FRASER RIVER ACTION PLAN

Summary Technical Report

Richmond Landfill 1996 Pollution Prevention Plan

DOE FRAP 1997-07

Environment Canada Environnement Canada

SUMMARY TECHNICAL REPORT

RICHMOND LANDFILL 1996 POLLUTION PREVENTION PLAN

DOE FRAP 1997-07

Prepared for:

Environment Canada
Environmental Protection
Fraser Pollution Abatement
North Vancouver, B.C.

Prepared by:

Reid Crowther & Partners LTD.
Victoria, B.C.

June 1997

DISCLAIMER

This consultant=s report was funded by Environment Canada under the Fraser River Action Plan through its Fraser Pollution Abatement Office. Environment Canada is not responsible for the content of this report but has made it available for public distribution.

Any comments regarding this report should be forwarded to:

Fraser Pollution Abatement Office
Environment Canada
224 West Esplanade
North Vancouver, B.C.
V7M 3H7

SUMMARY TECHNICAL REPORT
RICHMOND LANDFILL
1996 POLLUTION PREVENTION PLAN

TABLE OF CONTENTS

TABLE OF CONTENTS, CONTINUED

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

In 1996 Ecowaste Industries Ltd. prepared a pollution prevention (P2) plan that was jointly funded through a cost sharing agreement between Environment Canada - Fraser Pollution Abatement Office and the company. The P2 plan is a demonstration project for implementing pollution prevention plans in the DLC landfill industry.

The P2 planning process has three stages as described below:

Stage I	Preparation of an environmental review addressing waste management issues, management systems, baseline conditions of the receiving environment and identification of pollution prevention opportunities;
Stage II	Identification and detailed analysis of pollution prevention options; and
Stage III	Preparation of the pollution prevention plan which outlines the schedule and requirements for implementation.

The following materials enter the Richmond Landfill:

- soil and fill
- demolition waste and construction waste
- source separated gypsum
- biosolids
- clean green (yard waste)
- dry MSW

The primary operations of the landfill are as follows:

- Gatehouse: (loads are accepted and recorded or rejected);
- Unloading: (trucks are directed to the appropriate areas for unloading);
- Salvaging: (loads are sorted to recover recyclables);
- Filling and compacting: (material incorporated into the active face);
- Maintenance of vehicles and equipment;
- Composting: (clean green, biosolids, dry MSW);
- Leachate collection and treatment;

- Hazardous waste disposal;
- Concrete and gypsum recycling; and
- Management and administration.

The following pollution prevention opportunities were identified:

Opportunity No. 1	Prevention of Fuel Spills
Opportunity No. 2	Enhance Recycling of Wood and Other Materials
Opportunity No. 3	Increase Recycling of Fill Material
Opportunity No. 4	Improve Composting Program
Opportunity No. 5	Leachate Quality
Opportunity No. 6	Waste To Energy
Opportunity No. 7	Improving Maintenance
Opportunity No. 8	Improve 3R's Through Education and Training

The pollution prevention options generated from the P2 opportunities are screened according to the technical, environmental and economic criteria. Each criterion is assigned a numerical rating between 1 and 5 which enables the options to be prioritized according to their total scored value.

A number of P2 options were selected as being both feasible and economically viable at this time and a number of options were deemed not to be feasible at this time but may become feasible in the future. The prioritized feasible options (numbering associates an option with an opportunity) include:

Option 2.2	Optimize Salvage Operations
Option 2.1	Bonus Pool and Salvager's Suggestions
Option 8.1	Education and Training
Option 3.1	On-site Screening of Fill Material
Option 3.2	Off-site Use by Delta Topsoil
Option 1.1	Double Walled Fuel Tanks
Option 2.9	Increase Number of Salvagers
Option 5.2	Leachate Quality
Option 2.3	Increase the On-site Use of Compost
Option 5.1	Reduce Hazardous Material Entering the Landfill

There are a number of options that were not feasible at this time due to a variety of reasons. Markets may change in the future to make these options feasible or regulations may change to warrant their implementation.

