Environment Canada
Canada

Environmental
Protection
Service

Environnement
Canada

Service de la
Protection de
l'environnement

AN ASSESSMENT OF LIQUID EFFLUENT STREAMS AT SYDNEY STEEL CORPORATION

Surveillance Report EPS-5-AR-80-5
Atlantic Region

ENVIRONMENTAL PROTECTION SERVICE REPORT SERIES

Surveillance reports present the results of monitoring programs carried out by the Environmental Protection Service. These reports will usually be published on a regular basis.

Other categories in the EPS series include such groups as Regulations, Codes and Protocols; Policy and Planning; Economic and Technical Appraisal; Technology Development; Briefs and Submissions to Public Inquiries; and Environmental Impact and Assessment.

Inquiries pertaining to Environmental Protection Service Reports should be directed to the Environmental Protection Service, Environment Canada, Dartmouth, Nova Scotia. B2Y 2N6.

AN ASSESSMENT OF LIQUID EFFLUENT STREAMS

AT SYDNEY STEEL CORPORATION

by

G.L. Trider, P.Eng. and O.C. Vaidya, Ph.D.
Air and Water Branch
Environmental Protection Service
Atlantic Region

Report No. EPS-5-AR-80-5

December, 1980

Abstract

Waste discharges from the Sydney Steel Corporation are characterized by measuring the conventional steel mill pollutants and flows. The discharge of each pollutant is determined in pounds per day for each of the waste flows. The environmental effect of each discharge is assessed and recommendations are made to correct the problem. In particular, waste treatment is considered and recommended or rejected for each waste discharge.

Résumé

Les eaux residuaires de la Corporation Sydney Steel sont caracterisées en mesurant les polluants normaux et le volume d'eaux débitées. Le taux de déversement de chaque polluant est présenté en livres par jour pour chacune des eaux residuaires. On évalue l'effet environnemental de chaque déversement et on recommande des mesures correctives. En particulier, le traitement de chacune des eaux residuaires est recommendé ou rejeté.

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

There are a number of waste flows at the Sysco mill that have a very serious environmental implication. The level of pollutants in these streams is such that they must be treated.

A number of physical changes can be made on the plant site that will make the treatment of the various waste streams more convenient.

An unusually high iron concentration was found in the coke oven brook following rainfall. It is suspected that this is caused by landwash of particulate fallout from the steel mill air emissions.

Of particular concern are the effluents from the total coke by-products, the blast furnace clarifier, the bloom mill scale pit and the cooling pond.

RECOMMENDATIONS

1. Additional sampling of the coal pile runoff should be carried out to confirm a suspected landwash problem.

2. The quench water should be isolated from the total coke by-products stream and discharged independently without treatment. Thermal effects might result and this stream should be examined for a possible downstream thermal effect.

3. Further work should be carried out to identify sources of phenol, cyanide, thiocyanates and oil and grease in the coke oven brook upstream of Station 015. These sources should be prevented from discharging to the brook and should be treated.

4. The effluent at Station 015, the total coke by-products, must be treated. In particular, phenol, ammonia, cyanide, oil and grease and thiocyanate must be removed. Removal will require waste treatment or a combination of treatment and by-product production. If the existing facilities are to be upgraded and kept in operation, the collection system should be examined for suspected infiltration and if confirmed it should be corrected.

5. There are significant pollutants in the blast furnace clarifier effluent and this stream should be treated for removal of ammonia, cyanide and fluoride as a minimum treatment.

6. The continuous caster effluent and the sinter plant sewer should be examined at such time as those installations are operating to determine if there is a need for treatment.

7. If the bloom mill scale pit effluent is to remain an independent stream, it should be treated for oil and grease removal.

8. The cooling pond effluent must be treated for oil and grease removal. It might be useful to combine this flow with the bloom mill scale pit effluent for treatment. The cooling pond is in poor physical condition; if it is to remain in service, repair or reconstruction should be considered.

9. The benzol condenser non contact cooling water and the benzol oil cooler non contact cooling water should be isolated from the flow at Station 015 and be discharged independently without treatment.

1. HISTORY[1,2]

One of the first attempts to smelt iron ore in Canada took place at New Glasgow, Nova Scotia, in 1872. That attempt led to the first manufacture of steel in Canada at what is now Trenton, Nova Scotia in 1883, from pig iron imported from Scotland. In 1892, iron was produced by a blast furnace located at Ferrona, Nova Scotia. Initially the iron was produced from local ores using coke made from locally mined coal as well as from coal mined in the Springhill and Sydney coal fields. The Nova Scotia Steel and Coal Company Limited which evolved from these developments prospered until, in 1912, it was making nearly 50% of all steel produced in Canada and by 1918 had expanded into railway car manufacture, ship building and munitions.

The men of genius who developed the Nova Scotia Steel and Coal Company Limited were Graham Fraser, Forrest MacKay and Thomas Cantley, all decendents of immigrant Scots. The company grew and progressed under their direction until the formation of the British Empire Steel Corporation (Besco) in 1920. Fraser left in 1903 and became General Manager of Dominion Iron and Steel Company in Sydney, the plant which is now Sydney Steel Corporation. MacKay died in 1917 and Cantley had been made Chairman of the Board in 1917. The merger of the Dominion Iron and Steel Company of Sydney with the Nova Scotia Steel and Coal Company Limited took place and Besco was formed. At this time, the Nova Scotia Steel and Coal Company Limited consisted of the original works in Pictou County plus a newly completed steel mill at Sydney Mines.

In 1892 Mr. H.M. Whitney of Boston consolidated many of the small coal mining companies in Cape Breton and in 1893 established the Dominion Coal Company. The coal output of this company exceeded demand and it was decided to take advantage of bounties offered by the Dominion Government for the manufacture of pig-iron. This led to the formation of the Dominion Iron and Steel Company Limited at Sydney in 1899. The first of the four original blast furnaces was lighted in 1900 under direction of A.J. Moxham, the first General Manager of Dominion Iron and Steel Company Limited. Mr. Moxham resigned in 1902 after construction was completed and was succeeded by Graham Fraser, formerly of the Nova Scotia Steel and Coal Company Limited. The Dominion Iron and Steel Company, like the Nova Scotia Steel and Coal Company, prospered until the Besco merger.

