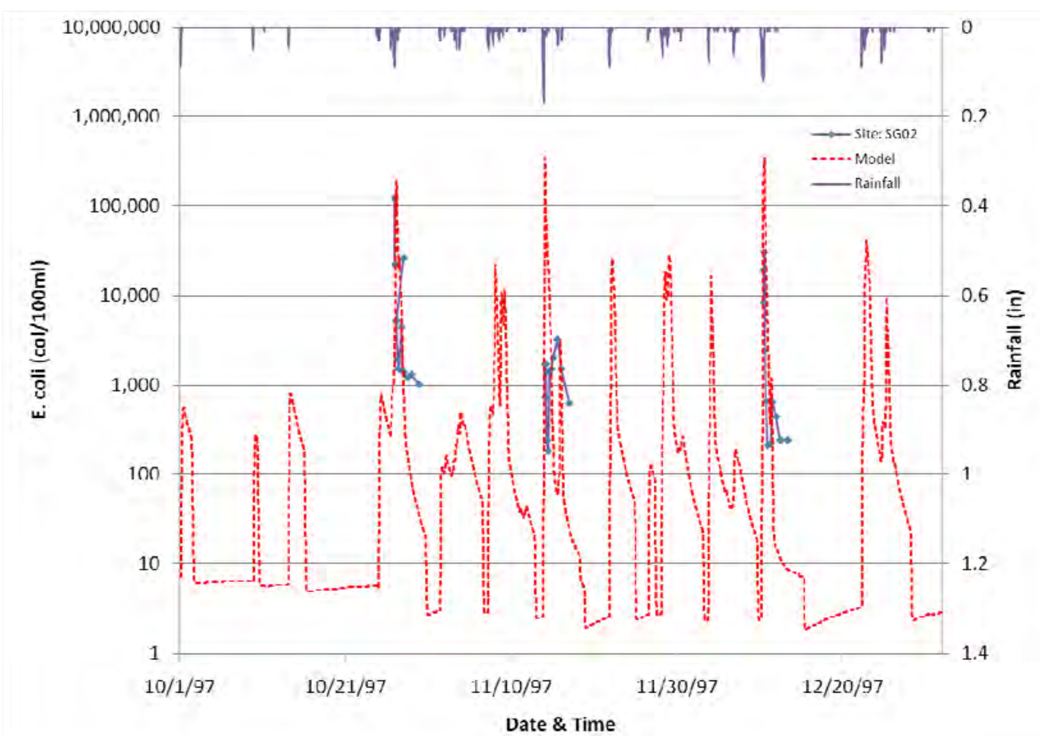
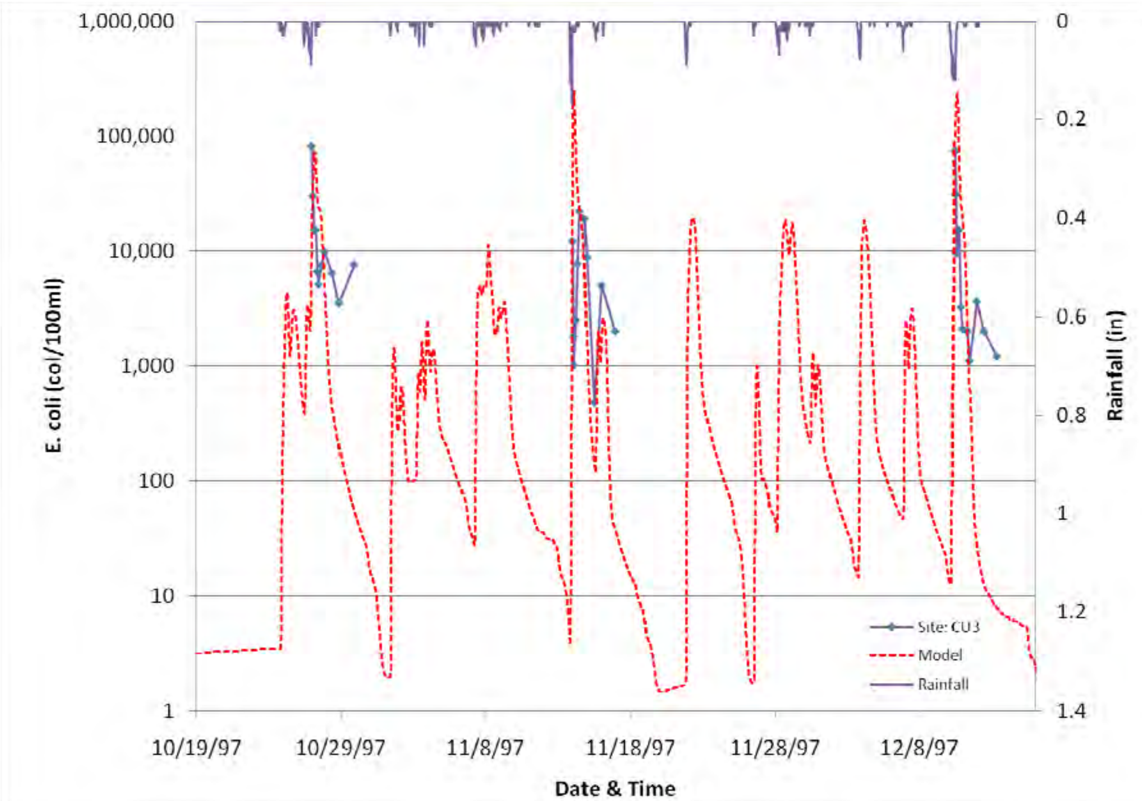


