

**INCIDENTS OF POLLUTION  
OF THE CARONI RIVER  
AFFECTING THE  
CARONI ARENA WATER TREATMENT  
PLANT (CAWTP)  
ON  
NOVEMBER 7, 2003  
JANUARY 31, 2004  
AND  
FEBRUARY 2, 2004**

Classification: External/Information  
Distribution: Public  
Reference No: TO/01/04  
Publication Date: May 2004

# **REPORT ON THE INCIDENTS OF POLLUTION OF THE CARONI RIVER AFFECTING THE CARONI ARENA WATER TREATMENT PLANT (CAWTP)**

## **Introduction**

This report provides the background to three incidents, on November 7, 2003, January 31, 2004 and February 2, 2004 that affected the CAWTP of the Water and Sewerage Authority (WASA). It details the actions of the service provider, summarises the results of the RIC investigation into the cause of the incidents, and presents the RIC's recommendations and conclusions.

## **The Incident of November 7, 2003**

1. The incident commenced at 2:20 am on November 7, 2003, when a foul odour was detected at the plant. Efforts were made to control and minimise the situation but these were unsuccessful.
2. The plant was subsequently shut down at approximately 9:00 am that same day.
3. The plant was disinfected using chlorine, the clearwell flushed and operations recommenced at 9:30 pm that evening.
4. Press releases were initially issued by WASA to advise of a disruption to supply and later to advise customers that the plant was re-commissioned and the water was safe for drinking.
5. From bacteriological reports obtained from WASA, very high levels of coliform (300,000 cfu/100 ml as opposed to a norm of 15,500 cfu/100 ml) were found in the raw water supply (**see Appendix 1**). Consequently, WASA commenced patrols of the Caroni River to determine the source of pollution. This was done in conjunction with the Environmental Management Authority (EMA). One possible source of pollution identified was the National Housing Authority's (NHA) sewage pumping station (SPS) in La Horquetta.
6. Flushing operations in the distribution system commenced on Friday November 7 and continued throughout the weekend.

## **The Impact**

1. The poor quality water was able to reach the distribution system. Affected areas included Carapo Village, El Carmen, St Helena, Caroni, Piarco and Charlieville. Residents complained of a foul odour in the water and several also complained of feeling ill and described the colour of the water flowing through their taps as black.
2. With the plant taken out of service to correct the problem, areas served by the CAWTP were affected by a loss of supply. These included areas as far south as La Brea, as far west as Port of Spain and environs and north into Santa Cruz. This

would have been between the period 9:00 am to possibly midnight on November 7, 2003.

### **The Incidents of January 31, 2004 and February 2, 2004**

1. At approximately midnight on January 30, 2004, a high chlorine demand in the raw water was observed. This was not accompanied by any foul odour as in the previous incident (see above). The plant was eventually taken out of operation at 1:15 am on January 31, 2004 due to the inability to hold chlorine residual levels above 1.5 parts per million (ppm) in the final water. The plant was returned to operation at approximately 8:00 am that same day after improvements in the raw water quality, a disruption of approximately 7 hours.
2. A similar pattern was observed around midnight on February 1, 2004. Unable to hold the residual to acceptable limits, the plant was removed from operation at 3:45 am. It was brought back into operation at approximately 1:40 pm following improvements in raw water quality and flushing at the plant. Normal operation on the transmission system was achieved by 6:00 pm and in the distribution system within 24 hours.
3. The problem on both occasions was attributed to high levels of free ammonia in the river water in the vicinity of the plant. This would concur with the problems that were being experienced at the plant, since the presence of ammonia would result in chlorine depletion. Other problems that would arise would be reduction in pH and alkalinity, nitrite/nitrate formation and possible formation of trihalomethanes, which are known carcinogens associated with high levels of chlorine dosing. All these would be considered to pose a public health threat.
4. WASA undertook river patrols to try to identify the source of the problem. It also enlisted the assistance of the Environmental Management Authority (EMA) and the Institute of Marine Affairs (IMA) in an attempt to detect the problem.

