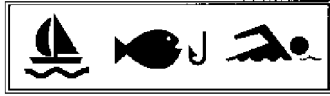


THE ROUGE RIVER PROJECT
A WORLD CLASS EFFORT



BRINGING OUR RIVER BACK TO LIFE

Rouge River National Wet Weather Demonstration Project

Wayne County, Michigan

TASK PRODUCT MEMORANDUM Illicit Connection Detection in the Middle 2 Nonpoint Work Plan No. URBSW8.2

RPO-NPS-TPM52.00

August 1998

Rouge River National Wet Weather Demonstration Project

Wayne County, Michigan

Illicit Connection Detection in the Middle 2

TASK PRODUCT MEMORANDUM

Nonpoint Work Plan No. URBSW8.2, Task No.

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Rouge River National Wet Weather Demonstration Project

MISSION STATEMENT

The mission of the Rouge River National Wet Weather Demonstration Project is to demonstrate effective solutions to water quality problems facing an urban watershed highly impacted by wet weather and develop potential solutions and implement projects which will lead to the restoration of water quality in the Rouge River. The project will address both conventional and toxic pollutants to:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downstream water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state and local environmental laws which protect human health and the environment.

This will be accomplished through the development, implementation and financial integration of technical, social and institutional frameworks leading to cost-efficient and innovative watershed-based solutions to wet weather problems. This watershed-based national demonstration project will provide other municipalities across the nation facing similar problems with guidance and potentially effective solutions.

PREFACE

The Rouge River and its watershed are a primary source of pollution to the Great Lakes. The Clean Water Act of 1972 intended to make waterways "fishable and swimmable" by 1972. Although that goal has not been reached, great progress has been made in improving water quality in most waterways. The Rouge River Remedial Action Plan (RAP) provided a basis for which The Rouge River National Wet Weather Demonstration Project (Rouge Project) efforts were created: it identified the major sources of pollution and measured the relative contributions of each. The RAP is the continuing foundation for the Rouge Project and presents a framework for addressing the problems within the Rouge River by looking beyond treatment and focusing instead on prevention methods.

The Rouge Project was established under the initial Rouge Grant 1 from the United States Environment Protection Agency, Region 5, and enabled Wayne County to initiate a comprehensive watershed-wide pollution-control approach that addresses combined sewer overflow (CSO), stormwater management, and other nonpoint source controls through the application of innovative technologies, progressive financial and institutional arrangements, and creative public involvement and education programs.

Rouge Grant 2 provides the framework for the progression and implementation of Project goals as Wayne County continues its mission to develop potential solutions and implement projects which will lead to the restoration of water quality in the Rouge River. The Project will address both conventional and toxic pollutants to:

- provide a safe and healthy recreational river resource for present and future generations;
- re-establish a healthy and diverse ecosystem within the Rouge River Watershed;
- protect downstream water resources such as the Detroit River and Lake Erie; and
- help ensure compliance with federal, state, and local environmental laws which protect human health and environment.

This will be accomplished through the development, implementation, and financial integration of technical, social, and institutional frameworks leading to cost-efficient and innovative watershed-based solutions to wet weather problems. This watershed-based national demonstration project will provide other municipalities across the nation facing similar problems with guidance and potentially effective solutions.

Under Rouge Grant 2, the Rouge Project will build on lessons learned from Grant 1 efforts and focus on further integration of the goals of the overall Mission. To this end, Rouge Grant 2 concentrates on the following key Project areas:

- **Watershed Management** will continue under Rouge Grant 2 with the development and evaluation of wet weather and stormwater alternatives, the planning of long-term monitoring programs, and the ongoing efforts to enhance instream water quality, monitor rain and flow levels, interpret data analysis, and present recommendations.

- **Nonpoint Source Pollution Control** will provide for the stormwater management, permit applications, and development of financial and institutional alternatives for wet-weather watershed management in concert with enhanced efforts to establish institutional partnerships. Toward the goal of institutional partnering, several community projects will be undertaken with watershed communities. Additional efforts include the inventory of wetlands and measurement of pollutant loads from abandoned dumps and air deposition with possible remediation of some sites.

- **CSO Construction Coordination** will continue to monitor the construction of CSO demonstration projects established under Grant 1. Additional planning and assistance will allow project coordinators to make additional recommendations on the design criteria of future CSO abatement facilities.

- **Public Involvement and Information** will reach and interact with more stakeholders, institutions, and regulatory agencies, thus fostering a renewed understanding and continued commitment to reducing pollution, and continuing the transfer of watershed management approaches beyond the project. It will be the central mechanism for transmittal of the Project's Decision Support System tools, processes, and information necessary for sustaining a watershed management support system directly to varied audiences both within and outside the Rouge watershed.

Additional information on the Rouge River Project is available from many sources, including the Wayne County Department of Environment (WCDOE) and the Rouge Program Office (RPO).