Figure 2-10 Instream Conditions Calibration



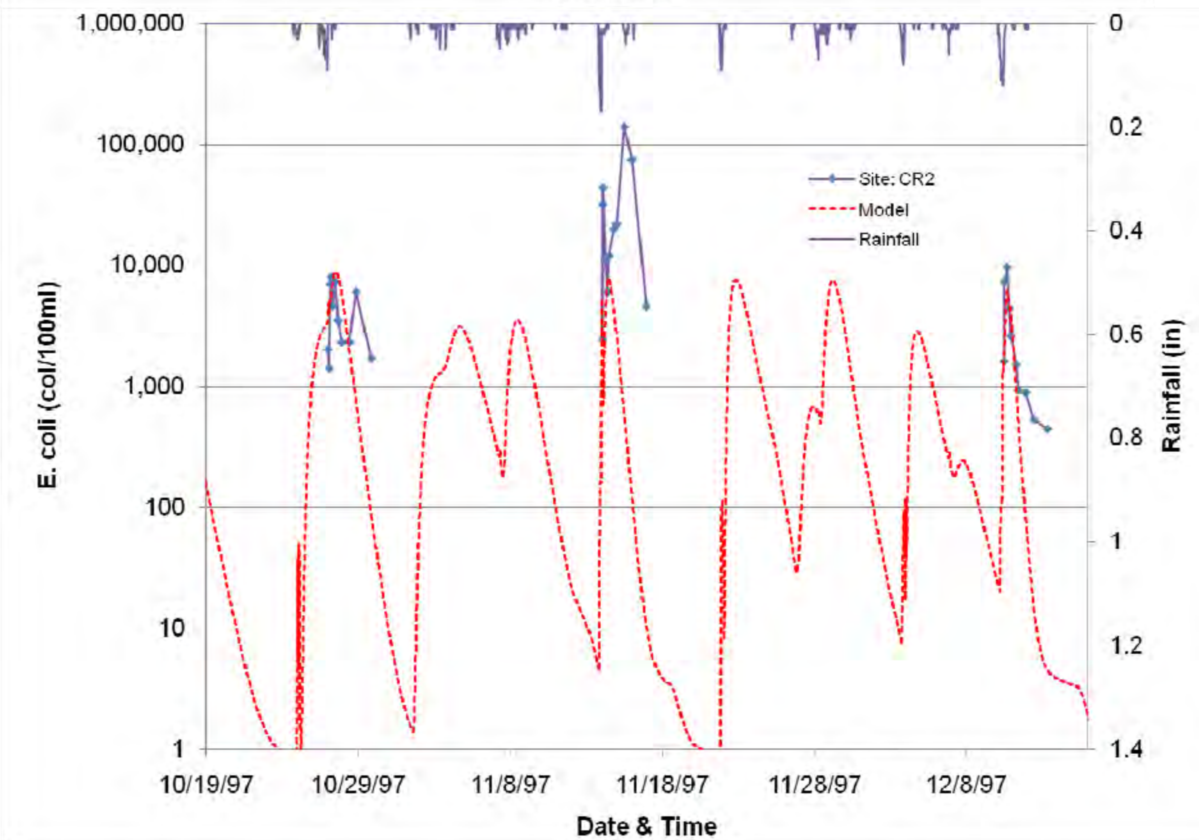


Figure 2-10 Instream Conditions Calibration (Continued)

CSO loadings were input to the model based on the CSO flows calculated by the collection system model and an average CSO concentration of E. coli. This concentration was based on the value of 500,000 colonies per 100 ml, established in the 1998 LTCP for fecal coli form multiplied by a factor of 0.77, which is the average ratio of E. coli to fecal coliform counts measured in the 1997 monitoring. For separate stormwater areas, an event mean concentration of 50,000 colonies per 100 ml (multiplied by 0.77) was used. In the receiving waters, a die off rate of 0.8 day^{-1} was applied.

Following calibration, the model was used to evaluate the water quality improvements brought about by different CSO control alternatives. As indicated above, the Ohio E. coli standards include a maximum geometric mean during the recreational season and a single sample maximum. The standard is consistent with samples being collected and analyzed at intervals of one or more days. In contrast, water quality models predict bacterial counts continuously over time. To quantify the magnitude and duration of the water quality impacts, the model results were used to calculate the number of hours of exceedance of the single sample maximum, as well as the corresponding number of events per year. These data do not represent statistics of standard violations, since the recreation standards are for the recreation period only. These data are intended to quantify CSO impacts on receiving water quality beyond the number and volume of activations, and to account for other sources of contamination.