Monitoring programs have been developed to track the implementation and progress of the options.

SOMMAIRE

En 1996, la société Ecowaste Industries Ltd. a préparé un plan de prévention de la pollution (P2) financé conjointement, dans le cadre d'une entente de partage des coûts, par elle-même et par Environnement Canada (Bureau de réduction de la pollution du Fraser). Ce plan est un projet pilote pour la mise en oeuvre de plans de prévention de la pollution des sites d'enfouissement des matériaux de démolition, de débroussaillage et de construction.

Le processus de planification P2 comporte trois étapes :

Étape I — Préparation d'une étude environnementale concernant les problèmes de gestion des déchets, les systèmes de gestion, les conditions exigées pour le milieu récepteur et l'identification des moyens de prévention de la pollution.

Étape II — Définition et analyse détaillée des moyens de prévention de la pollution.

Étape III — Préparation d'un plan de prévention de la pollution établissant le calendrier et les critères de mise en oeuvre.

Matériaux enfouis à la décharge de Richmond :

terre et matériaux de remblai
matériaux de démolition et de construction
gypse (séparé à la source)
biosolides
rebuts verts (résidus de jardinage)
résidus urbains solides

Principales activités au site d'enfouissement :

Réception : (réception/consignation ou rejet des chargements)
Déchargement : (envoi des camions à la zone d'enfouissement appropriée)
Récupération : (tri des chargements pour récupérer les matériaux recyclables)
Enfouissement et compactage : (incorporation des matériaux dans l'étage actif)
Maintenance des véhicules et du matériel
Compostage : (matériaux de jardinage, biosolides, résidus urbains solides)
Collecte et traitement des produits de lixiviation
Évacuation des déchets dangereux
Recyclage du béton et du gypse
Gestion et administration

Moyens de prévention de la pollution :

N° 1 Prévention des déversement de combustibles
N° 2 Amélioration du recyclage du bois et autres matériaux

N° 3 Augmentation du recyclage des matériaux de remblai
N° 4 Amélioration du programme de compostage
N° 5 Amélioration de la qualité des produits de lixiviation
N° 6 Transformation des matériaux de rebut en source d'énergie
N° 7 Amélioration des activités de maintenance
N° 8 Mise en valeur des « 3R » par la formation et l'éducation

Les options de prévention de la pollution découlant du programme P2 sont évaluées selon des critères techniques, écologiques et économiques. On attribue à chaque critère un chiffre de 1 à 5 afin de prioriser l'option en question selon sa valeur de rendement totale.

Un certain nombre d'options P2 ont été déterminées comme étant techniquement faisables et économiquement viables dès maintenant et un certain nombre ont été jugées non faisables pour le moment mais susceptibles de l'être plus tard. Options faisables priorisées (le chiffre associe un moyen et une occasion de prévention) :

Option 2.2 Optimisation des activités de récupération
Option 2.1 Boni et suggestions des récupérateurs
Option 8.1 Éducation et formation
Option 3.1 Évaluation in-situ du matériau à enfouir
Option 3.2 Utilisation extra-muros par Delta Topsoil
Option 1.1 Réservoirs de carburant à double paroi
Option 2.9 Augmentation du nombre de récupérateurs
Option 5.2 Augmentation de la qualité des lixiviats
Option 2.3 Utilisation accrue du compost in-situ
Option 5.1 Réduction des matériaux dangereux entrant dans le site d'enfouissement

Pour diverses raisons, plusieurs options ne sont pas faisables pour le moment. Les marchés peuvent toutefois évoluer de sorte qu'elles seront économiquement intéressantes et les mesures de réglementation peuvent être modifiées pour en justifier l'application.

Les programmes de contrôle ont été établis pour assurer le suivi des mesures d'application et le progrès des moyens utilisés.