From the Besco merger through the Dominion Steel and Coal Corporation (Dosco) era, the company suffered financially. The Dosco merger was carried out in 1928-1930 and like the Besco merger was mainly an exchange of shares with no capital input to upgrade the works. Ultimately, under Dosco, steel making became concentrated at Sydney in the former Dominion Iron and Steel Company plant.

In 1957, the Dosco shareholders accepted an offer by A.V. Roe (Canada) Limited and Dosco became a subsidiary of A.V. Roe (Canada) Limited, a member of the Hawker Siddeley Group of companies. In the mid sixties, Hawker Siddeley decided to abandon the steel plant at Sydney and the shipyard at Halifax, both of which had been acquired from Dosco. The Trenton plants were kept because they were still profitable. In particular, Eastern Car Company

Limited, was saved and because of the change in technology from rivetted railway cars to welded railway cars it remained a viable plant.

To prevent closure of the steel mill at Sydney and consequent unemployment, the government of Nova Scotia assumed ownership of the mill. Since then, piecemeal efforts have been made to upgrade the plant until it has been recognized, several decades late, that a large input of capital and a major rebuilding of the plant are the only things that will bring the plant back to a competitive position in today's high technology market.

Sydney Steel Corporation (Sysco) is able to employ three thousand persons when at full production of ingots, blooms, billets, slabs, rails, bars and tie plates. The plant is an integrated steel mill with a basic pig iron capacity of approximately nine hundred thousand tons per year and a crude steel capacity of approximately 1,000,000 tons per year. Sysco is equipped with coke ovens, blast furnaces, open hearth furnaces, bloom mill, billet mill, rail mill, bar mill and continuous casting equipment.

2. SURVEY BACKGROUND

The neglect of the Besco and Dosco periods of ownership has come sharply into focus during the past decade and the mill is now losing in the order of $50 to $60 millions annually. It would appear that the blast furnaces require considerable capital input while the open hearth furnaces will probably have to be replaced by the basic oxygen or Q-BOP process. Further, the coke ovens are nearing the end of their economic life and will have to be replaced in the future. It is expected that the cost of this proposed upgrading would be in the order of $400 to $500 million to maintain a two blast furnace operation.

Other alternate solutions might be to convert to a one blast furnace operation, a mini steel plant based on an electric furnace mill or a complete close down of the mill. At the time of writing, the alternatives above are under consideration and it is assumed, in view of the Sysco Business Plan, that the mill will continue to operate in one or other of the alternative formats.

In light of the major investments that will be required to upgrade Sysco, the Environmental Protection Service is concerned that environmental issues be given a high priority in any modernization. Such large amounts of public money that will of necessity have to come from the provincial and federal governments should not be permitted to contribute toward continuing pollution in the Sydney area by the steel plant. As a consequence of this philosophy, a survey was conducted at Sysco in the spring of 1979 in order to characterize the waste water being discharged from various locations in the Sysco mill. The survey was undertaken, as well, as part of a national survey of steel mills.

In 1977 the Environmental Protection Service (EPS) reactivated a program to develop federal effluent control for the Canadian Steel Industry. A questionnaire was prepared in 1977 in cooperation with the steel mills, the regional offices of EPS and the provinces. The discussion paper that resulted from the questionnaire showed those areas where information and data were lacking and led to a number of field surveys of steel mills in 1978 and 1979. Stelco, Dofasco, Algoma and Sysco were all surveyed under the program and the body of this report is based on the information collected at the Sysco mill in 1979.

3. METHODOLOGY

3.1 Field Procedures

Data for this report was collected during May and June of 1979 at the Sydney Steel complex, Sydney, Nova Scotia. Grab and composite samples were collected at thirty one stations located in the plant. Flow measurements were made at three locations by constructing weirs. All other flow data was obtained from company records. Table 1 lists all sampling stations and shows the number of grab and composite samples and flow determinations taken at each station. Figures 1 and 2 are a flow schematic and a plant layout showing sampling locations.

3.2 Laboratory Procedures

The preserved[3,4] and refrigerated samples from Sydney Steel Corporation were shipped daily to the Environmental Protection Service laboratory at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia, for chemical analysis.

The unpreserved samples were analyzed, immediately upon receipt, for phenol, ammonia, total kjeldahl nitrogen and oil and grease. Procedures for the analysis were those recommended by "Chemical Analysis of Water and Wastewater"[4].

Metals in the fresh water samples were determined by the use of an inductively coupled argon plasma atomic emission spectrometer. For the salt water samples, the

TABLE 1 - SAMPLE SITES AND FREQUENCY

Station	Comp	Grab	Flow	Remarks
001 Raw water intake		12		
002 Coal pile drainage		3		
003 Coke pile drainage		3		
004 Ore pile drainage		3		
005 Coke oven drainage		Not Accessible		
006 Coke wharf drainage		Not Accessible		
007 Primary cooler effluent		12		
008 Quench water effluent		12		
009 Final cooler effluent		12		
010 Weak ammonia liquor		12		
011 Benzol condenser NCCW		3		
012 Benzol oil cooler NCCW		3		
013 Benzol crude separator effluent		12		
014 Upstream coke oven brook		12	6	
015 Total coke by-product	12		6	
016 Blast furnace clarifier influent	13	1		
017 Blast furnace clarifier effluent	14			
018 No. 1 blast furnace NCCW		3		
019 No. 3 blast furnace NCCW		3		
020 No. 1 open hearth NCCW		3		

TABLE 1 - Continued

	Station	Comp	Grab	Flow	Remarks
021	No. 2 open hearth NCCW		3		
022	Sinter plant sewer		3		
023	Continuous caster scale pit influent				Not Accessible
024	Continuous caster clarifier influent		1		Not Operating
025	Continuous caster clarifier effluent		1		Not Operating
026	Rod and bar mill scale pit influent				Not Accessible
027	Rod and bar mill scale pit effluent	12			
028	Bloom mill scale pit influent		12		
029	Bloom mill scale pit effluent	11			
030	Billet mill scale pit influent		12		
031	Billet mill scale pit effluent	12			
032	Rail mill scale pit influent		12		
033	Rail mill scale pit effluent	12			
034	Cooling pond influent	12			
035	Cooling pond effluent	12		6	