Model results for existing conditions (in regard to the collection system) as well as the hypothetical case of all CSOs being removed are summarized in Table 2-9. Two sets of results are presented. Table 2-9(a) includes the upstream boundary loading. Table 2-9(b) includes a hypothetical scenario where all upstream loading has been removed to evaluate hours of exceedance attributable to CSO loading only. These results are for the adjusted 1994 typical year rainfall. With the upstream boundary loading included, the results show that removing all CSOs would decrease the number of hours of threshold exceedance, as well as the number of events, but in general, the reductions are relatively small. For most of the Cuyahoga River and Little Cuyahoga River, there would no reduction in the number of events resulting in an exceedance, and the decrease in the number of hours of exceedance in the typical year is less than 10%. With the CSOs loading only, the existing conditions hours of exceedance are significantly reduced in the Cuyahoga and the Little Cuyahoga Rivers. As was previously concluded, bacteria loading from upstream boundaries have a significant influence on receiving water quality, and Akron CSO discharges themselves have a limited impact on the number of hours of exceedance of the water quality criteria that are observed in the Cuyahoga River and Little Cuyahoga River.

Table 2-9 Water Quality Model Results

(a) With Upstream Boundary Loading

Station	Stream	Class	E. coli Limit (#/100ml)	Hours of Exceedance per Year			Number of Events		
				Existing	Zero CSO	% Reduction	Existing	Zero CSO	% Reduction
CR2	CR	A	298	2,668	2,476	7%	47	41	13%
CRVV	CR	A	298	2,897	2,668	8%	48	48	0%
CR3	CR	A	298	2,981	2,790	6%	56	56	0%
CU2	LCR	B	523	2,183	2,183	0%	80	80	0%
CU3	LCR	B	523	2,086	2,063	1%	77	77	0%
SG02	OC	B	523	1,036	524	49%	59	36	39%

(b) CSOs Loading Only

Station	Stream	Class	E. coli Limit (#/100ml)	Hours of Exceedance per Year			Number of Events		
				Existing	Zero CSO	% Reduction	Existing	Zero CSO	% Reduction
CR2	CR	A	298	454	0	100%	37	0	100%
CRVV	CR	A	298	771	0	100%	44	0	100%
CR3	CR	A	298	775	0	100%	43	0	100%
CU2	LCR	B	523	516	0	100%	49	0	100%
CU3	LCR	B	523	929	0	100%	53	0	100%
SG02	OC	B	523	868	0	100%	53	0	100%

2.3 Aquatic Biological Community

This section summarizes the health and condition of surface water aquatic resources in the main receiving waters of the Akron CSO project area based on available biological monitoring data, and assesses the potential impacts to these aquatic resources as a result of reducing CSO flows and loads through implementation of the long-term control program. Although no modeling was conducted to determine the impacts to aquatic resource indices as a result of reducing CSO activation events, a general discussion detailing anticipated impacts of CSO reduction is provided based on historical information.

Each water body in the state of Ohio is assigned one or more aquatic life habitat use designations. These habitat designations are based on selected geographically specific control sites (EcoRegion) from which attainable biological criteria (BioCriteria) with regards to fish and macro invertebrates can be defined and used for reference purposes to assess ecological responses as a result of management actions. The existing aquatic life habitat use designations and condition of the receiving waters in the Akron CSO area discussed in this section are based on biological field assessments performed throughout various portions of the Cuyahoga River basin by the Ohio Environmental Protection Agency (EPA) from 1984 to 2008 and presented in preliminary form (EPA 2008) and in Ohio EPA Technical Reports EAS/1992-12-11 (EPA 1994), MAS/1997-12-9 (EPA 1998a), and MAS/1998-12-4 (EPA 1998b).

Attainment of the aquatic life habitat use designations is determined by generating numerical values for the Index of Biotic Integrity (IBI), the Modified Index of Well-Being (MIwb), and the Invertebrate Community Index (ICI) for comparison with established EcoRegion BioCriteria values. Full attainment is designated if all three indices meet the applicable criteria, partial if at least one index does not attain and performance does not fall below the fair category, and non attainment is designated if all indices fail to attain or any index shows poor to very poor performance.

2.3.1 Background

Although the biological assessments conducted by the Ohio EPA were comprehensive monitoring efforts to characterize spatial and temporal trends within the entire Cuyahoga River basin, the focus of this section is the segments of the Cuyahoga River and associated tributaries (Little Cuyahoga River, Camp Brook, and Ohio Canal) classified as receiving waters of Akron CSO discharge. Additional reaches of the Cuyahoga River Basin located upstream and downstream of the Akron CSO project area are discussed for comparative purposes to assess the potential impacts associated with CSO improvement.

Physical Community

The physical habitats in the Cuyahoga River and tributaries located within the Akron CSO project area were described by the Ohio EPA using the Qualitative Habitat Evaluation Index (QHEI). The QHEI provides a quantitative evaluation of a river or tributary's qualitative physical characteristics using a combination of metrics that score variables such as substrate type and quality, in stream vegetative cover, channel morphology and stabilization, quality of riparian buffer and floodplain vegetation, quality of pool and riffle habitats, and elevation change. These metrics were tabulated by Ohio EPA and described for portions of the Cuyahoga River, Little Cuyahoga, Camp Brook, and Ohio Canal located in the Akron CSO area. Although maximum QHEI scores of 100 indicate pristine habitat conditions, historically, QHEI scores above 60 are indicative of habitat conditions capable of supporting warmwater faunas (EPA 2010).