SECTION 1.0
INTRODUCTION

SECTION 1.0
INTRODUCTION

1.1 GENERAL

Ecowaste Industries Ltd. (Ecowaste) owns and operates the Richmond Landfill a DLC (selected waste) landfill in Richmond, BC which serves the Greater Vancouver Regional District (GVRD). The landfill accepts demolition, land clearing and construction (DLC) wastes.

In 1996 Ecowaste prepared a pollution prevention (P2) plan that was jointly funded through a cost sharing agreement between Environment Canada - Fraser Pollution Abatement Office and the company. The P2 plan is a demonstration project for implementing pollution prevention initiatives in the DLC landfill industry. The process that was used and the results of this project are the subject of this Summary Technical Report.

Pollution prevention is defined by Environment Canada in their P2 Plan Reference Workbook (PCA Consultants, 1994) as:

> *"The use of processes, practices, materials or energy that avoid or minimize the creation of pollutants and wastes without creating or shifting new risks to communities, workers, consumers or the environment."*

The P2 planning process has three stages as described below:

Stage I	Preparation of an environmental review addressing waste management issues, management systems, baseline conditions of the receiving environment and identification of pollution prevention opportunities;
Stage II	Identification and detailed analysis of pollution prevention options; and
Stage III	Preparation of the pollution prevention plan which outlines the schedule and requirements for implementation.

The P2 process is as much about increasing efficiencies, reducing waste management costs, improving flexibility and gaining a competitive advantage as it is about enhancing the ability to protect the environment.

In the P2 process options are screened by the P2 Hierarchy as a means to ensure that there is a continual emphasis on minimization of waste generation. BC Environment's Guide to Preparing a P2 Plan (draft, June 1995) explains the hierarchy, as follows:

1. Avoidance, elimination or substitution of polluting products;
2. Reduction in the use of polluting products;
3. Elimination of and reduction in the generation of polluting by-products;
4. Reuse and recycling of polluting by-products;
5. Energy recovery from polluting by-products; and if necessary
6. Treatment or containment of polluting residuals; and
7. Remediation of contaminated sites.

1.2 SCOPE AND OBJECTIVES

The scope of this P2 plan includes all operational activities of the company from the entry of "waste" materials into the landfill, recycling and reuse of salvageable items, management of residual waste materials and everything in between.

The objectives were to:

- reduce and/or eliminate the release of pollutants to the environment;
- optimize the reuse and recycle materials;
- conserve energy and water; and
- minimize environmental management costs and liabilities.

1.3 COORDINATING STEERING COMMITTEE

This project was undertaken by Ecowaste with assistance from Reid Crowther consulting engineers. A Coordinating Steering Committee (CSC) was formed to direct the P2 Planning Process. The CSC was made up of representatives from:

- Ecowaste Industries

- Environment Canada
- BC Environment
- Greater Vancouver Regional District
- City of Richmond
- Reid Crowther & Partners