Fig. I SYSCO Flow Schematic

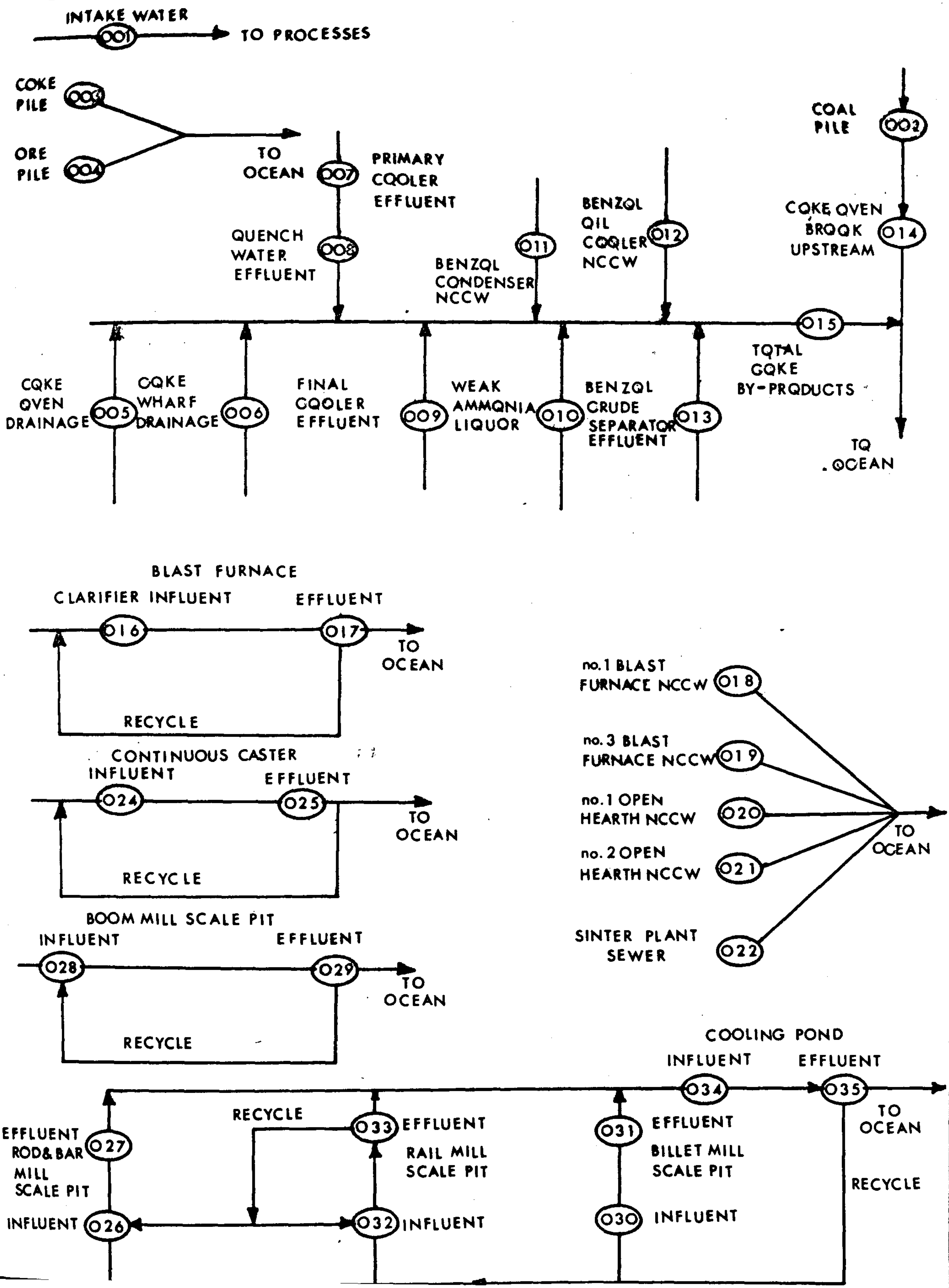
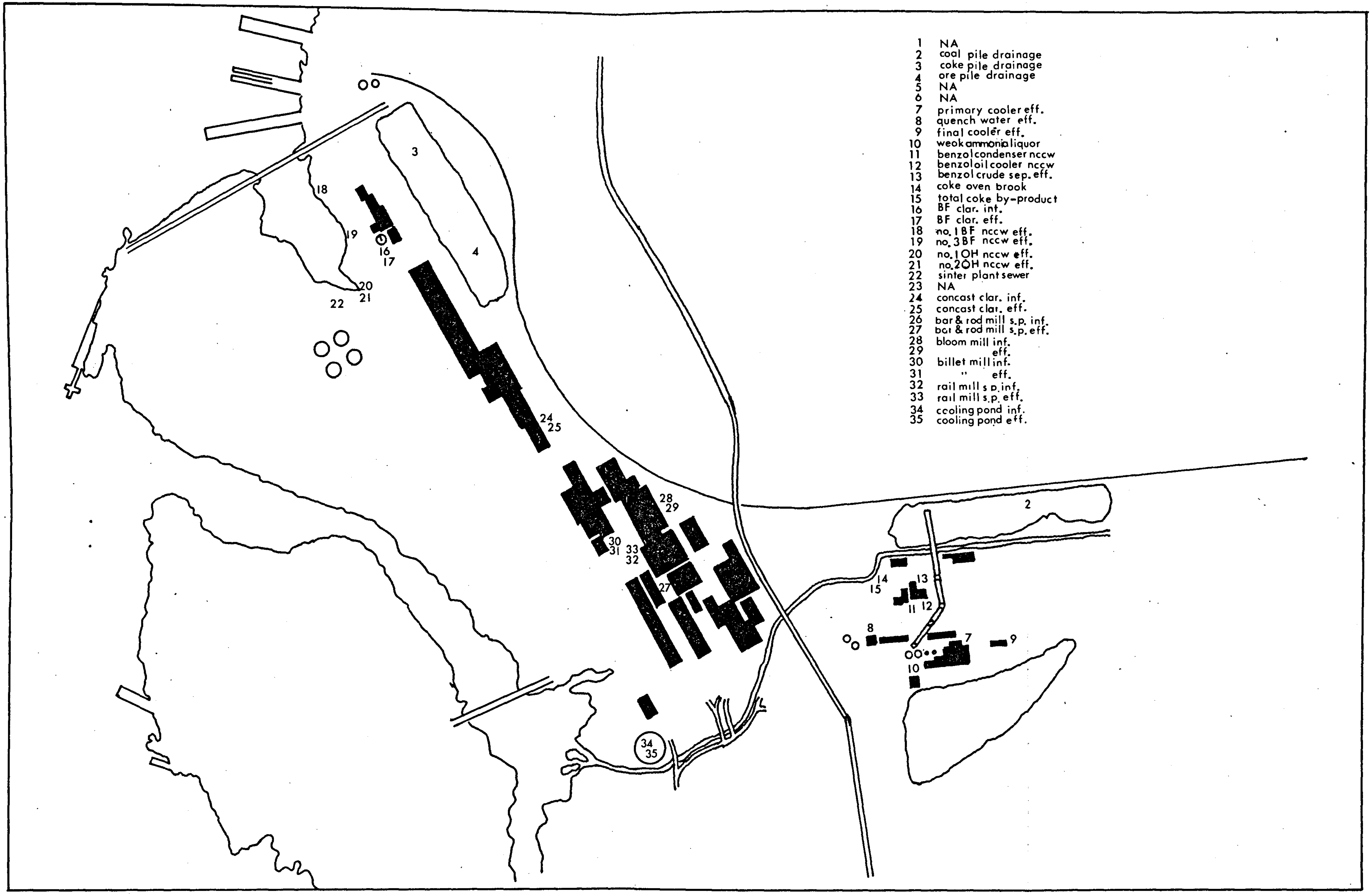