Macro Invertebrate Community

The Ohio EPA's primary methodology to assess macro invertebrate community performance was based on modified multiple plate artificial substrate samplers deployed in target monitoring locations for six weeks during the June to September time period. In addition to the artificial substrate sampler, a qualitative collection of the macro invertebrates inhabiting the natural substrate at selected monitoring locations was also conducted. Collected organisms from both techniques were identified to the lowest taxonomic category.

Results from Ohio EPA field efforts were used to determine the ICI. The ICI incorporated numerous graded metrics which were based on geographically specific undisturbed reference locations (EcoRegion BioCriteria). The metrics used to calculate the ICI included: the total number of taxa, number of mayfly taxa, number of caddisfly taxa, number of dipteran taxa, percent mayflies, percent caddisflies, percent tanytarsinsi midges, percent of other non-insect and dipteral, percent tolerant organisms, and qualitative collections of Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) taxa (EPT). The ICI values calculated were used to determine the spatially specific attainment level for each specific habitat, in this case primarily warm water habitat (WWH). In the Erie-Ontario Lake Plain region, the ICI EcoRegion BioCriteria is 34 for WWH and 22 for Modified Warmwater Habitat (MWH).

Fish Community

Fish sampling methods used to assess community performance included boat and wader based electrofishing techniques at each location. These methods were employed to characterize representative populations of fish in each monitoring location. All fish collected were speciated, weighed, measured, and external anomalies were identified.

Results from the Ohio EPA field efforts were used to determine the IBI and MIwb. The MIwb is based on structural attributes of the fish community present whereas the IBI incorporates additional functional characteristics. Both indices were used to assess community performance as the combination provided a more robust evaluation. Both indices are derived from numerous graded metrics based on geographically specific undisturbed reference locations (EcoRegion BioCriteria). Metrics used to calculate the indices included: the number of indigenous species, proportion of round bodied Catostomidae, number of sunfish species, number of sucker species, number of intolerant species, percent abundance of tolerant species, omnivore metrics, proportion of insectivores, proportion of top carnivores, number of individuals in a sample, proportion of individuals as simple lithophilic spawners, and proportion of individuals with deformities. The IBI and MIwb values calculated were used to determine the spatially specific attainment level for each specific habitat, in this case primarily WWH. In the Erie-Ontario Lake Plain region, the IBI EcoRegion BioCriteria is 40 for WWH and 24 for MWH, while the MiWB EcoRegion BioCriteria is 6.2 for MWH and 7.9 (wading) to 8.7 (boat based) depending on which methodology is employed for fish capture.

2.3.2 Characterization

The majority of the Akron CSO receiving waters is designated as WWH. These include all portions of the Cuyahoga River and the Little Cuyahoga River, which includes the Camp Brook tributary. Another tributary of the Little Cuyahoga River, the Ohio Canal, is designated as MWH (RM 2.84 to RM 1.25 and RM 0.47 to the mouth), and one portion (RM 1.25 to RM 0.47) is designated as limited resource water (LRW) (Figure 2-5). WWH use represents the primary target for successful restoration for the majority of surface water management efforts in the State of Ohio.

Results of the 1996 monitoring efforts indicated that Cuyahoga River segments in partial to full attainment of the WWH designation were found almost exclusively upstream of the

Akron CSO receiving waters (RM 75.8 to 57.6). RM 57.6 to RM 22.0, located immediately upstream and downstream of Akron CSO discharges (RM 44.0 to 37.5), were in partial and non attainment of WWH status with the exception of RM 44.0, which was in full attainment of WWH status (EPA 1998b). The entire Little Cuyahoga River, in which the majority of Akron CSO overflow occurs, is in non attainment of WWH status (EPA 1998a).

Physical Habitat

Based on the 1996 Ohio EPA monitoring efforts, the Cuyahoga River had an average QHEI score of 65.5 (range 46.5 to 82.0) from RM 57.5 to 33.3 (Table 2-10) (EPA 1998b). Although this score was conducive to WWH, large portions were devoid of aquatic vegetation. Predominant substrates within this segment were comprised of cobble and boulder upstream of the confluence with the Little Cuyahoga with a transition to finer silts, sands, and gravels downstream of the confluence. The Little Cuyahoga River had an average QHEI score of 61.8 (range of 49.5 to 75.5) and demonstrated consistent habitat comprised of alternating riffles, runs, and pools through most of its length (EPA 1998a). The Camp Brook tributary had an average QHEI score of 54.8 (Table 2-10).