SECTION 2.0 COMPANY PROFILE

SECTION 2.0
CORPORATE PROFILE

2.1 ECOWASTE INDUSTRIES LTD.

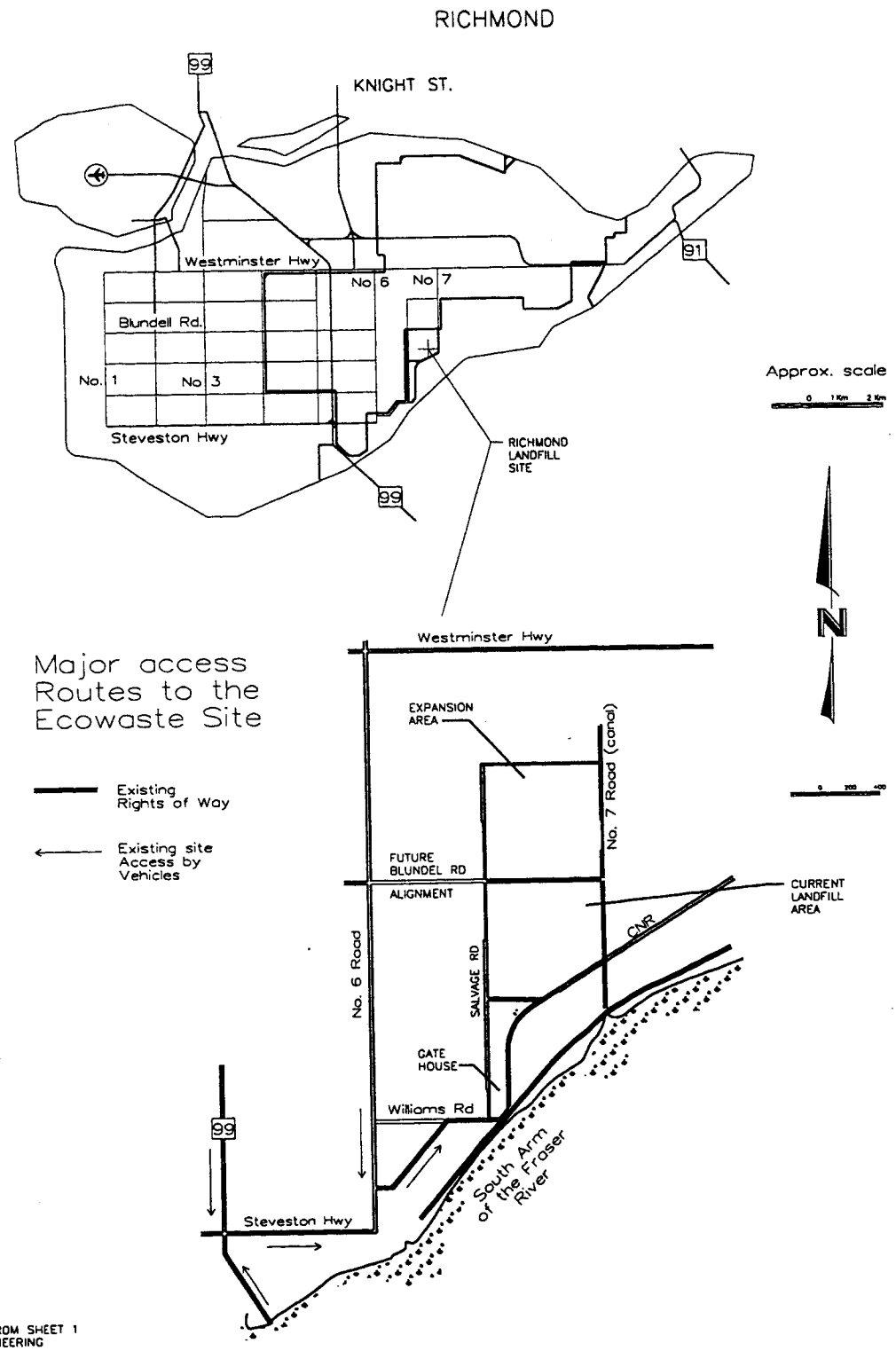
Ecowaste Industries Ltd., formerly Richmond Landfill Ltd., has over 20 years of waste management experience. Ecowaste operated the former Fraser River Harbour Commission municipal solid waste (MSW) landfill from 1971 to 1986. Ecowaste then purchased the adjacent site and started operations at the current landfill. Besides the landfill operations the company also operates a windrow compost facility for yard waste, dry MSW waste from a municipal recycling facility and biosolids. The resulting compost is blended with topsoil and sold to private and public customers by Delta Topsoil Ltd., a division of Ecowaste Industries Ltd.

The Richmond Landfill is located north of the main arm of the Fraser River in Richmond, British Columbia, as shown in Figure 2.1. The area is located in the Fraser River Delta. The landfill was formerly a working peat bog between 1948 and 1970 until all the marketable peat was extracted.