Figure 2 Plant Layout



atomic absorption method was used. A summary of all analyses and methods is given in Table 2.

3.3 Data Organization

The data was organized with the aid of a computer program run on a CYBER 74 computer located at the Wastewater Technology Centre in Burlington, Ontario. Gross concentration, flow and production data for each station were entered in the computer. An average flow was calculated for each station and used for sampling days where no flow was measured. The program calculated a flow-weighted mean intake water concentration for each parameter using data from the intake water samples. This mean intake water concentration was then subtracted from each gross concentration value for all parameters except pH to yield a net concentration value for each replicate of each parameter. Net concentration values and flow data were used to calculate a net discharge (lb/day) value for each replicate. The unit loading data was then calculated using net discharge and production data for each replicate. Detail data for Sysco is held on the CYBER 74 at Burlington.

TABLE 2 - METHODS OF ANALYSIS

Parameter	Method
Chromium (Cr)	Atomic Emission and Absorption
Copper (Cu)	Atomic Emission and Absorption
Iron (Fe)	Atomic Emission and Absorption
Manganese (Mn)	Atomic Emission and Absorption
Lead (Pb)	Atomic Emission and Absorption
Zinc (Zn)	Atomic Emission and Absorption
Hydrogen Ion Concentration (pH)	pH Meter
Total Suspended Solids (TSS)	Gravimetric
Total Dissolved Solids (TDS)	Gravimetric
Total Organic Carbon (TOC)	Combustion - Infrared Method
Phenol	Chloroform Extraction - Colorimetric
Total Kjeldahl Nitrogen (TKN)	Acid Digestion - Specific Ion Electrode
Ammonia (NH_3)	Specific Ion Electrode
Total Cyanide (TCN)*	Distillation - Specific Ion Electrode
Thiocyanate (CNS)	Colorimetric

TABLE 2 - Continued

Parameter	Method
Sulfide ($S^=$)	Specific Ion Electrode
Chloride (Cl^-)	Colorimetric - Automated
Sulfate ($SO_4^=$)	Barium Chloride Titrimetric
Fluoride (F^-)	Specific Ion Electrode
Oil and Grease	Petroleum Ether Extraction

* During cyanide determination thiocyanate decomposes to volatile sulfide during distillation. Soluble sulfide interference with the cyanide ion selective electrode was removed by precipitating sulfide with lead carbonate prior to cyanide determination.

4. WASTEWATER SAMPLING DATA

4.1 Raw Material Storage

4.1.1 Coal Pile Runoff - Station 002. The coal pile at Sysco is located north of the coke oven and coke by-products complex. The drainage from the coal pile is carried off in the coke oven brook and contributes an upstream effect to the data for Station 014.

Of particular interest at this station were the dramatic increases in total iron on May 25 and May 31, as well as a significant increase in suspended solids on May 31. Investigation indicates that there was never any storage of iron ore in the coke ovens area. This information, when considered in light of the high rainfall on May 21, 24, 25 and 26 plus moderate rainall on May 27 and 29, suggests a land wash effect. It is known that the Sysco plant has a high particulate fallout[7], and it is suspected that landwash of this fallout is the cause of the high iron and suspended solids values. This same effect occurs at Station 014.

Three grab samples were collected at Station 002, which is not a large number upon which to base any conclusions. When the values obtained at Sysco are compared to the average Canadian data in the Preliminary Discussion Paper on Effluent Controls for the Iron and Steel Industry[8], Sysco compares well. Total suspended solids are considerably below the range presented in the discussion paper, while other values are comparable with the exception of total iron. Total iron in the coal pile runoff at Sysco

TABLE 002 - COAL PILE RUNOFF

Parameter	Net Concentration (mg/l) Mean	SD	From Discussion Paper
pH	3.1	0.1	8.
SS	59.	37.	1010-9085
TDS	2093.	231.	
NH_3	0.6	0.5	
Phenol	0.001	0.001	0.2
TCN	0.03	0.06	0.01-0.22
Oil and Grease	1.	2.	3.4 -9.5
TKN	1.9	1.8	
TFe	82.08	72.29	8.2
TCu	0.03	0.01	
TZn	0.80	0.06	
TMn	14.2	1.0	
TPb	0.01	0.01	

is a factor of ten higher than the industry average[8]. This is explained by the suspected landwash discussed earlier.

Additional sampling of runoff or drainage from the coal pile would be useful in establishing the suspected fallout and landwash problem as the source of high iron and suspended solids.

4.1.2 Coke Pile Runoff - Station 003. The Sysco coke pile is located adjacent the blast furnaces in the stock yard storage area. The drainage from the coke pile discharges directly to Sydney Harbour. During the period of the study, three grab samples of the drainage were collected and the results of the analysis are shown in Table 003.