### **The Impact**

1. No major water quality problems were experienced in the distribution network on account of these incidents. While WASA did not provide test results for the final water leaving the plant, there were no adverse media reports regarding the water quality leaving the plant.
2. With the plant out of service, areas served were affected by a loss of supply for at least 9 hours on January 31 and 14 hours on February 2.

## Findings of RIC Investigation

The RIC investigated the incidents that occurred on November 7, 2003 and January 31/February 2, 2004 and concluded that there were unacceptable failures in the supply of water from the CAWTP in the case of the November 7 incident. The January/February incidents raised additional concerns that need to be addressed by the service provider.

The following delineates the main issues that arose from the three incidents.

### 1. Response Time to Incidents

The shutdown on November 7, 2003 occurred 7 hours after the problem was first detected. This period was extremely lengthy and allowed for the poor quality water to enter the distribution system as reported by the media. **WASA responded by stating that it was committed to utilising all available resources in the maximisation of production levels.** This statement concerned the RIC as it paid no regard to quality issues. There may be an abundant supply of water produced at the plant but if that supply is of poor quality then WASA may still be culpable.

Having regard to the incident in November 2003, WASA took precautions on January 31, 2004 and February 2, 2004 to ensure that the problem did not unduly affect customers. The plant was shut down within 4 hours on both days as opposed to the 7 hours in the November episode.

### 2. Water Quality

In the case of the November incident, water leaving the treatment plant was bacteriologically safe. Tests done by WASA, CARIRI on the RIC's behalf and the Public Health Laboratory all confirmed this (see **Appendix II**). The chlorine level residual was adequate, thereby confirming disinfection of the water supply and removal of any pathogens. Chlorine residual testing is fast, easy and provides a performance record warning of abnormal operation as it did in this case.

The water, however, was not aesthetically acceptable. There was a foul odour, similar to that emitted by chloramines, which are usually found in wastewater. There was also evidence of discolouration. The water reached the distribution system and resulted in persons complaining of feeling ill, as confirmed by media reports. The odour and colour problems meant that contaminants were present in significant levels even though they were not biological in nature. **The water was, therefore, not fully up to drinking water standards**, which require taste and odour criteria to be met, as well as definitive coliform limits.

In the case of the February incident, WASA reported that all the water distributed met drinking water standards. There were no adverse media reports on the water quality

leaving the plant. However, sample results of the final water were not made available to verify the water quality.

There were a number of samples taken of the raw water by WASA and the EMA. These generally confirmed the presence of ammonia above acceptable levels (see **Appendix III**).

### **3. Public Information**

WASA insisted **there was no need for a “boil water” advisory** to be issued during the first incident since tests had proven the water to be bacteriologically safe. Results however were only obtained 24 hours after the sample was taken. Therefore, there was no immediate data to indicate that contamination did not take place. As a safety measure, a precaution against illness and a desire to be customer focused, a “boil water” advisory should be issued whenever there is a risk of contamination from treatments works, a broken main or other problems in the distribution system. This is a standard procedure employed by water companies in several states in the United States of America such as Florida, New Jersey, Mississippi and Texas, and by water companies regulated by the Drinking Water Inspectorate of the United Kingdom, who see it as a necessary part of the public health armoury. Once there are quality issues with water, the public will question its safety for consumption even though it may be pronounced safe to drink.

In addition, there was no special notification to schools and other institutions of the impending problem, which probably would have been warranted by the situation. There were no other services such as truck borne water from other sources or identification of uncontaminated points of supply available to consumers to compensate for the poor quality supply and eventually the lack of it.

A “boil water” advisory was also not issued for the second and third incidents. Information was not communicated to the public until Monday and the RIC had no formal notification of the problem from WASA.

### **4. Deficiencies in operations**

#### **(a) Filters**

The absence of activated carbon within the filters precluded the plant’s ability to deal with the odour problem. This was indeed a major disadvantage, as its presence would certainly have reduced the impact of the problem. The activated carbon would also have helped in removing organic pollutants present in the water supply.