ABSTRACT

This document summarizes the procedures and results obtained from an illicit connection detection program by the Wayne County Department of the Environment. The study was performed in the Middle 2 subwatershed of the Rouge River and comprised two phases. Phase one was conducted in the communities of Westland, Plymouth Township, Canton Township, Plymouth and Livonia. Storm sewer maps of each community were obtained and manholes nearest to outfalls were targeted for investigation as it was assumed that if there was a problem in the line that it could be found in the most downstream manhole. Sewers were tested during periods of dry weather. If a problem was encountered, then field crews moved up the sewer line to try and identify the source. The primary indicator of pollutants for phase one was the presence of ammonia. A colorimetric field test kit was used to determine the presence of ammonia. If ammonia concentrations were high, then samples were taken to a lab to determine if E. Coli bacteria was present. No apparent correlation was found between bacteria and ammonia for the storm sewers sampled in this project. For phase two it was decided to try using a new indicator. Several manholes that were previously tested in phase one were selected based on their appearance or their ammonia levels. A colorimetric surfactant test kit was used in the field to determine the presence of detergents in the flows as a possible indicator of an illicit connection. In addition, ammonia and E. Coli bacteria tests were also performed at each of the manholes to try and determine some correlation between the three tests.

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EXECUTIVE SUMMARY

The purpose of the Illicit Connection Detection Program URBSW 8.2, was to investigate the Middle 2 Subwatershed of the Rouge River Watershed for illicit residential and industrial sewer connections to the storm sewer system. Several high bacteria counts at sampling stations throughout the Middle 2 Subwatershed two years prior, led to the initiation of this particular investigation, which is a subject of the overall URBSW8.2 program. In this investigation, the reaches tributary to the sampling stations with high bacteria counts were inspected for illicit sanitary sewer connections to the storm sewer system. There were two phases in the inspection effort.

Phase 1 involved manhole inspection conducted from January to May of 1997 in the communities of Westland, Plymouth, Livonia, and Plymouth and Canton Townships. Colorimetric ammonia testing was used to determine areas where illicit connections to storm sewer systems may have occurred.

Manholes within the tributary boundaries were opened and tested for ammonia. They were also inspected for any suspicious conditions, such as algae, rust, debris, staining etc., which indicated the presence of sanitary flows. The selected manholes consisted of all manholes which were upstream from outfalls to the stream section under investigation. Photographs of the insides of manholes and catch basins were taken, and field forms were filled out at every structure that was investigated. Field forms included the date, time and location of the inspection, as well as information pertaining to existing conditions in the manhole at the time of the inspection. The forms also included ammonia test results and sketches of the inside of the structures as well as a map location. Daily logs were produced for record keeping, as well as a map of the stream segment under investigation with the location of all the manholes inspected and their respective ammonia test results, if any.

In Phase 1, approximately fifteen percent of all manholes tested had ammonia levels greater than 1.0 ppm. There were however, just as many manholes that had suspicious characteristics, and tested low for ammonia. A total of 516 manholes were tested in Phase 1, with the majority (256 manholes) being in Canton Township.