Table 2-10 Aquatic Life Use Attainment Status and IBI, MIwb, ICI, and QHEI values according to River Mile for reaches of the Cuyahoga, Little Cuyahoga, Camp Brook, and Ohio Canal calculated from data collected during 1996 Monitoring Efforts (EPA 1998a, 1998b)

River	River Mile	IBI	Miwb	ICI[a]	QHEI	Attainment Status
Cuyahoga	57.5	32.0	5.6	24.0	56.5	NON
Cuyahoga	56.0	34.0	6.7	32.0	67.5	PARTIAL
Cuyahoga	54.3*	28.0	7.6	44.0	70.0	PARTIAL
Cuyahoga	53.4	31.0	6.7	38.0	64.0	PARTIAL
Cuyahoga	52.0	30.0	7.5	-	54.0	NON
Cuyahoga	51.0	30.0	6.2	-	48.5	NON
Cuyahoga	49.0*	26.0	7.1	42.0	56.0	PARTIAL
Cuyahoga	48.0	24.0	6.7	44.0	46.5	NON
Cuyahoga	46.0	28.0	6.7	34.0	67.0	PARTIAL
Cuyahoga	44.0	35.0	7.6	38.0	76.0	FULL
Cuyahoga	42.8	38.0	6.9	40.0	82.0	PARTIAL
Cuyahoga	42.0	26.0	6.9	34.0	68.5	PARTIAL
Cuyahoga	38.3*	26.0	6.1	32.0	76.0	NON
Cuyahoga	37.4	19.0	5.1	24.0	-	-
Cuyahoga	37.2	21.0	5.5	26.0	78.0	NON
Cuyahoga	35.3	20.0	5.6	28.0	77.5	NON
Cuyahoga	33.3	17.0	4.8	24.0	60.5	NON
Little Cuyahoga	11.3	22.0	-	24.0	57.0	NON
Little Cuyahoga	11.0	25.0	4.3	36.0	58.0	NON
Little Cuyahoga	9.7	20.0	4.7	42.0	67.0	NON
Little Cuyahoga	8.5	24.0	4.1	40.0	49.5	NON
Little Cuyahoga	7.3	21.0	4.6	32.0	52.5	NON
Little Cuyahoga	7.1	21.0	4.7	28.0	59.0	NON
Little Cuyahoga	5.1	20.0	4.5	26.0	56.0	NON
Little Cuyahoga	4.2	19.0	3.0	20.0	75.5	NON
Little Cuyahoga	4.1	21.0	2.2	P	71.0	NON
Little Cuyahoga	2.9	23.0	6.5	F	66.0	NON
Little Cuyahoga	1.8	25.0	5.2	16.0	61.5	NON
Little Cuyahoga	0.3	24.0	6.5	24.0	68.0	NON
Camp Brook	1.0	24.0	-	P	48.5	NON
Camp Brook	0.2	20.0	-	P	61.0	NON
Ohio Canal	0.1	-	-	20.0	-	NON

* Average river mile between fish and macro invertebrate monitoring

Macro invertebrate Community

Results of 1996 monitoring indicated macro invertebrate community performance in the Cuyahoga River ranged from good to very good at RM 56.1 to RM 42.0, attaining the WWH criteria (ICI score of 34). Downstream of the confluence with the Little Cuyahoga River (RM 42.4), ICI scores decreased but remained in the lower good to marginally good category. At RM 37.4, a sharp increase in pollution tolerant species such as enrichment tolerant oligochaetes and predominance of hemoglobin-utilizing midges was observed in macro invertebrate samples collected in 1996 (EPA 1998b).

ICI scores estimated from 1996 monitoring efforts indicated increases in macro invertebrate community health within the area of Akron CSO discharge (RM 44.0 to RM 37.5) compared to previous Ohio EPA monitoring efforts conducted in 1986 and 1991 (Figure 2-11). In 2008, additional monitoring efforts (EPA 2008) on the Cuyahoga River indicated ICI scores of 42 at RM 39.95 (downstream of Little Cuyahoga River confluence) and 36 at RM 42.75 (upstream of Little Cuyahoga River confluence). These values represent a stable macro invertebrate community at RM 39.95 and slightly increased performance at RM 42.75 compared to 1996 efforts (Figure 2-11). These results support and confirm the increased health of the macro invertebrate community is spatially correlated with ongoing CSO improvements.

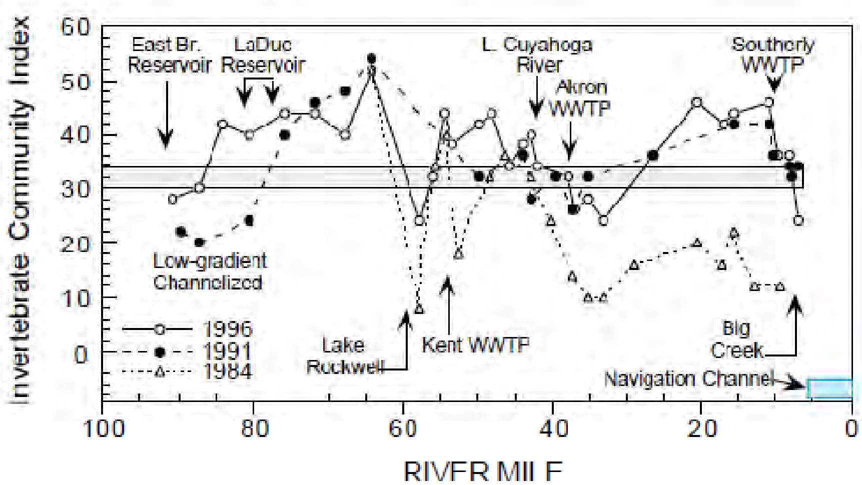


Figure 2-11 Longitudinal Trend in Invertebrate Community Index in the Cuyahoga River from Ohio EPA Monitoring Conducted in 1984, 1991, and 1996 (EPA 1998b).