### **(b) Early Warning System**

In November 2003, there was no early detection system present to alert the plant of contamination upstream of the river. The use of monitors, both computerised and biological, would have assisted with that situation.

In response, the pollution monitoring station in the Caroni River in the vicinity of St Helena has been reactivated, including pollution monitors along the river at El Carmen and Tumpuna. This is to be commended. However, WASA has indicated that these monitors do not check for nitrates and ammonia, and so were not helpful as an early warning system, particularly in addressing the problem of high levels of free ammonia when it arose.

### **(c) Liaison/Follow up with Environmental Management Authority (EMA) and National Housing Authority (NHA).**

WASA needs to have a constant rapport with the EMA with respect to environmental issues affecting this and other plants. The NHA is also a major player in this matter, if as suspected, the sewage treatment plant was the point source of pollution in the November incident. River patrols were established to locate the potential pollution source. To date, the pollution source(s) that affected the plant has not yet been positively identified.

## **Recommendations**

Based on the above incidents and analysis, the following actions are recommended and summarized in Tables 1 and 2 below.

1. There is consensus by both the RIC and WASA that the activated carbon needs to be replaced in the filters at the CAWTP. This would be of immense benefit in dealing with problems of taste, odour and organic pollutants. Another means of carbon adsorption is the application of dry or slurried carbon powder before the filtration process, but care has to be taken using this application together with chlorine as it absorbs chlorine.

**Recommendation: Activated carbon be replaced in the filters at the CAWTP. Approximate cost of this measure is \$20M.**

2. Installation of adequate pollution monitoring devices upstream of the plant and the identification of potential sources of pollution upstream of plant should be done by WASA in partnership with the EMA. The EMA has suggested the formation of a multi-agency team to address the problem and WASA is currently awaiting feedback. Final costs for a monitoring system will be based on the monitoring method selected and the devices and technologies used.

**Recommendation: Install pollution monitors upstream of Caroni River. The approximate cost of this measure could be of the order of \$2M to \$5M.**

3. As the water quality remains uncertain for a period of time during an incident of this nature, it is prudent to make consumers aware of the situation and to take necessary precautions until the supply can be declared safe.

The water quality programme at WASA also needs to be addressed. Annual compliance for bacteriological quality is adequate but the presence of inorganic chemicals such as heavy metals and organic chemicals derived from pesticides remain a concern. Testing for these chemical contaminants is done periodically and having regard for the quality of water in the Caroni River the frequency may need to be reviewed in the future. Annual chemical quality compliance appears to be low even though WASA indicates there is no WHO guideline. It acknowledges this inadequacy as it links this compliance level to deficient treatment plant processes.

**Recommendations:**

- a) **“Boil Water Advisories” be issued to affected areas immediately in incidents of this nature as a precautionary step until laboratory tests are completed.**
  - b) **Commence a review of laboratory facilities at CAWTP, especially since the water from the Caroni River is of such poor quality and subject to a variety of pollutants.**
  - c) **Make general laboratory services fully functional so that effective island wide monitoring of water quality can be re-established having been seriously impaired in the late nineties due to health and safety concerns at WASA’s main laboratory.**
4. WASA should have a shutdown procedure for CAWTP in emergencies. This should be strictly followed and would help prevent water of unknown quality reaching the distribution system.

**Recommendation: Develop and implement a shutdown procedure for CAWTP in emergencies.**

5. Prompt public notification of shutdowns and disruptions to supply should be made. It is unclear if any notification was given for the event of February 2, 2004.

**Recommendation: Prompt public notification of shutdowns and disruptions to supply/service be made.**

6. WASA should improve its liaison with the EMA with a view to reducing the occurrence of similar and other incidents. This liaison has already started with WASA utilising the services of the EMA and IMA in both incidents to take and analyse samples of the potential contamination source as well as of the river itself. The RIC will actively participate in encouraging and pursuing cooperation between these two organizations.