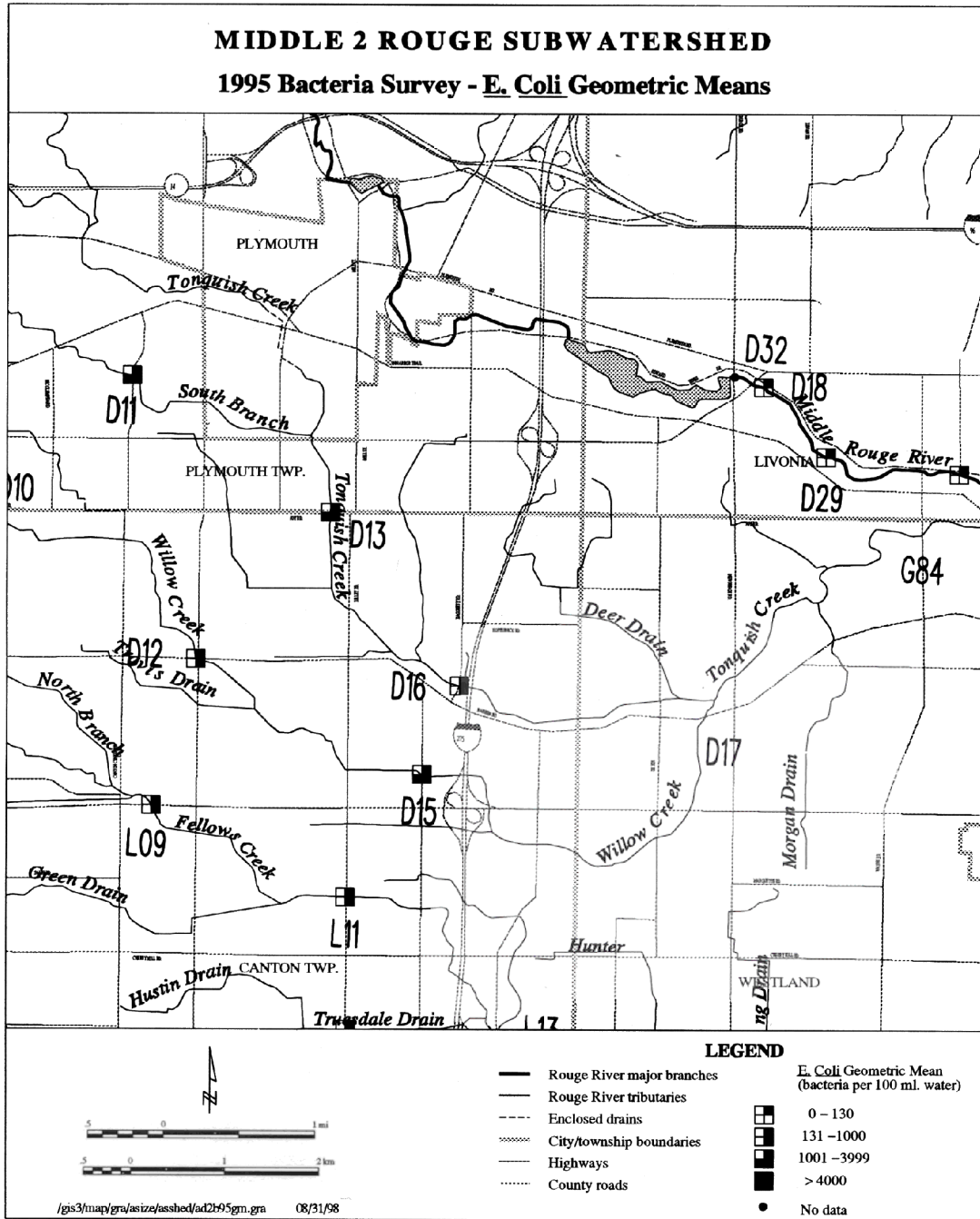
Phase 2 illicit connection detection program included further testing of manholes in Canton Township that tested high for ammonia in Phase 1, or had suspicious characteristics. A total of 60 manholes were chosen to test, 31 of which had previous high ammonia readings, and 29 that had suspicious characteristics(i.e., staining, deposits, high flow). The tests to be performed on these manholes, included colorimetric ammonia tests, colorimetric anionic surfactant tests, and E.Coli bacteria tests. The sample data was collected as in Phase 1 (field sheets, photographs, etc.).

The intent of Phase 2 was to try and find a relationship between high ammonia or surfactant and high bacteria counts. Ammonia results between Phase 1, and Phase 2 remained essentially the same, but no direct correlation between any of the utilized tests could be found. Future possible studies to determine illicit connections may involve using different indicators of sanitary waste, such as flow monitoring.

1.0 INTRODUCTION. The purpose of the Illicit Connection Detection Program URBSW 8.2, was to investigate the Middle 2 Subwatershed of the Rouge River Watershed for illicit residential and industrial sewer connections to the storm sewer system. Several high bacteria counts at sampling stations throughout the Middle 2 Subwatershed two years prior led to the initiation of this investigation. The locations of these stations were the Middle Rouge River and its tributaries within the Middle 2 Subwatershed, as shown on *Figure 1-1: “1995 Bacteria Survey - E. Coli Geometric Means”*. The reaches tributary to the sampling stations with high bacteria counts were also investigated for illicit sanitary sewer connections to the storm sewer system.

There were two primary phases to the Illicit Connection Detection Program URBSW 8.2 investigation. Phase 1 of this investigation required field crews to test and sample storm sewer structures throughout the Middle 2 Subwatershed, using ammonia and sensory observation as indicators of possible sanitary waste. The areas of investigation included Westland, Plymouth Township, Canton Township, City of Plymouth and Livonia. Phase 2 of the investigation was a more specific investigation based on the data received in Phase 1. Canton Township was the chosen location for the Phase 2 investigation.

Figure 1-1
1995 Bacteria Survey - E.Coli Geometric Means



2.0 OUTLINE OF DOCUMENT. Section 1.0 of this memorandum is the introduction which outlines where and why the investigation was performed. Section 2.0 explains the content of the document. Section 3.0 describes Phase 1 and the methodology involved with this investigation. The results and recommendations for Phase 1 are discussed in Section 3.2. Section 4.0 describes Phase 2 and the methodology involved with this phase of the investigation. The results and recommendations for Phase 2 are discussed in Section 4.3. Appendix-A of the memorandum is a Standard Operating Procedure which was developed from experience gained during the field work. Appendices B through F contain the results from the Phase 1 investigation which includes field forms, ammonia test results, daily field summaries and maps of investigated areas detailing manholes surveyed and ammonia results if any. Appendix-G includes the results from the Interim investigation. Appendix-H contains the results from Phase 2, including field forms, test results and a map of the investigated area and results. Finally, Appendix-I includes the photographs of the manholes and outfalls obtained throughout both phases of the investigation.

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

3.0 PHASE 1. The manhole inspection was conducted from January to May of 1997 in the communities of Westland, Plymouth, Livonia, Plymouth Township and Canton Township. Colorimetric ammonia testing was used to determine areas where illicit connections to storm sewer systems may occur or, have occurred.