In general, the results of the coke pile runoff compare favourably with the Canadian averages as reported in the Preliminary Discussion Paper[8]. Phenols and cyanide at this location are within the standards set by Guidelines for Canadian Drinking Water Quality, 1978[5].

TABLE 003 - COKE PILE RUNOFF

Parameter	Net Concentration (mg/l)		From Discussion Paper
	Mean	SD	
pH	8.4	0.1	8-8.1
SS	53.	37.	28-3590
TDS	517.	89.	
TOC	1.	1.	
Phenol	0.001	0.001	0.5
TCN	0.06	0.05	0.025-0.05
Oil and Grease	1.	2.	2.5-9.5
TKN	9.2	15.9	
TFe	1.64	1.45	
TMn	0.4	0.3	
CNS	0.2	0.3	

4.1.3 Ore Pile Runoff - Station 004. The ore pile at Sysco, like the coke pile, is located in the stock yard area adjacent the blast furnaces. Although the cyanide is slightly elevated when compared to the levels coming from the coal and coke piles, it is not at an alarming level.

TABLE 004 - ORE PILE RUNOFF

Parameter	Net Concentration (mg/l)	
	Mean	SD
pH	8.3	0.2
SS	66.	43.
TDS	530.	21.
TCN	0.08	0.08
TFe	1.91	2.11
TMn	0.5	0.3
F^-	6.90	0.69

Very little iron is being leached out of the pile. On all three days that the ore pile runoff was sampled (May 24, 25, 31, 1979), there was rain. The pH of the ore pile remained stable in the range of 8.1 to 8.4 , and iron in the runoff was in the range of 1 to 4.70 mg/l. Given an adjacent source of sulphur dioxide in the steel plant, one might suspect acid rain at this location, but there is no evidence of any effect. Possibly the pile is too close to the source to be affected.

4.2 By-Product Coking

4.2.1 Primary Cooler Effluent - Station 007. The primary cooler effluent at the Sysco mill is used for quench water and has no direct effect on the environment. It has a secondary effect in that it is discharged as an effluent after being used in the quenching operation.

In general, there are no significant levels of pollutants or toxics in the primary cooler effluent.

TABLE 007 - PRIMARY COOLER EFFLUENT

Parameter	Net Concentration (mg/l)	
	Mean	SD
pH	5.5	0.6
SS	4.	2.
TDS	1.	2.
TOC	1.	2.
Phenol	0.004	0.005
Oil and Grease	3.	8.
TKN	0.3	0.9
TFe	1.17	0.57

4.2.2 Quench Water Effluent - Station 008. The quench water effluent at Sysco exhibits no serious level of pollutants. The flow from this location would probably have an elevated temperature and should probably be cooled prior to discharge.

If new coke ovens are ultimately constructed, it might be possible to take advantage of the existing cooling pond; otherwise, a new cooling pond should be constructed if an examination of temperature elevation downstream justifies it. In either event, this waste stream should be isolated from the total coke by-products stream at Station 015 to which it discharges now.

TABLE 008 - QUENCH WATER EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	6.8	1.0	-	-
SS	9.	6.	92.	60.
TDS	1.	5.	14.	48.
TOC	1.	4.	13.	38.
Phenol	0.007	0.010	0.1	0.1
Oil and Grease	1.	1.	5.	12.
Cl^-	1.	5.	15.	51.
TKN	0.4	1.3	4.	13.
TCr	0.002	0.05	0.2	0.5
TFe	0.83	0.37	8.3	3.7
CNS	0.1	0.3	1.4	3.4

Flow (Mean) 645,000 Igpd

4.2.3 Final Cooler Effluent - Station 009. High levels of ammonia, phenol, cyanide, sulfide and thiocyanate are present in the effluent from the final coolers at the coke plant. All these parameters have a harmful environmental effect and they should be eliminated if possible.

TABLE 009 - FINAL COOLER EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	9.4	0.1	-	-
SS	5.	4.	53.	37.
TDS	68.	75.	678.	752.
TOC	200.	41.	1998.	409.
NH_3	637.6	154.1	6376.	1541.
Phenol	11.024	5.540	110.2	55.4
TCN	33.45	42.98	1334.5	429.8
Oil and Grease	9.	6.	91.	57.
TKN	607.5	131.1	6075.	1311.
$S^=$	391.8	169.5	3918.	1695.
TFe	0.03	0.08	0.3	0.8
CNS	120.3	67.7	1202.5	676.8

Flow (Mean) 1,000,000 Igpd

Of particular concern in this stream are ammonia, phenol and cyanide, all of which are toxic. The pH at this location is high and although thiocyanate is mildly toxic, it is not a serious problem at the recorded pH levels. There is a danger, however, of cyanide emission should acid conditions develop.

4.2.4 Weak Ammonia Liquor - Station 010. The pollutants discharged in the weak ammonia liquor at the Sysco plant are all of the same order as the national averages established by the Position Paper on Effluent Controls and the State of the Art Report prepared by L.S. Love and Associates[9].

The mean ammonia levels are below the national average range of 3200-3500 mg/l, while both cyanide and phenols can be considered to fall within the ranges established as national averages, the cyanide range being 26-38 mg/l and the phenol range being 400-500 mg/l.

TABLE 010 - WEAK AMMONIA LIQUOR

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	8.6	0.5	-	-
SS	37.	12.	11.	3.
TDS	3949.	2067.	1145.	600.
TOC	1316.	545.	382.	158.
NH_3	1214.	664.	352.	193.
Phenol	438.	173.	127.2	50.3
TCN	41.	11.	11.9	3.4
Oil and Grease	23.	16.	7.	5.
TKN	2141.1	842.1	621.	244.
$S^=$	53.9	21.5	16.	6.
TFe	1.76	0.78	0.5	0.2
CNS	275.7	94.5	79.9	27.4

Flow (Mean) 29,000 Igpd

Ammonia, phenol, cyanide and thiocyanate are all present in significant concentrations. All of these parameters are toxic and their discharge to the environment should be avoided.

Like that of the final cooler effluent, the pH of the weak ammonia liquor appears stable and the risk of cyanide gas release is low, but would be a danger in the event of acid conditions.