Monitoring efforts conducted in 1996 indicated that macro invertebrate community performance in the Little Cuyahoga River declined from good (ICI =36) at RM 11.0 to poor (only qualitative information available) at RM 4.1, located immediately upstream of the confluence with the Ohio Canal. Where the Little Cuyahoga drains into the Cuyahoga River, an ICI of 24.0 indicated that the macro invertebrate community is in the fair range (EPA 1998a). It should be noted that portions of the Ohio Canal, a tributary which drains into the Little Cuyahoga River, are designated as MWH which has an ICI criteria of 22.

The main contributors for the low ICI scores observed in the Little Cuyahoga River were a result of decreased taxa richness and increased population percentages of tolerant and other dipterna/non-insect species. With the exception of the confluence with the Ohio Canal, ICI scores estimated from 1996 monitoring efforts indicated increases in macro invertebrate community health along the majority of the Little Cuyahoga River compared to previous Ohio EPA monitoring efforts conducted in 1986 (Figure 2-12).

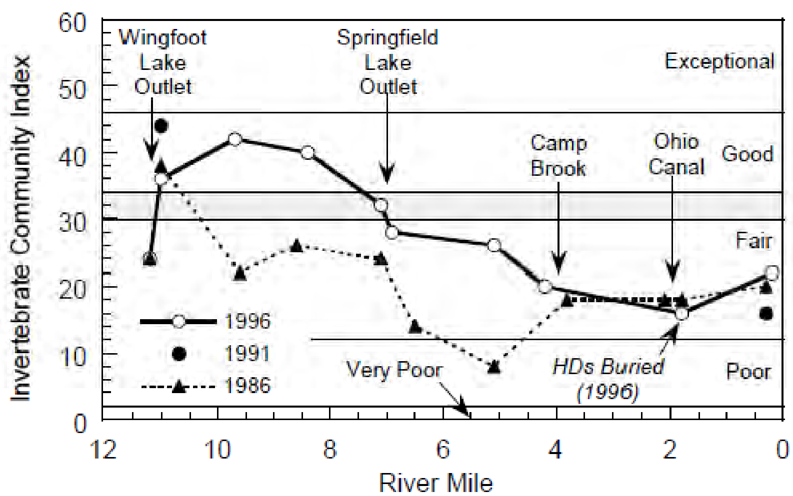


Figure 2-12 Longitudinal Trend in Invertebrate Community Index in the Little Cuyahoga River from Ohio EPA Monitoring Conducted in 1984, 1991, and 1996 (EPA 1998a).

ICI scores in the Camp Brook tributary (RM 1.0 and RM 0.2) were poor (only qualitative information available) and were the result of low abundance and species diversity. The declining macro invertebrate conditions observed in 1996 monitoring efforts in the Camp Brook tributary compared to 1986 Ohio EPA monitoring efforts appear to be a result of rapid development within the watershed.

Comparisons between 1986 (ICI =10) and 1996 (ICI =20) monitoring efforts in the Ohio Canal indicate an increase in the macro invertebrate community from poor to fair. This elevated status was the result of decreasing abundance of tolerant organisms and an increase in toxic intolerant species of midges observed in 1996 benthic samples.

Fish Community

Results of Ohio EPA 1996 monitoring efforts indicated that fish community performance remained in the fair to poor range from RM 57.5 to RM 46.0, resulting in neither the IBI nor MIwb meeting the WWH criteria in this stretch of river. From RM 44.0 to RM 42.8 both indices increased and marginally met the WWH criteria (EPA 1998a). In a downstream direction beginning at RM 42.0, fish community performance did not meet the WWH criteria as IBI and MIwb scores decreased rapidly and were inversely correlated with habitat quality (Table 2-10, Figure 2-13).