3.1 PHASE 1 METHODOLOGY. The field crew following the Standard Operating Procedure located in Appendix A, was assigned a community to inspect. Community representatives were contacted and notified that a field crew was expected to work in the area. Available sewer system maps were obtained from the community and tributary boundaries were established for the stream segments under investigation.

Prior to testing manholes, a preliminary walk of the stream segment was performed. The purpose of the walk was to verify available storm sewer maps, and to make any necessary adjustments for outfalls that did not appear on the current maps. Manholes and catch basins within the tributary boundaries were opened and tested for ammonia. They were also inspected for any suspicious conditions which indicated the presence of sanitary flows such as algae, rust, sanitary debris or staining. The selected manholes consisted of all manholes which were upstream from outfalls to the stream section under investigation. Photographs of the insides of manholes and catch basins were taken, and field forms were filled out at every structure that was investigated. Field forms included the date, time and location of the inspection, as well as information pertaining to existing conditions in the manhole at the time of the inspection. The forms also included ammonia test results and sketches of the insides of the structures as well as a map location. Daily logs were produced for record keeping, as well as a map of the stream segment under investigation with the location of all the manholes inspected and their respective ammonia test results, if any.

When manholes were selected for inspection, care was taken to follow the standard operating procedure located in Appendix-A. The standard operating procedure stresses safety with the opening of manholes, and the possibility of handling sanitary waste. It is important to fill out the field forms and take pictures for future reference, when investigating a manhole.

A 1.0 ppm concentration of ammonia was selected as the base indicator of possible sanitary waste because of previous State of Michigan experience with the Phase 1 Stormwater NPDES program and literature regarding a similar investigation in Toronto in 1983.¹ If an ammonia reading of greater than or equal to 1.0 ppm was obtained, county field crews were contacted for follow-up investigation. Manholes with ammonia readings greater than 1.0 ppm were recorded on a table which is located in each communities specific appendix. In addition, manholes further up the sewer line were tested to try and determine the source of

¹P. H., Robert, Melinda Lator, Richard Field, Donald Dean Adrian & Donald Barbe', Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems, U.S. Environmental Protection Agency, EPA/600/R-92/238, Risk Reduction Laboratory, Cincinnati, Ohio, p22.

the high ammonia reading. Wayne County Department of the Environment used the ammonia test results to further the investigation, performing bacteria tests on manholes with high ammonia readings. When a manhole tested over 1.0 ppm, a field crew was sent to test that particular structure to take a bacteria sample. Several manholes in each community had suspicious conditions, but ammonia test results were less than the base indicator of 1.0 ppm. These manholes are noted in *Table 3: "Suspicious Manholes/Outfalls with Ammonia Results < 1.0 ppm"*.

3.2 DISCUSSION OF PHASE 1 RESULTS. A total of 516 manholes were tested, averaging approximately 7-8 manholes/day. *Table 3.3: "Comparison of Results"*, compares percentages of manholes tested with respect to high ammonia and suspicious characteristics. The procedure to determine suspicious manholes was based on the photographs and field notes. After Wayne County performed bacteria tests on the manholes that had high ammonia readings, it was found that there was no direct correlation between high ammonia and high bacteria levels. It was recommended that for the next phase of testing, a different approach be taken. Monitoring flows or testing for other substances (i.e. anionic surfactants), may be better indicators of sanitary waste.

**Table 3.1
Suspicious Manholes/Outfalls with Phase 1 Ammonia Results < 1.0 ppm**

No.	Developed By	Community	Site ID	Condition
1	RPO	Westland	22	Oil
2	SIGMA	Westland	32	Oil Sheen
3	SIGMA	Westland	48	Oil Sheen
4	SIGMA	Plymouth Township	52	Odor
5	SIGMA	Plymouth Township	53	Odor
6	RPO	Plymouth Township	54	Stains
7	RPO	Plymouth Township	59	Scum
8	RPO	Plymouth Township	82	Stains
9	RPO	Plymouth Township	83	Dirty Water
10	SIGMA	Plymouth Township	109	Dirty Water
11	RPO	Plymouth Township	136	Stains
12	RPO	Plymouth Township	144	Suds
13	RPO	Plymouth Township	147	High Flow
14	RPO	Plymouth Township	153	Suds
15	RPO	Plymouth Township	163	Stains
16	SIGMA	Plymouth Township	174	High Flow
17	SIGMA	Plymouth Township	175	Oil Sheen
18	RPO	Plymouth Township	179	Scum