4.2.5 Benzol Condenser Non Contact Cooling Water - Station 011; Benzol Oil Cooler NCCW - Station 012. Because there is no direct contact with the process stream, the non contact cooling waters from the benzol condenser and the benzol oil cooler are only mildly contaminated. Because of the pH and phenol values, leakage is suspected.

Any action taken with respect to these two streams should probably be to isolate them from the combined flow at Station 015. The apparent buffering capacity of the flow at Station 015 is capable under normal circumstances of maintaining a high pH, but it would seem prudent to isolate any low pH flows.

Further, although the phenols are high from the point of view of human consumption, these flows are not a high risk in that they are discharged to the ocean and there is no downstream use. The BOD_5 load generated at these concentrations would not be significant.

TABLE 011 - BENZOL CONDENSER NON CONTACT COOLING WATER

Parameter	Net Concentration (mg/l)	
	Mean	SD
pH	4.9	0.4
SS	3.	3.
Phenol	0.085	0.101
TCN	0.01	0.00
TKN	0.6	0.7
TFe	0.15	0.11

TABLE 012 - BENZOL OIL COOLER NCCW

Parameter	Net Concentration (mg/l)	
	Mean	SD
pH	5.0	0.6
SS	11.	16.
Phenol	0.021	0.026
TCN	0.01	0.00
Oil and Grease	1.	2.
TKN	0.1	0.1
TFe	0.04	0.08

4.2.6 Benzol Crude Separator Effluent - Station 013. Relative to other streams at Sysco, the flow from the benzol crude separator is of minor proportions with a low deposit rate in spite of significant concentrations. Ammonia, phenol, cyanide, chloride and thiocyanate are all present in this stream.

The volume of discharge from the benzol crude separator is low relative to other discharges from the plant, but contains a number of toxic substances. Given the scale of treatment facilities that will be required at Sysco, this discharge should be treated. The flow of 5000 Igpd will not cause a significant enlargement of any treatment facility, and although the concentrations are relatively low, the cost of including this stream for treatment is justifiable.

TABLE 013 - BENZOL CRUDE SEPARATOR EFFLUENT - STATION 013

Parameter	Net Concentration (mg/l) Mean	SD
pH	6.7	0.4
SS	8.	6.
TDS	4.	9.
TOC	287.	82.
NH_3	14.4	11.2
Phenol	5.551	4.449
TCN	21.10	13.23
Oil and Grease	16.	22.
Cl	126.	109.
TKN	19.6	11.5
$S^=$	10.6	5.5
Fe	0.18	0.19
CNS	17.7	22.9

4.2.7 Upstream Coke Oven Brook - Station 014. The discussion in paragraph 4.1.1 refers to Station 014 in the observations on coal pile runoff, since runoff from the coal pile discharges via Station 014. The mean gross concentration of iron in the coke oven brook is 5.36 mg/l. On May 31, 1979, the concentration of iron rose to 20.60 mg/l following rain on May 21, 24, 25, 26, 27 and 29. The increase in iron is attributed to the runoff from this period of rain.

The source of the iron at this location is unclear. Iron ore at Sysco is stored in the stockpile area adjacent to the blast furnace area and this is located over a mile from the Station 014 site. Upstream of Station 014 are located the Sysco coal pile plus coal piles owned by the Cape Breton Development Corporation and a private operator. Interviews at Sysco indicate no knowledge of any iron ore storage in the area in question, although it is possible that this may have occurred at some time in the past.

In addition to high iron concentrations following rain, the concentration of suspended solids, dissolved solids and oil and grease elevated significantly.

TABLE 014 - UPSTREAM COKE OVEN BROOK

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	6.1	0.9	-	-
SS	106.	215.	5783.	19819.
TDS	459.	127.	4599.	7651.
TOC	8.	2.	79.	111.
NH_3	0.9	0.5	7.	11.
Phenol	0.474	0.554	1.9	1.9
TCN	0.12	0.11	0.9	1.2
Oil and Grease	8.	16.	433.	1486.
TKN	2.6	1.3	22.	36.
$S^=$	0.2	0.0	2.	5.
TFe	5.36	4.84	156.7	471.1
CNS	1.4	3.5	8.8	14.8

The effect of rainfall on this station can be seen in the large standard deviations in the deposit rate for suspended solids, total dissolved solids, oil and grease and iron.

It appears that the elevated concentrations at this location are a consequence of landwash. Work carried out in the past by the Air Pollution Division[7] indicates a high level of particulate deposit in the Sydney area as a consequence of emissions from the Sysco plant. Suspected landwash of this particulate matter gives rise to the theory that it is the source of the elevated concentrations at Station 014 following rainfall.

The high oil and grease concentrations would not of course be a consequence of fallout. It is felt that the oil and grease concentrations come from leakage and spillage associated with mechanical equipment working at the coal pile, including conveying equipment. Deposits of these materials would tend to be washed downstream in the event of high rainfall.

The flows at Station 014 are such as to preclude treatment of a conventional nature. The wide variation of flows would require too large and costly a system to accommodate peak flows and proper operation would be difficult during periods of low flow.

Further investigation should be carried out in this area of the plant to confirm the suspected in-plant sources of phenol, cyanide, oil and grease and thiocyanates which should then be isolated for treatment. Organics at this location can be considered to originate from a municipal dump site upstream of the Sysco installations and from drainage and landwash of the watershed.

Although the high iron levels following rain are suspected to originate from landwash because of their association with rainfall, it is common to have high iron associated with coal[6]. A further source could be leaching of iron from car bodies and other iron bearing materials in the municipal dump.

4.2.8 Total Coke By-Products - Station 015. The total coke by-products effluent at the Sysco plant is a combined flow made up of the effluents from Stations 007 to 013, inclusive. This combination of flows results in the discharge of a veritable witches' brew of pollutants to the coke oven brook and ultimately to Sydney Harbour.

Of particular concern in this flow is the discharge per day of 735.5 pounds of phenol, 10,447 pounds of ammonia, 919.4 pounds of cyanide, and 2,058.1 pounds of thiocyanate, as well as 995 pounds of oil and grease.