The Richmond Landfill plays a significant role in the solid waste management plan of the GVRD. The Richmond Landfill accepts up to 85% of the region's DLC waste stream, (Khevin Development, 1992). The landfill annually handles over 600,000 tonnes of DLC materials annually. Of this, approximately 10% to 15% is recycled or reused, as composted yard waste. Other materials recycled include concrete, ferrous and non-ferrous metals, gypsum, tires, mattresses, batteries, electronic appliances, beverage containers and others. Figure 2.2 provides an overview of waste stream flows.

2.2 ENVIRONMENTAL RESPONSIBILITIES

Ecowaste is committed to its environmental responsibilities, compliance with regulations, worker training and incentives to improve their environmental performance. Ecowaste has emerged as a leader in the DLC Landfill sector in the GVRD through its many programs to reduce the impacts on the

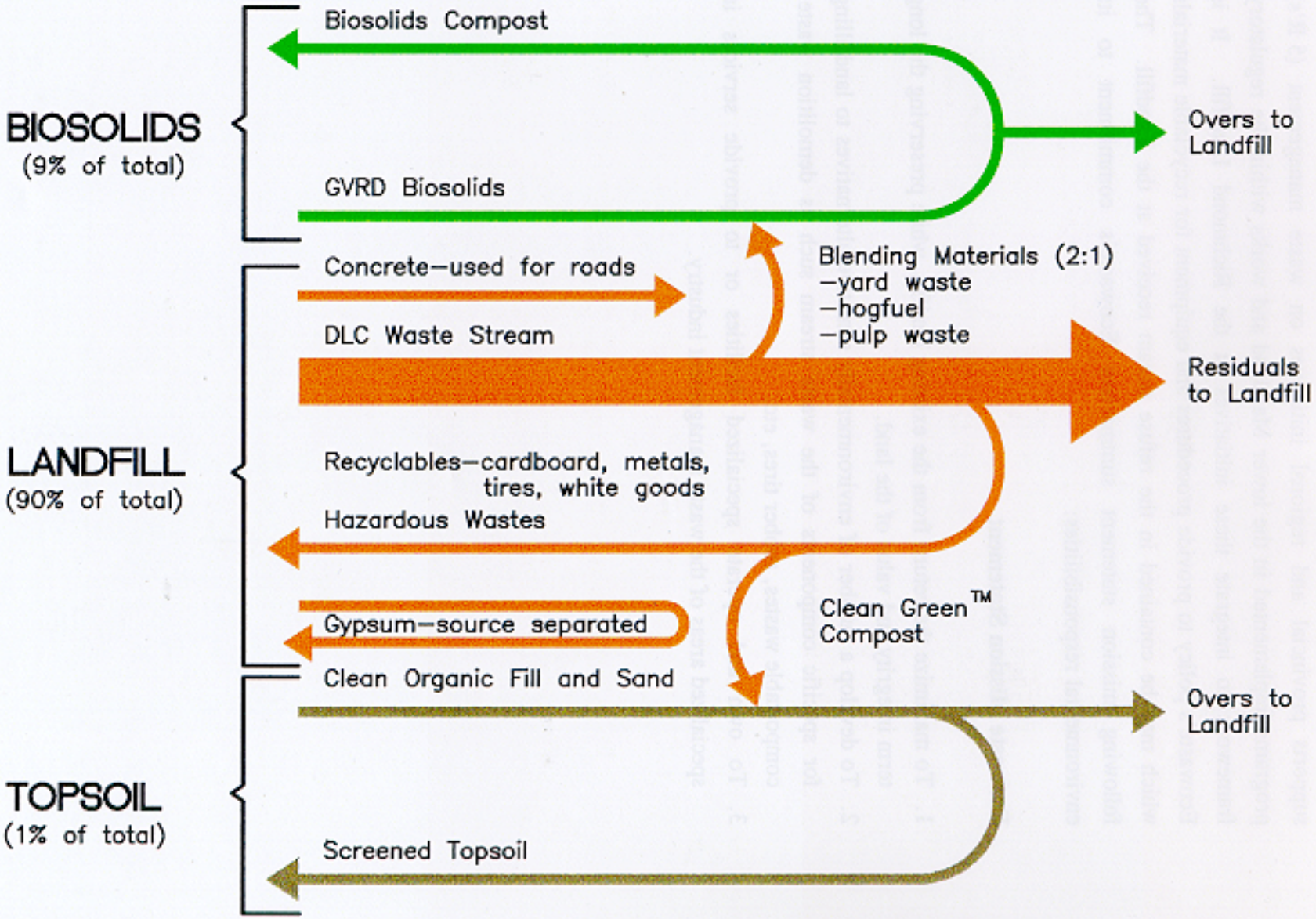


NOTE:
BASE DRAWING TAKEN FROM SHEET 1 PROVIDED BY GNH ENGINEERING

~RCPL~ 19-JUN-97 15:03 H:\35652\ENVIR\ACAD\SK8

Reid Crowther
SUITE #300 - 4243 GLANFORD AVENUE
VICTORIA, B.C. V8Z 4B9
PHONE : 744-2100 FAX : 744-1700

POLLUTION PREVENTION PLAN	DRAWN	DATE MARCH 1996	
	SCALE NTS	APPROVED	
ECOWASTE INDUSTRIES LOCATION PLAN & ACCESS ROUTES	DRAWING NUMBER FIGURE 2.1	REVISION	PROJECT REF 35652



Reid Crowther

Figure 2.2
Waste Stream Flows Overview
Richmond Landfill