No.	Developed By	Community	Site ID	Condition
19	RPO	Plymouth Township	183	Deposits
20	RPO	Plymouth Township	192	Stains
21	RPO	Plymouth Township	194	Stains/Deposits
22	RPO	Plymouth Township	195	Scum
23	SIGMA	Canton Township	211	Debris
24	RPO	Canton Township	212	Rust Staining
25	RPO	Canton Township	232	Sediment and Cigarette Butts
26	SIGMA	Canton Township	233	Sediment
27	RPO	Canton Township	237	Sanitary Manhole?
28	RPO	Canton Township	243	Sanitary Manhole?
29	RPO	Canton Township	256	Rust Staining
30	RPO	Canton Township	257	Oil Sheen
31	RPO	Canton Township	259	Debris
32	SIGMA	Canton Township	268	Sediment
33	SIGMA	Canton Township	269	Sediment
34	RPO	Canton Township	270	Oil
35	RPO	Canton Township	271	Sewage?
36	RPO	Canton Township	274	Oil Sheen
37	RPO	Canton Township	278	Debris
38	RPO	Canton Township	280	Debris
39	SIGMA	Canton Township	281	Oil Sheen
40	RPO	Canton Township	289	Dirty Water/Debris
41	SIGMA	Canton Township	292	Sediment
42	SIGMA	Canton Township	296	Sediment
43	RPO	Canton Township	305	Dirty Water/Debris
44	SIGMA	Canton Township	306	Stains
45	SIGMA	Canton Township	314	Oil Sheen
46	SIGMA	Canton Township	315	Oil Sheen
47	SIGMA	Canton Township	316	Stains
48	RPO	Canton Township	319	Debris
49	SIGMA	Canton Township	324	Oil Sheen/Odor/Stains
50	SIGMA	Canton Township	336	Sediment
51	SIGMA	Canton Township	360	Debris
52	SIGMA	Canton Township	363	High Flow
53	SIGMA	Canton Township	385	Oil Sheen/Odor
54	SIGMA	Canton Township	400	White Build-up

No.	Developed By	Community	Site ID	Condition
55	SIGMA	Canton Township	402	Sediment
56	SIGMA	Canton Township	425	Sediment
57	SIGMA	Canton Township	426	Sediment
58	SIGMA	Canton Township	438	Submerged Pipes
59	SIGMA	Canton Township	440	Pipes half submerged
60	SIGMA	Plymouth	465	Standing Water
61	SIGMA	Livonia	476	Rust Staining, high flow
62	SIGMA	Livonia	480	Rust Staining, deposits
63	SIGMA	Livonia	490	Rust Staining, deposits
64	SIGMA	Livonia	502	Rust Staining
65	SIGMA	Livonia	505	Rust Staining, deposits
66	SIGMA	Livonia	511	Deposits

**Table 3.2
Manholes/Outfalls with Phase 1 Ammonia Results > 1.0 ppm**

No.	Community	Site ID	Ammonia (ppm)
67	Westland	5	2.0
68	Westland	14	1.0
69	Westland	29	2.0
70	Westland	42	5.5
71	Westland	43	1.5
72	Plymouth Township	67	2.0
73	Plymouth Township	87	1.0
74	Plymouth Township	100	1.0-2.0
75	Plymouth Township	102	1.0-2.0
76	Plymouth Township	108	1.0-2.0
77	Plymouth Township	110	1.0-2.0
78	Plymouth Township	111	1.0-2.0
79	Plymouth Township	130	9.0
80	Canton Township	213	1.0-2.0
81	Canton Township	217	5.0
82	Canton Township	226	3.0
83	Canton Township	227	1.5
84	Canton Township	242	5.0
85	Canton Township	245	1.5
86	Canton Township	248	2.0
87	Canton Township	249	1.0
88	Canton Township	253	1.5
89	Canton Township	258	2.0
90	Canton Township	260	1.2
91	Canton Township	272	5.0
92	Canton Township	273	3.0
93	Canton Township	293	6.5
94	Canton Township	300	1.0
95	Canton Township	312	1.0
96	Canton Township	313	1.0
97	Canton Township	317	1.5
98	Canton Township	322	1.5
99	Canton Township	323	1.0
100	Canton Township	357	1.5

No.	Community	Site ID	Ammonia (ppm)
101	Canton Township	359	1.0
102	Canton Township	388	2.0
103	Canton Township	395	5.0
104	Canton Township	396	1.5
105	Canton Township	397	4.0
106	Canton Township	398	4.0
107	Canton Township	404	1.0
108	Canton Township	406	1.5
109	Canton Township	409	2.5
110	Canton Township	413	1.0
111	Canton Township	439	1.0
112	Canton Township	443	1.0
113	Plymouth	449	1.5
114	Plymouth	450	6.0
115	Plymouth	473	1.0
116	Plymouth	474	1.0
117	Livonia	487	1.0
118	Livonia	496	1.0
119	Livonia	499	1.5
120	Livonia	500	2.5
121	Livonia	501	2.5
122	Livonia	503	1.0
123	Livonia	504	1.0
124	Livonia	506	1.5
125	Livonia	507	2.0
126	Livonia	509	2.0
127	Livonia	510	2.0
128	Livonia	512	1.5

Table 3.3
Comparison of Phase 1 Results

Community	Total	Ammonia > 1.0 ppm	Suspicious with Ammonia < 1.0 ppm	% of Ammonia > 1.0 ppm	% of Suspicious with Ammonia < 1.0 ppm	Ratio of Ammonia > 1.0 ppm to Suspicious
Westland	48	5	3	10.42	6.25	1.67
Plymouth Township	150	8	19	5.33	12.67	0.42
Canton Township	246	33	46	13.41	18.70	0.72
Plymouth	30	4	1	13.33	3.33	4
Livonia	42	12	6	28.57	14.20	2