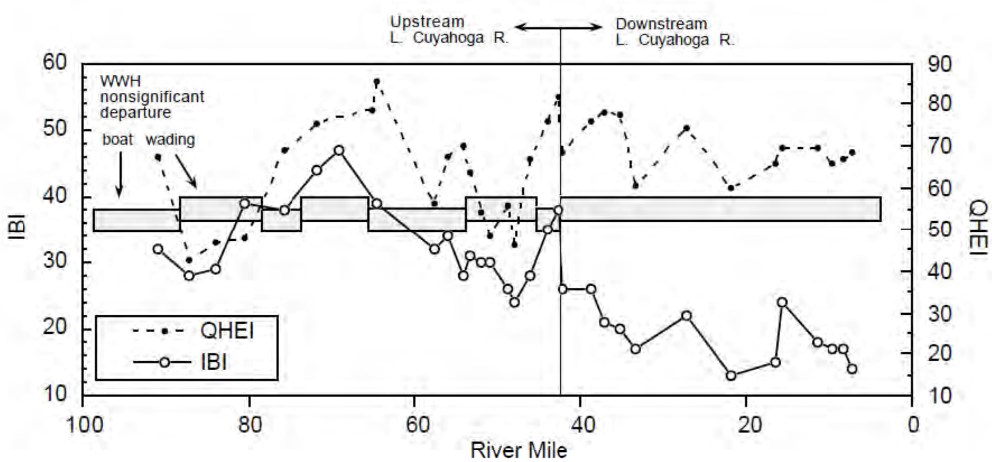


Figure 2-13 Index of Biological Integrity (IBI) and Qualitative Habitat Evaluation Index (QHEI) according to Cuyahoga River Mile (EPA 1998b)

Decreases in both IBI and MIwb were a result of declines in species diversity and increased abundance of highly tolerant species such as bluntnose minnow, white sucker, and common carp. In addition, apex predators, insectivores, and recreational sport fish species were infrequently captured during 1991 and 1996 monitoring efforts. Downstream of RM 37.4, IBI and MIwb reflected compositional shifts towards increased numbers of creek chub and spotfin shiner and pollution sensitive species, indicative of poor community performance.

In 2008, additional monitoring efforts on the Cuyahoga River at RM 39.95 (downstream of Little Cuyahoga River confluence) and RM 42.75 (upstream of Little Cuyahoga River confluence) reflected full WWH attainment status with IBI scores of 36 and 46, respectively. Compared to previous monitoring in 1991, these results represent a transition in the fish community from fair to marginally good at RM 39.95 and from fair to marginally good at RM 42.75.

Previously implemented CSO discharge improvements conducted since 1998, several sewer repair and lining projects, increased operation and maintenance activities involving the CSO Racks, and a new CSO storage facility completed in 2006 have resulted in improved fish community performance since the 1986, 1991, and 1996 monitoring efforts. The 2008 monitoring efforts indicated the improved status of specific river segments within the immediate Akron CSO receiving waters. These data demonstrate the effectiveness of previous CSO elimination efforts by the City of Akron and lend credence to additional benefits to the fish community as a result of the CSO improvements proposed.

Historically, fish community performance in the highly urbanized Little Cuyahoga River has been in non-attainment of WWH BioCriteria, a trend which has been consistent between monitoring efforts in various years. Where IBI scores have remained relatively consistent between monitoring years and indicated little latitudinal variability from upstream to downstream reaches, MIwb values between monitoring locations were more variable. Overall fish indices were similar between stretches of the Little Cuyahoga River located upstream and downstream of CSO activity (Figure 2-14) even though percentage of sunfish, simple lithophile, top carnivore, and insectivore species decreased near the confluence with the Cuyahoga River. This similarity between upstream and downstream indices suggests that conditions leading to degraded communities may originate from a broader watershed scale as opposed to a direct result of CSO activity.

Fish monitoring in the upstream portions of the Camp Brook tributary (RM 1.0) resulted in the capture of only 5 species. Increased habitat quality in the downstream monitoring location was not correlated with increased fish community performance as the entire 1996 monitoring effort resulted in only three tolerant species (blacknose dace, white sucker, and creek chub) and is consistent with Ohio EPA previous monitoring efforts in 1986 and 1991.

2.3.3 Anticipated Impacts

Based on the results of previous monitoring efforts, biological assemblages of macro invertebrates and fish communities in the Cuyahoga River upstream of RM 54.4 were in full attainment of the WWH biocriteria. Full attainment is typical of a primarily rural watershed and is indicative of good water quality, suitable habitat, and minimal point source pollution. Major impacts to biological indices and declines into non-attainment as the Cuyahoga River passes downstream are a result of increasingly larger municipal point source and non-point source discharges directly into the Cuyahoga River or indirectly through the Little Cuyahoga River and its tributaries. Although community