environment. This P2 Plan is another example of that commitment. Ecowaste supports provincial and regional initiatives on waste management (5 R's) programs implemented in the lower Mainland and works within the regulatory framework to integrate these initiatives at the Richmond Landfill. It is Ecowaste's policy to provide procedures and equipment for recyclable materials which may be contained in the refuse stream received at the Landfill. The following mission statement summarizes Ecowaste's commitment to its environmental responsibilities:

Ecowaste Mission Statement

1. To maximize the return from the existing landfill, while preserving the long term integrity and value of the land.
2. To develop a number of environmentally sensitive alternatives to landfilling for specific components of the waste stream such as demolition waste, compostable wastes, rubber tires, etc.
3. To own and operate specialized facilities or to provide services in specialized areas of the waste management industry.

SECTION 3.0 ENVIRONMENTAL SETTING

SECTION 3.0
ENVIRONMENTAL SETTING

3.1 SITE GEOLOGY, TOPOGRAPHY AND HYDROLOGY

The site geology is made up of lake deposits overlying alluvial and deltaic deposits. The near surface stratigraphy is made up of 1 to 2 meters of peat overlying approximately 2 to 4 meters of grey clayey silt. This layer acts as the "bottom liner" of the landfill. This stratigraphy is underlain by alternating alluvial and deltaic deposits, consisting of fine to medium sands and minor silt beds existing for 10 to 25 meters below grade (Golder Associates, 1994).