**Recommendation: Collaboration and working relationships with environmental bodies such as EMA and IMA be improved and a multi-agency team be formed. A Memorandum of Understanding (MOU) has been signed between WASA and EMA.**

7. In the long term, there should be a functional integrated water supply system (national water network system). This would allow affected consumers to be partially or fully serviced from other sources once their supply is interrupted.

**Recommendation: Develop integrated network for distribution/transmission system in Trinidad and Tobago.**

## **Conclusion**

The Commission has conveyed its analyses, queries and recommendations to WASA and will continue to monitor the performance of WASA's water distribution service to consumers.

Finally, outlined below are some of the actions taken by the RIC as a result of these incidents:

1. The RIC has formulated and issued to service providers, an **Event Notification and Response Management Plan**. In the future, events such as these must be expeditiously reported to the RIC and investigations undertaken to ascertain what caused them and provide recommendations to reduce further occurrences;
2. An additional **Quality of Service Standard** has been created to cater for poor water quality incidents, identified by the RIC. Compensation will be available to affected customers; and
3. The consideration of a **memorandum of understanding (MOU)** between the RIC and the EMA as provided for under Section 31 of the Environmental Management Act of 2000, which will facilitate future cooperation between the EMA and the RIC.



**Table 1 - Specific Recommendations arising from Incidents**

<b>Problems arising from incidents</b>	<b>Recommendations</b>	<b>Cost</b>	<b>Action by</b>
1. Defective Filters	Replace activated carbon in the filters at the CAWTP.	\$20M TT	WASA
2. River Pollution	Install pollution monitors upstream of CAWTP.	\$2M TT-\$5M TT	WASA/EMA
3. Water Quality	a) Immediate issuing of “Boil Water Advisories” to affected areas as a precautionary step until laboratory tests are completed. b) Commence a review of laboratory facilities at CAWTP, especially since the water from the Caroni River is of such poor quality and subject to a variety of pollutants. c) Make general laboratory services fully functional so that effective island wide monitoring of water quality can be re-established.		WASA
4. Emergency Shutdown Procedure	Develop and implement of a shutdown procedure for CAWTP in emergencies. This procedure to be strictly followed as it would help prevent water of unknown quality reaching the distribution system.		WASA
5. Public Notification of water/sewerage problems	Prompt public notification of shutdowns and disruptions to supply/service to be made.		WASA
6. Environmental Issues	Improve collaboration and working relationships with environmental bodies such as EMA and IMA by the formation of a multi-agency team.		WASA/EMA/IMA

**Table 2 – General Long Term Recommendations**

<b>Issues</b>	<b>Recommendations</b>	<b>Action by</b>
1. Water Distribution System	Develop integrated network for distribution/transmission system in Trinidad and Tobago. This would allow affected consumers to be partially or fully serviced from other sources once their supply is interrupted.	WASA

## Appendix I

Source: Caroni River

<b>Sample</b>	<b>Date</b>	<b>Time</b>	<b>Total Coliform (cfu/100ml)</b>	<b>Faecal Coliform (cfu/100ml)</b>
Caroni Raw from Intake	7/11/03	9:55 am	570 000	300 000
Caroni River at El Carmen Propagating Station	7/11/03	10:45 am	60 000	17 000
Caroni Raw	10/11/03	11:15 am	6 000	1 000
Caroni Raw (Annual Average – Dry Season)	2001	-	41 000	10 000
Caroni Raw (Annual Average – Wet Season)	2001	-	17 000	6 000

## Appendix II

### WASA

#### Source: Caroni Final Water

Date	Time	Total Coliform (cfu/100ml)	Faecal Coliform (cfu/100ml)	Classification	Residual Free Chlorine (mg/L)
3/11/03	10:54 am	ND	ND	Safe	5.1
4/11/03	8:47 am	ND	ND	Safe	1.2
5/11/03	8:51 am	ND	ND	Safe	3.3
6/11/03	8:42 am	ND	ND	Safe	4.4
7/11/03	9:00 am	ND	ND	Safe	1.6
10/11/03	8:52 am	ND	ND	Safe	3.5
12/11/03	9:38 am	ND	ND	Safe	3.6
13/11/03	10:40 am	ND	ND	Safe	4.3