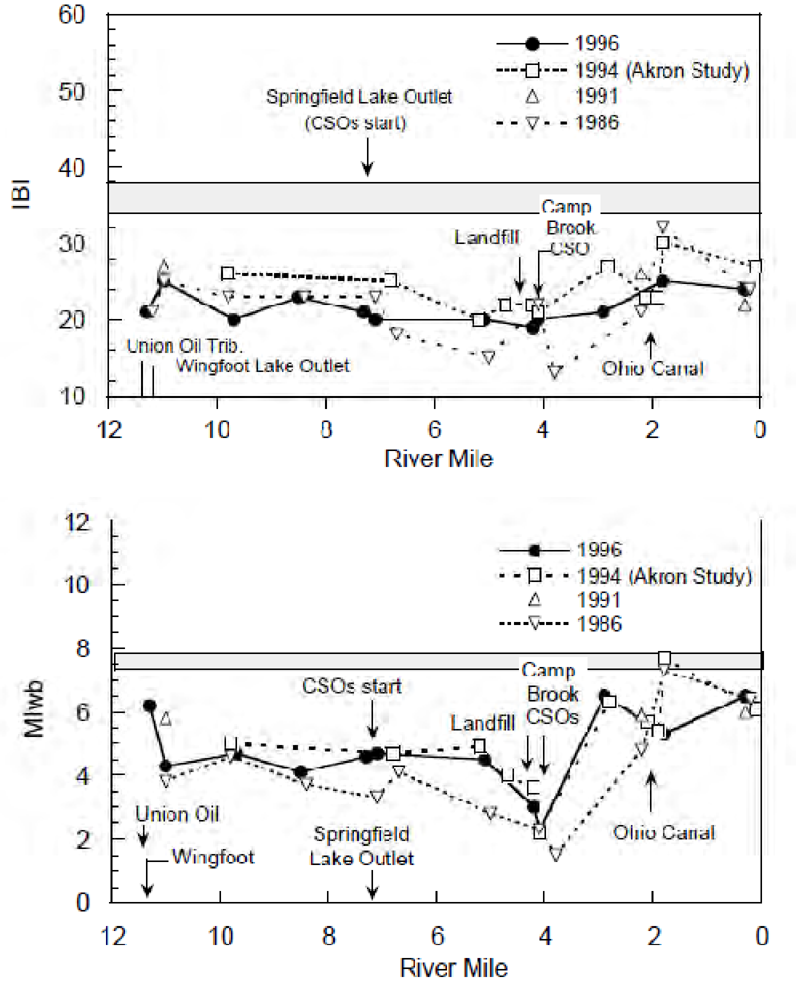


Figure 2-14 Index of Biological Integrity (IBI) and Modified Index of Well Being (MIwb) Index according to Little Cuyahoga River Mile (EPA 1998a)

performance resulted in non attainment of the WWH biocriteria downstream of the confluence with the Little Cuyahoga River, levels did not reflect acutely toxic conditions and indicated an improvement in community performance from Ohio EPA monitoring conducted in 1984 to 1986.

The partial elimination of Akron's CSO discharge through construction of the Ohio Canal Interceptor Tunnel and multiple sewer separation modifications proposed in the long term control plan will improve macro invertebrate and fish biological community performance in the Akron CSO receiving waters. Reduced CSO discharges should increase mayfly and caddisfly species richness, overall diversity and abundance, as well as provide water quality conditions which are conducive to sensitive macro invertebrate species. Although increases in macro invertebrate abundance and diversity should consequently stimulate development of currently diminished trophic webs through recruitment of sunfish species, insectivores, and top predators, considerable improvements to physical stream characteristics and stream flow regimes may be required for full attainment of fish communities as they are typically more sensitive to degraded habitats. Additionally, river reaches upstream of the Akron CSO area appear to support the fish biomass and species diversity capable of providing adequate egg and larval production required for colonization in the downstream municipal reaches as water quality habitat conditions improve.

Although the proposed project identifies alternatives that would result in reduced number of CSO overflows per year, it is difficult to conclusively predict the effect of these scenarios on biological communities as the receiving waters receive pollutant loadings from other sources which likely contribute to the current impairment levels. In the Cuyahoga River watershed located upstream of Akron, nutrient loading from non point sources and flow alteration /modification from Lake Rockwell dam operations have had significant effects on biological and habitat indices, while additional point and non-point sources located within the CSO area are probable contributors to current beneficial use and biological impairment status (Ohio EPA 2001). While proposed reductions in CSO discharges would reduce bacteria levels and nutrient loadings, it is important to note, as discussed above in Section 2.2.3, that background and non point source loadings have a significant impact on receiving water quality, and, in fact, far exceed the CSO loading on an annual basis. Successively higher levels of CSO control are unlikely to have a marked effect on attainment of biocriteria unless accompanying reductions in other loadings are also achieved. In addition to reducing CSO discharges, treatment (primarily disinfection) of remaining CSO discharges has also been considered. While additional treatment of remaining overflows would further reduce bacteria loading from CSOs, it is anticipated to have a marginal effect on receiving water nutrient loading, a factor known to decrease dissolved oxygen levels and consequently impair biological community status. Therefore, additional treatment of remaining overflows may have little or no impact on the potential for improving biocriteria attainment.

The biological indices discussed in this section were developed by the EPA as a method to detect a wide variety of anthropological disturbance which may impact biological community performance. The species composition indicators and trophic relationship metrics used to develop the indices are highly responsive to a multitude of slight changes in biotic and abiotic surrounding conditions. The utility of the biological characterization effort is to track the overall health of a particular aquatic ecosystem. In this respect, it is difficult to isolate any one factor as responsible for overall impairment. Even if all CSO discharges were eliminated, it is unlikely that the receiving waters in the Akron combined sewer area would achieve full attainment of the WWH biocriteria due to the continued presence of other point and non-point source discharges, and poor habitat quality. Therefore, the conditions observed in the Cuyahoga and Little Cuyahoga Rivers, where multiple factors are affecting beneficial use and biological impairment status, suggest that a holistic watershed approach to biological community improvements would be a more effective method to achieve long term success in reducing biological impairment than a focus on elimination of CSO discharges at all cost.