TABLE 015 - TOTAL COKE BY-PRODUCTS

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	9.3	0.2	-	-
SS	66.	127.	2606.	5071.
TDS	173.	86.	6750.	3392.
TOC	71.	45.	2775.	1809.
NH_3	269.3	93.5	10447.	3146.
Phenol	18.855	11.672	735.5	456.9
TCN	23.54	9.04	919.4	349.3
Oil and Grease	25.	15.	955.	597.
TKN	259.7	37.3	10336.	1486.
$S^=$	119.6	165.6	4701.	6611.
TFe	8.07	19.80	320.6	788.2
CNS	52.7	23.1	2058.1	898.3

Flow (Mean) 3,981,250 Igpd
2,940 Igal/Ton

The quality of the waste being discharged by this stream is such that treatment must be a mandatory requirement of any upgrading of the coke plant.

A serious investigation should be made of the by-products operation to assess the value of removal of a portion of the pollutants through by-product production prior to treatment. At the present time, the by-products plant is only partially in operation, and this is making a significant contribution to the discharge of pollutants.

If a new coke plant is to be built, then a new by-products plant should be considered in relation to the need for treatment of this waste stream.

Should the existing coke plant be upgraded, infiltration into the collection system should be investigated prior to design of any treatment system. Significant increases in flow occurred after rainfall, which suggests there is infiltration into the collection system.

TABLE 015A - COKE PLANT EFFECT

Parameter	Mean Unit Loading (lb/Ton)	
	Mean	SD
SS	1.966	3.898
TDS	4.993	2.533
TOC	2.555	0.935
NH_3	7.689	2.202
Phenol	0.544	0.338
TCN	0.678	0.257
Oil and Grease	0.709	0.455
TKN	7.661	1.087
$S^=$	3.478	4.920
TFe	0.242	0.604
CNS	1.514	0.658

4.3 Blast Furnaces and Open Hearth Furnaces

4.3.1 Blast Furnace Clarifier Effluent - Station 017.

The blast furnace clarifier treats the scrubber water from the blast furnace gas scrubbers at Sysco. There is a high proportion of recirculation of this water, and the flow from the clarifier represents only a blowdown.

Ammonia, cyanide and fluoride are high at this location, and further treatment should be considered to reduce the concentrations of these items to acceptable levels. Chlorides at the levels shown are not considered hazardous.

Although zinc is a toxic metal, it is not hazardous at the concentrations measured.

TABLE 017 - BLAST FURNACE CLARIFIER EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	8.7	0.2	-	-
SS	108.	59.	104.	56.
TDS	1662.	330.	1596.	316.
TOC	37.	24.	35.	23.
NH_3	30.6	13.6	29.	13.
Phenol	0.043	0.151	-	-
TCN	1.28	0.70	1.2	0.7
Cl	204.	52.	196.	49.
TFe	4.22	2.66	4.1	2.6
TZN	0.95	0.79	1.	1.
TMn	3.0	0.8	3.	1.
F	64.70	13.59	62.	13.

Flow (Mean) 96,000 Igpd
50 Igal/Ton

4.3.2 Blast Furnace and Open Hearth Furnace Non Contact Cooling Water - Stations 018 to 021. These four streams are salt water used for cooling. Apart from the naturally occurring high dissolved solids and chlorides, there are no elevated concentrations of the pollutants measured. All four streamms are almost identical in analyses, and it is considered that no treatment will be necessary.

4.3.3 Sinter Plant Sewer and Continuous Caster Clarifier Effluent - Stations 022 and 025. The sinter plant and continuous caster were not operating during the period of sampling.

The sinter plant sewer samples exhibit the characteristics of the cooling water being discharged to the sewer. This is non contact salt water with the expected high values of dissolved solids and chlorides. None of the pollutants that were examined are present in significant concentrations in the samples taken. However, this waste stream should be sampled again at such time as the sinter plant is in operation.

Only one sample was taken of the continuous caster clarifier effluent because the continuous caster was not operating during the sampling period. This effluent should be evaluated further at such time as the continuous caster is in operation.

4.4 Rolling Mills

All the data for the rolling mills is based on a two shift per day operation. Should the mills operate in a three shift per day mode, the flows and daily discharge will be one half again higher than they are shown in the data.

4.4.1 Bloom Mill Scale Pit Effluent - Station 029. The boom mill scale pit has an independent discharge to Muggah Creek downstream of the coke oven brook.

TABLE 029 - BLOOM MILL SCALE PIT EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	7.2	0.4	-	-
SS	29.	9.	263.	80.
TDS	2.	6.	19.	58.
TOC	7.	6.	65.	57.
Oil and Grease	57.	57.	511.	516.
TFe	1.69	0.76	15.2	6.9
TCu	0.03	0.06	0.3	0.5
TZn	0.16	0.17	1.	1.
TMn	0.1	0.1	1.	1.
TPb	0.01	0.02	0.1	0.2

Flow (Mean) 900,000 Igpd

The most serious pollutant being discharged at this location is oil and grease and efforts should be made, if this stream remains independent, to provide for oil and grease removal. Oil and grease discharge appear on some occasions to be in slugs.

Other pollutants examined at this location are within reasonable limits and need not be treated.

4.2.2 Rod and Bar, Billet and Rail Mill Effluents and Cooling Pond Effluent - Stations 027, 031, 033 and 035. The rod and bar, billet and rail mill scale pits at the Sydney Steel Corporation all discharge to the cooling pond, and because of this they will not be discussed individually.

The cooling pond effluent has a mean flow of 201,667 gallons per day and exhibits no high concentrations of any of the parameters measured, except for oil and grease. The standard deviation for oil and grease indicates that these materials are being discharged as slugs, and the mean value is probably high as a result. The slug discharge has been observed on site and there are photographs that show a continuous film discharge as well. Under these circumstances, it is felt that oil and grease removal is necessary. It might be of advantage to combine this stream with the bloom mill scale pit effluent and carry out combined oil and grease removal.

The cooling pond is in poor physical condition and repair or reconstruction should be considered. This will be influenced, of course, by the final long term development plan.