ND – None detected

### WASA

#### Source: Caroni New Plant Final Water

Date	Time	Total Coliform (cfu/100ml)	Faecal Coliform (cfu/100ml)	Classification	Residual Free Chlorine (mg/L)
3/11/03	10:48 am	ND	ND	Safe	5.3
4/11/03	8:56 am	ND	ND	Safe	3.4
5/11/03	9:02 am	ND	ND	Safe	2.9
6/11/03	8:42 am	ND	ND	Safe	5.2
7/11/03	9:00 am	ND	ND	Safe	2.6
10/11/03	9:02 am	ND	ND	Safe	2.5
11/10/03	9:37 am	ND	ND	Safe	3.9
12/11/03	9:46 am	ND	ND	Safe	2.8
13/11/03	10:30 am	ND	ND	Safe	3.8

ND – None detected



Caribbean Industrial Research Institute  
Mailing Address: Tunapuna Post Office, Trinidad and Tobago  
Telephone: (868) 662-7161 Telefax: (868) 662-7177  
E-Mail: carri@trinidad.net

## SERVICE PROJECT REPORT

### MICROBIOLOGY REPORT

Page 1 of 2

Attention: Garvin Alexander

**CLIENT** : Regulated Industries Commission

**CLIENT ADDRESS** : 1<sup>st</sup> & 3<sup>rd</sup> Floors, Furness House,  
Cor. Wrightson Road & Independence  
Square, Port of Spain

**CLIENT ORDER NO./REF** : N/A

**PROJECT NO.** : EC038901142/03

**REPORT NO.** : EC038901142/03 RN01

**DATE RECEIVED** : November 13, 2003

**DATE OF REPORT** : November 17, 2003

**DESCRIPTION OF SAMPLES** : Three (3) samples of Potable Water.

**TEST(S)** : (1) Enumeration of Total Coliforms;  
(2) Enumeration of Faecal Coliforms and  
*E.coli*.

<b>LABORATORY SAMPLE NO.</b>	<b>CLIENT SAMPLE LABEL</b>
B 1246/03	Bel Air Tank Supplies
B 1247/03	Caroni Hindu Tank Supplies
B 1248/03	Bel Air Laundry

**SAMPLING** (NENAS Accredited)

Three (3) samples of Potable Water were submitted by the client on November 13, 2003 to the Microbiology Laboratory for analysis.

**METHODOLOGY**

Enumeration of Total Coliforms using Membrane Filtration - CARIRI MICRO Method No. 008

Enumeration of Faecal Coliforms and *E.coli* using Membrane Filtration - CARIRI MICRO Method No. 004

**RESULTS**

Date of Analysis: 03-11-13 to 03-11-14

TEST	Bel Air Tank Supplies -B 1248/03	Caroni Hindu Tank Supplies -B 1247/03	Bel Air Laundry -B 1248/03	GUIDELINE VALUE*
TOTAL COLIFORM COUNT (CFU/100mL)	0	0	0	0
FAECAL COLIFORMS (CFU/100mL)	0	0	0	0
<i>Escherichia coli</i> (CFU/100mL)	0	0	0	0

\*CFU - Colony Forming Unit.


**REMARKS**

No coliform bacteria were detected in any of the three (3) samples tested.

**References:**

\*World Health Organization. Guidelines for drinking water quality, 2<sup>nd</sup> ed, 1996

  
Siva Singh  
Deputy Laboratory Manager (Ag.)