4.0 PHASE 2. Sigma Associates Inc., was further retained by the Rouge Program Office and Wayne County to conduct Phase 2 of the illicit connection detection program. Sigma's responsibilities for Phase 2 of the illicit connection detection program included further testing of manholes in Canton Township that tested high for ammonia in Phase 1 (*Table 3.2*) were deemed suspicious by Sigma, the RPO and Wayne County (*Table 3.1*) A total of 60 manholes were chosen to test, 31 of which had previous high ammonia readings, and 29 that had suspicious characteristics (i.e., staining, deposits, high flow). The tests to be performed on these manholes, included colorimetric ammonia tests, colorimetric anionic surfactant tests, and E.Coli bacteria tests. Testing procedures are located in Appendix A, Standard Operating Procedures.

4.1 INTERIM. Prior to the start of Phase 2, interim tests were completed. These tests were done primarily to become familiar with the colorimetric anionic surfactant kit. Both colorimetric ammonia tests and surfactant tests were included in the interim testing. The results from the interim testing are found in *Table 4.1* and *Figure 4-1*. Field sheets from the interim phase can be found in Appendix G. The interim results are summarized as follows:

- 50% (8 of 16) of the manholes tested in the interim had surfactant levels greater than 0.5 ppm.
- 25% (4 of 16) of the manholes in the interim had ammonia levels greater than 1.0 ppm.
- 100% (4 of 4) of the manholes which tested high for ammonia also tested high for surfactant.

The interim results indicated a possible relationship between high levels of ammonia and high levels of surfactant. Phase 2 would be used to further investigate that possibility.

4.2 PHASE 2 METHODOLOGY. The selected 60 Phase 2 test sites were tested for ammonia, anionic surfactant, and E.Coli bacteria. Manholes were also inspected for suspicious conditions, such as algae, rust, deposits etc. Photographs were taken of the insides of the manholes and catch basins, and field forms were filled out. Field forms included the date, time and location of inspection, as well as information pertaining to existing conditions in the manhole at the time of the test. The forms also include the ammonia and anionic test results. Bacteria tests were taken to the University of Michigan to be analyzed. A map was made of Canton Township with the location of the manholes inspected and their respective results.

Sigma Associates Inc., along with the Rouge Program Office and Wayne County decided that the indicators of possible sanitary waste were results greater than or equal to 1.0 ppm, 0.5 ppm, and 1000 cfu/100 ml for ammonia, anionic surfactant, and E.Coli respectively.

4.3 DISCUSSION OF PHASE 2 RESULTS. The results of the testing on the selected 60 manholes are located in *Table 4.2*. *Table 4.2* also compares the results, and *Table 4.3* shows the variance, standard deviation and mean of the Phase 2 data. The ammonia results from Phase 1 and Phase 2 remained essentially the same, however, there was no definite correlation

between any three of the tests (ammonia, anionic surfactant, bacteria). Future possible studies may include storm sewer flow monitoring. Phase 2 results are summarized as follows:

- 65% (20 of 31) of the manholes that ammonia levels greater than 1.0 ppm in Phase 1, had ammonia levels greater than 1.0 ppm in Phase 2.
- 47% (28 of 60) of the manholes tested in Phase 2 had ammonia levels greater than 1.0 ppm.
- 45% (27 of 60) of the manholes tested in Phase 2 had surfactant levels greater than 0.5 ppm.
- 32% (19 of 60) of the manholes tested in Phase 2 had E.Coli levels greater than 1000CFU/100ml.
- 46% (13 of 28) of the manholes which tested high for ammonia in Phase 2, also tested high for surfactant in Phase 2.
- 36% (10 of 28) of the manholes which tested high for ammonia in Phase 2, also tested high for E.Coli in Phase 2.
- 22% (6 of 27) of the manholes which tested high for surfactant Phase 2, also tested high for E.Coli in Phase 2.
- 14% (4 of 28) of the manholes which tested high for ammonia in Phase 2, also tested high for surfactant AND for E.Coli in Phase 2.

Findings in Washtenaw County showed that counts of fecal coliform that exceeded 1000 CFU/100ml, generally indicated an illicit connection². Using a factor of 1:7 for fecal bacterial to E.Coli, yields a threshold of 140 CFU/100ml E.Coli. Using 140 CFU/100ml as a threshold, results in the following:

- 67% (40 of 60) of the manholes tested in Phase 2 had E.Coli levels greater than 140 CFU/100 ml.
- 50% (14 of 28) of the manholes which tested high for ammonia in Phase 2, also tested high for E.Coli (>140 CFU/100ml) in Phase 2.
- 59% (16 of 27) of the manholes which tested high for surfactant in Phase 2, also tested high for E.Coli (>140 CFU/100ml) in Phase 2.