TABLE 027 - ROD AND BAR MILL SCALE PIT EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	7.3	0.4	-	-
SS	55.	37.	915.	610.
TDS	6.	9.	100.	149.
TOC	7.	3.	113.	55.
Oil and Grease	26.	10.	432.	164.
TFe	2.57	0.92	42.4	15.1
TCu	0.02	0.05	0.3	0.8
TZn	0.12	0.14	2.	2.
TMn	0.1	0.0	1.	1.
TPb	0.09	0.03	1.5	0.6

Flow (Mean) 1,651,200 Igpd

TABLE 031 - BILLET MILL SCALE PIT EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	7.7	0.6	-	-
SS	33.	19.	171.	98.
TDS	10.	12.	50.	62.
TOC	13.	8.	66.	43.
Oil and Grease	60.	49.	311.	252.
TFe	2.51	1.10	13.0	5.7
TZn	0.13	0.14	1.	1.
TMn	0.1	0.1	-	-
TPb	0.08	0.03	0.4	0.2

Flow (Mean) 518,400 Igpd

TABLE 033 - RAIL MILL SCALE PIT EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	7.0	0.2	-	-
SS	89.	30.	595.	198.
TDS	2.	5.	14.	33.
TOC	21.	14.	141.	96.
Oil and Grease	135.	85.	910.	571.
Cl	1.	1.	4.	7.
TFe	2.63	0.98	17.6	6.6
TZn	0.12	0.12	1.	1.
TPb	0.09	0.02	0.6	0.1

Flow (Mean) 672,000 Igpd

TABLE 035 - COOLING POND EFFLUENT

Parameter	Net Concentration (mg/l)		Net Discharge (lb/day)	
	Mean	SD	Mean	SD
pH	7.2	0.2	-	-
SS	53.	56.	114.	133.
TDS	2.	4.	5.	9.
TOC	6.	3.	13.	8.
Oil and Grease	1258.	3732.	3704.	11567.
TKN	0.4	0.8	1.	1.
TFe	2.07	0.85	4.3	2.4
TPb	0.07	0.04	0.1	0.1

Flow (Mean) 201,667 Igpd

5. DISCUSSION

Probably the most important factor in resolving the pollution control problem at Sydney Steel Corporation will be the resolution of the question of the long term development of the Corporation. The solutions with respect to waste flow will depend upon the final physical layout of the plant and upon the degree of coke by-product recovery that will be carried out.

The recommendations discussed in this report consider the plant as it now stands (1980), and deal with the individual waste streams that were sampled during the 1979 program. The plan ultimately adopted will have a considerable influence on any pollution control scheme that is developed.

In particular, the site location of any new structures will influence selection of combined flows to be separated for treatment. Recirculation of waste streams will also be affected by the site layout. An extreme example of site location influence would be, for example, the relocation of the coke ovens adjacent to the blast furnace complex or the stock yard.

Operation of the coke by-products plant would significantly reduce the amount of pollutants being discharged. While it is likely that treatment will still be required, the operation of the coke by-products plant might offset some of the cost of operating pollution control equipment. This type of analysis is, of course, beyond the scope of this report, but it appears to be worth investigation.

Because of the unknowns involved in the future of Sysco, this report has been limited to identification of those waste streams that now discharge excess quantities of conventional steel mill pollutants. No attempt has been made to identify or recommend specific methods of treatment because the final configuration of the mill has not been established.

Further, waste water problems at Sysco should not be considered in isolation from the air pollution problems that exist at Sysco[7]. Solutions to both the water and air pollution problems should be developed concurrently.

It is estimated that air and water pollution control at the Sysco mill, in its present configuration, will cost between one hundred and one hundred and fifty millions of dollars.

REFERENCES

1. Vernon, C.W., Cape Breton, Canada, Nation Publishing Co., Toronto, 1902.

2. Cameron, James M., Industrial History of the New Glasgow District, The Hector Publishing Company Limited, New Glasgow, 1960.

3. American Public Health Association, Standard Methods for the Examination of Water and Wastewater, Fourteenth Edition, American Public Health Association, Washington, D.C., 1976.

4. Canada, Environment Canada, Environmental Protection Service, Methods for Chemical Analysis of Water and Wastewater, Surveillance Report EPS-5-AR-73-12, Halifax, N.S., 1973.

5. Canada, Health and Welfare Canada, Guidelines for Canadian Drinking Water Quality, 1978, Ottawa, Ontario, 1979.

6. Canada, Environment Canada, Environmental Protection Service, Environmental Monitoring of Coal Mining and Beneficiation Facilities in Nova Scotia and New Brunswick, Canada, Surveillance Report EPS-5-AR-79-5, Halifax, N.S. 1979.

7. Canada, Environment Canada, Environmental Protection Service, Air Pollution Assessment of Sydney Steel's Present and Future Steel-Making Operations, Ottawa, Ontario, 1973.

8. Canada, Environment Canada, Environmental Protection Service, Position Paper on Effluent Controls for the Canadian Iron and Steel Industry, Ottawa, Ontario, 1978.

9. L.S. Love and Associates Limited, Report on the State of the Art of Wastewaters and Their Control in the Canadian Steel Industry, Brampton, Ontario, 1975.

10. United States Steel Corporation, The Making, Shaping and Treating of Steel, Eighth Edition, Harold E. McGannon, Ed., 1964.

ACKNOWLEDGEMENTS

The Sysco survey was organized and directed by Robert Harvey of the Environmental Protection Service, Atlantic Region. Mr. Harvey was supported by the following field staff:

James Donnelly - EPS
Robert Gaudet - EPS
Michael Gauvin - EPS
Darlene Barkhouse - EPS
Aurel Landry - NSDOE
Peter Gauthreau - NSDOE
Bruce Reardon - NSDOE.

Both Jim Donnelly and Aurel Landry spent time submerged to their armpits at Station 015 recovering sand bags washed out by a storm. In addition to the above, Jack Leydon, Nova Scotia Department of the Environment, was very helpful in coordinating the provincial staff during the sampling program.

During the period of sampling, the field staff were given very generous help and assistance by Mr. Allan Balcolm and Mr. Barrie Nagy of Sysco. Without the cooperation and assistance of the Sysco personnel, this project could not have been carried out.

The laboratory work was carried out by Mr. Bill Horne and Miss Maureen MacIsaac of the Environmental Protection Service laboratories at the Bedford Institute of Oceanography. The large number of samples kept them both very busy for a number of weeks.

Conversion of the stored data to the standard national survey format was carried out by Derek Vachon of the Wastewater Technology Centre in Burlington, Ontario.

Finally, the report owes much to the patient typing of Barbara Pellerin of EPS and to Ian McLeod for preparation of the flow chart and plant layout.