  
Sharon Horner  
Microbiologist  
Laboratory Manager

\*\*\*\*\* T P H L \*\*\*\*\*  
 \*\*\*\*\* 8096225311 \*\*\*\*\*  
 \*\*\*\*\* 10:33 \*\*\*\*\*  
 -03

**FROM:** TRINIDAD PUBLIC HEALTH  
 LABORATORY  
 16-18, Jamaica Boulevard  
 Federation Park, Port-of-Spain  
 Tel. 622-2877/622-5311

**to:**  
 CMOH - ST GEORGE EAST

**INTERNATIONAL STANDARDS FOR DRINKING WATER**

2. The total coliform count must not exceed 3 organisms per 100 ml of water.

1. Faecal coliform must not be present.

I = UNSAFE      S = SAFE  
 P = PRESENT    A = ABSENT

**RE: WATER BACTERIOLOGICAL REPORT**

Date of Sampling: 07.11.03

Date Received at Laboratory: 07.11.03

Date of Analysis: 07.11.03

Lab. No.	Sample Address	Chlorine Residue	Total Background Count	Total Coliform Count	Faecal Coliform Count	Classification	Comments
1122	WASA TREATMENT PLANT, PHAD (OLD PLANT) Tap - 255 Kelly V'ge. Ave	-	Nil	Nil	A	S	
1123	Tap	-	Nil	Nil	A	S	
1124	K.F.C., St Helena Junction Tap - KFC Kitchen	-	Nil	Nil	A	S	
1128	Tap - Kitchen	-	Nil	Nil	A	S	
1125	WASA TREATMENT PLANT, Plainfield Tap - (New Plant)	-	Nil	Nil	A	S	
1126	Tap - (next to public washroom)	-	Nil	Nil	A	S	
1127	ST HELENA HC Tap - 1	-	Nil	Nil	A	S	

Technician: *L. Pollard 2/11/03*

Director: \_\_\_\_\_ Date: \_\_\_\_\_

# Appendix III

International Analytical Group  
 P.O. Box 514457  
 Hollywood, FL 33051-4407

Client: Miami  
 Water and Sewerage Authority  
 10000 SW 15th St  
 Miami, Florida, 33157, WI

Site Location/Project  
 Current  
 Secondary and Tertiary

Page 1  
 February 16, 2004  
 Report # 402000-402  
 Order # 10642  
 FDEP CompQA# 990  
 FL-DOH Certification # 2003-00003

Sample I.D.: GO-85-S-54F (Final)  
 Collected: 02/02/04 09:00  
 Received: 02/04/04 18:00  
 Collected by: Client

PARAMETER	RESULT	UNITS	METHOD	DETECTION LIMIT	DATE EXT.	DATE ANALY.	ANALYST
Seifen	24.6	mg/L	300.0	1.0	02/12/2004	02/12/2004	ST
Phosphate (Ascorbic)	0.450	mg/L	350.1	0.10	02/16/2004	02/16/2004	ST
Phosphate	.40	mg/L	376.1	0.4	02/10/2004	02/10/2004	ST

**REPORT CONVENTIONS:**  
 B.L.F. : Indicates Analyte is Below Detection Limit MEDF: Matrix Effect Dilution Factor  
 Units as determined, mg/Kg denotes wet weight

Unless otherwise noted in analyst section, all work performed by STL Miami  
 10709 USA Today Way, Miramar Florida 33025. (954) 431-4550

Project Manager

**IAG**  
 International Analytical Group  
 P.O. Box 814407  
 Hollywood, FL 33081-4407

Raymond Gittens  
 Water and Sewerage Authority  
 Farm Road  
 St. Joseph, Trinidad, WI

Site Location/Project  
 Caroli  
 February 2nd Pollution

Page 3  
 February 16, 2004  
 Report # 402000402  
 Order # 10644  
 FDEP CompQAT# 990102  
 FL-DOH Certification# E86349, 86413

Sample I.D.: GD-85-S-54R (Raw)  
 Collected: 02/02/04 00:00  
 Received: 02/04/04 10:00  
 Collected by: Client

PARAMETER	RESULT	UNITS	METHOD	DETECTION LIMIT	DATE EXT.	DATE ANALY.	ANALYST
Sulfate	10.4	mg/L	300.0	1.0	02/12/2004	02/12/2004	RZ
Nitrogen (Ammonia) as N	0.295	mg/L	350.1	0.10	02/16/2004	02/16/2004	DSR
Sulfide	.40	mg/L	376.1	0.4	02/10/2004	02/10/2004	SN