² Municipal and Industrial Wastewater Contamination, p121, Fecal Coliforms in the River, APHA 1992.

- 21% (6 of 28) of the manholes which tested high for ammonia in Phase 2, also tested high for surf AND E.Coli (>140 CFU/100ml) in Phase 2.

The ammonia results from Phase 1 and Phase 2 remained essentially the same, however, there was no definite correlation between any three of the tests (ammonia, anionic surfactant, bacteria). Future possible studies may include storm sewer flow monitoring.

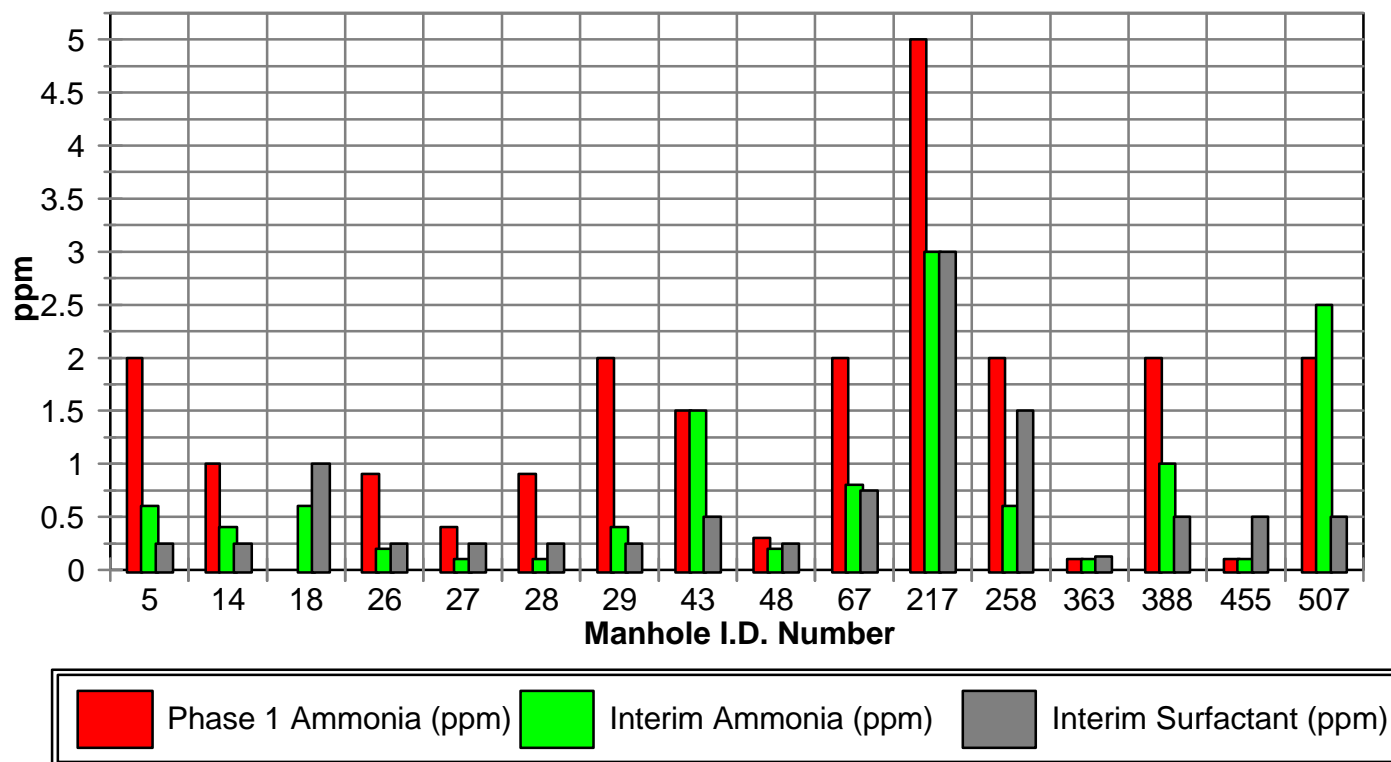
**Table 4.1
Interim Ammonia and Surfactant Results**

Manhole I.D. #	Community	Phase 1 Ammonia (ppm)	Interim Ammonia (ppm)	Interim Surfactant (ppm)
5	Westland	2.00	0.60	0.25
14	Westland	1.00	0.40	0.25
18	Westland	-	0.60	1.00
26	Westland	0.90	0.20	0.25
27	Westland	0.40	0.10	0.25
28	Westland	0.90	0.10	0.25
29	Westland	2.00	0.40	0.25
43	Westland	1.50	1.50	0.50
48	Westland	0.30	0.20	0.25
67	Plymouth Twp.	2.00	0.80	0.75
217	Canton Twp.	5.00	3.00	3.00
258	Canton Twp.	2.00	0.60	1.50
363	Canton Twp.	0.10	0.10	0.13
388	Canton Twp.	2.00	1.00	0.50
455	Plymouth	0.10	0.10	0.50
507	Livonia	2.00	2.50	0.50

Figure 4-1

Interim Ammonia and Surfactant Results

URBSW 8.2 - Middle 2



**Table 4.2
Summary of Phase 2 Results**

	Developed By:	Manhole I.D. #	Phase 1 Ammonia (ppm)	Phase 2 Ammonia (ppm)	Phase 2 Surfactant (ppm)	Phase 2 E.Coli CFU/100 ml
1	Sigma	213	1.0-2.0	1.00	0.50	8
2	Sigma	217	5.00	6.00	>3.0	3920
3	Sigma	226	3.00	1.00	0.50	<8
4	Sigma	227	1.50	1.50	0.25	1520
5	Sigma	242	5.00	5.00	>3.0	240
6	Sigma	245	1.50	1.00	0.25	<8
7	Sigma	248	2.00	7.00	0.25	96
8	Sigma	249	1.00	0.80	0.50	10560
9	Sigma	253	1.50	3.00	0.50	280
10	Sigma	258	2.00	0.30	0.25-0.50	152
11	Sigma	260	1.20	2.00	0.50	1368
12	Sigma	272	5.00	2.00	0.25	16
13	Sigma	293	6.50	0.40	1.50	48
14	Sigma	300	1.00	0.20	0.25	32
15	Sigma	312	1.00	1.00	0.25	32
16	Sigma	313	1.00	1.00	0.50	48
17	Sigma	317	1.50	0.80	0.25	<8
18	Sigma	322	1.50	1.00	0.25	83200
19	Sigma	323	1.00	0.80	0.25	4800
20	Sigma	357	1.50	0.20	1.00	664
21	Sigma	359	1.00	1.00	0.25	2480
22	Sigma	388	2.00	2.00	0.75	3520
23	Sigma	395	5.00	0.60	1.00	312
24	Sigma	396	1.50	1.00	0.25	3520
25	Sigma	397	4.00	1.50	0.50	<8
26	Sigma	398	4.00	2.00	0.50	48
27	Sigma	404	1.00	0.60	0.50	400
28	Sigma	409	2.50	0.60	0.75	152
29	Sigma	413	1.00	0.40	0.50	488
30	Sigma	439	1.00	1.00	0.25-0.50	56
31	Sigma	443	1.00	1.00	0.25	624
32	Sigma	211	0.00	1.00	0.25	1360
33	RPO	212	-	0.20	0.25	456
34	RPO	232	-	0.40	0.25	2080
35	RPO	237	-	0.40	0.5-0.75	1312

36	RPO	243	0.10	0.20	0.25	7200
37	RPO	256	0.30	0.80	0.50	64
38	RPO	257	-	0.30	0.75	456
39	RPO	259	0.80	1.00	0.25	304
40	RPO	270	0.50	1.00	0.5-0.75	2080
41	RPO	271	-	0.60	0.75	440
42	RPO	274	0.50	0.80	0.75	216
43	RPO	278	0.00	1.0-1.5	0.50	8
44	RPO	280	0.20	0.60	0.25	1280
45	RPO	289	-	0.80	1.50	2400
46	RPO	305	0.30	0.30	0.25	8000
47	Sigma	306	0.2	0.2	0.25	16
48	Sigma	314	0.20	2.00	.25-.50	1120
49	Sigma	315	0.00	0.80	0.25	2560
50	Sigma	316	0.50	1.00	0.25	<8
51	RPO	319	0.30	0.60	0.50	592
52	Sigma	324	0.90	0.80	0.25	160
53	Sigma	360	0.50	0.80	0.25	200
54	Sigma	385	0.40	0.60	0.25	800
55	Sigma	400	0.80	1.00	0.25	<8
56	Sigma	440	0.30	0.60	0.25	320
57	RPO	56	-	0.10	0.00	672
58	RPO	57	-	0.20	0.25	200
59	RPO	58	-	0.10	0.25	40
60	RPO	59	-	0.20	0.50	72

Dark Shading - Bacteria Greater than 1000 CFU/100mL
Light Shading - Ammonia Greater than 1.0 ppm

Table 4.3
Phase 2 Statistical Data

Phase 2	Mean	Std Deviation	Variance
Bacteria	2550.67	10695.89	114400000
Surfactant	0.525	0.539	0.291
Ammonia	1.106	1.268	1.609

APPENDIX A
STANDARD OPERATING PROCEDURES

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

APPENDIX B
PHASE 1 - CITY OF WESTLAND

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

APPENDIX C
PHASE 1 - PLYMOUTH TOWNSHIP

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

APPENDIX D
PHASE 1 - CANTON TOWNSHIP

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

APPENDIX E
PHASE 1 - CITY OF PLYMOUTH

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

APPENDIX F
PHASE 1 - CITY OF LIVONIA

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

**APPENDIX G
INTERIM DATA**

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

**APPENDIX H
PHASE 2 DATA**

NOTE: Due to the size of the material involved, the Appendices listed above have not been included in this basic document. Should you wish to view the appendices, contact Dean Tuomari @ WCDOE (734) 326-3936.

APPENDIX I
PHOTOGRAPH ALBUMS

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