**REPORT COMMENTS:**

BDL: Indicates Analyte is Below Detection Limit MEDF: Matrix Effect Dilution Factor  
 Unless otherwise noted, mg/Kg denotes wet weight

Unless otherwise noted in analyst section, all work performed by STL Miami  
 10200 USA Today Way, Miramar Florida 33025. (954) 431-4550

Project Manager



**THE UNIVERSITY OF THE WEST INDIES  
FACULTY OF ENGINEERING  
DEPARTMENT OF CIVIL  
AND ENVIRONMENTAL ENGINEERING**

Water and Wastewater Test Report

**Client -** Water and sewerage Authority  
Quality Control Department

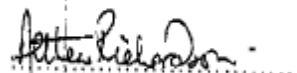
**Sample Date -** 02 February 2004

**Report Date-** 12 February 2004

**Source-** Caroni River System

Sample source	Parameters					
	pH	DO	BOD	COD	Free NH4+	Suspended Solids
Caroni Raw	7.39	6.51	-2	87	1.5	21
National Cannery Effluent	4.56	<1	1043	2330	7.8	610
O'Mera Industrial Estate Outfall	3.99	<1	1110	2633	19.6	304
Caroni River by Bonanza Stud Farm	7.19	6.45	5	117	2.66	463

All tests were done in accordance with Standard Methods for the Examination of Water and Wastewater.



Sen. Tech. UWI

**MARINE CHEMISTRY LABORATORY**

Environmental Incidents Report: WASA WATER QUALITY

DATE: February 3, 2004.

SAMPLE TYPE: River Water

SUBJECT: RESULTS OF ANALYSIS OF SAMPLES

Lab.No.	Stn No	Sample Type	NO <sub>2</sub> -N ug/ml	NO <sub>3</sub> -N ug/ml	NO <sub>3</sub> -N ug/ml	NH <sub>4</sub> -N ug/ml	TPO <sub>4</sub> -P ug/ml	pH	DO mg/L	Temp. °C	Sal. ppt	Cond. umho/cm	COD mg/L	Oil & Grease mg/L
0016/04	2	Effluent	0.03	3.54	0.23	2.13	5.47	4.21	30.2	0.2	428.3	1810.8	227.5	
0017/04	3	Effluent	0.02	0.15	0.72	11.21	6.26	1.84	29.3	0.6	966.0	2258.4	138.8	
EMA Water Pollution Rules (effluent) <sup>a</sup>			na	na	>0.01	>0.1	<6 or >9	<4	ambient ± 3°C	na	na	>60	>10	
EMA Water Pollution Rules (effluent) <sup>b</sup>			na	na	10	5	6-9	>4	35	na	na	250	10	

<sup>a</sup> First Schedule- Register of Water Pollutants (Concentration at which parameter defined as a pollutant)

<sup>b</sup> Second Schedule- Permissible Levels (Maximum values or acceptable ranges. Discharge of levels above maximum or outside range may require a permit)  
na none available

Lab.No.	Stn No	Sample Type	NO <sub>2</sub> -N ug/ml	NO <sub>3</sub> -N ug/ml	NO <sub>3</sub> -N ug/ml	NH <sub>4</sub> -N ug/ml	TPO <sub>4</sub> -P ug/ml	pH	DO mg/L	Temp. °C	Sal. ppt	Cond. umho/cm	COD mg/L	Oil & Grease mg/L
0015/04	1	River	0.02	0.76	0.18	0.24	7.72	4.00	26.9	0.1	239.2	155.4	<0.5	
0018/04	4	River	0.03	0.82	0.21	0.48	7.44	4.70	26.1	0.1	237.1	233.5	1.78	
Canadian Environmental Quality Guidelines (freshwater) <sup>a</sup>			0.06	na	0.019	na	6.5-9.0	5.5-9.5	na	na	na	na	na	

<sup>a</sup> Guidelines for the protection of aquatic life

na none available