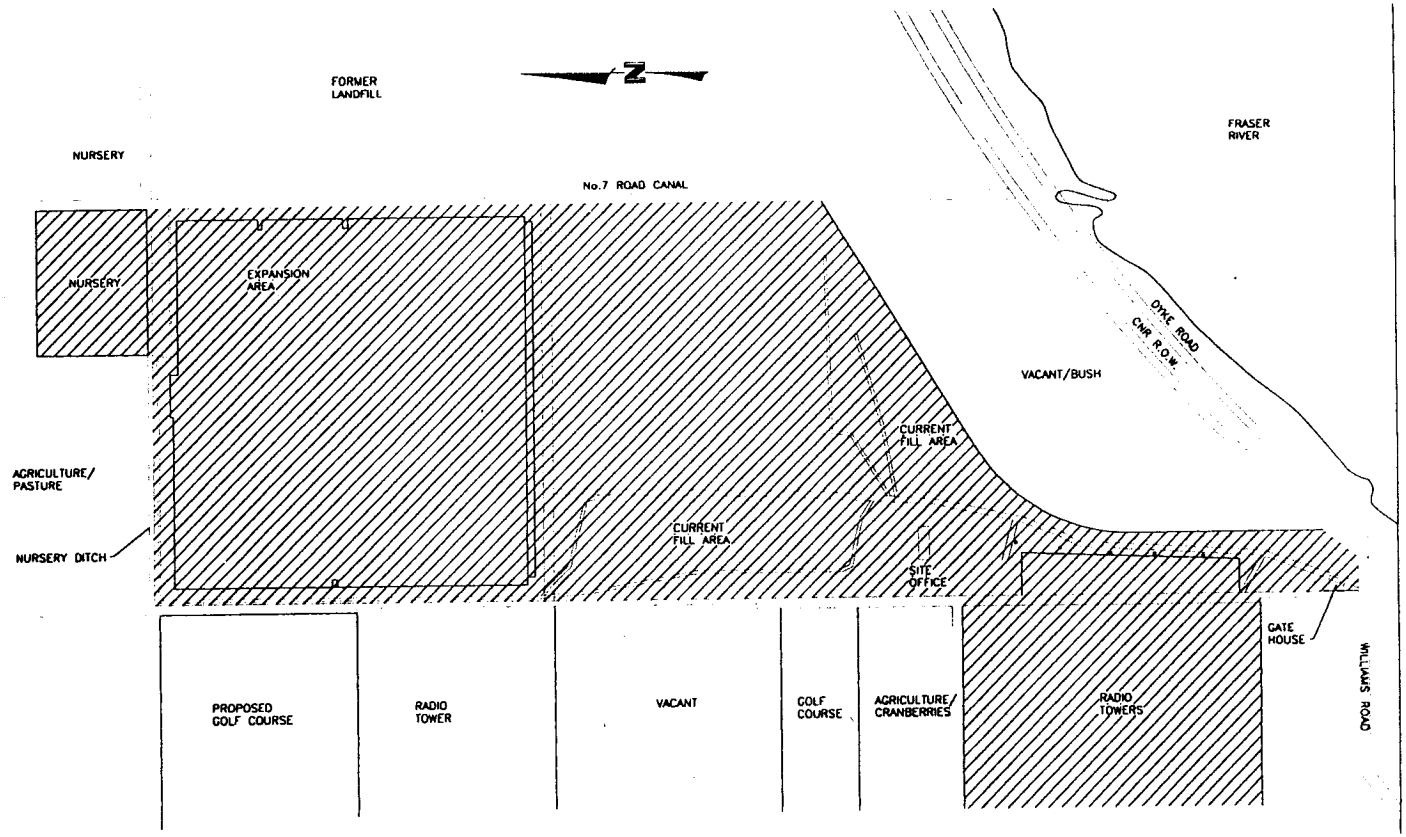
The site is relatively flat. Surface runoff water and landfill leachate are collected and transported via ditches to a leachate treatment marsh in the north portion of the landfill. The surface water and treated leachate eventually discharge to the Fraser River via a ditch along the east property line.

There is a shallow aquifer above the bottom liner. Groundwater in this aquifer flows north through the landfill and radially outward to the east toward the perimeter ditch and leachate collection trench. The groundwater flow in the deeper aquifer, below the clayey silt layer, is northwest towards the Fraser River.

3.2 ADJACENT LAND USE

The land to the west of the landfill, which is in the Agricultural Land Reserve (ALR) is used for a driving range, a radio tower site and agricultural uses. The land to the north is also in the ALR and is used for agricultural purposes. The land to the east is a former municipal landfill for the Fraser River Harbour Commission, which has been zoned for industrial development. To the south is the main arm of the Fraser River, as shown in Figure 3.1.

This part of Richmond is mostly agricultural with some undeveloped land and rural residential properties. The closest residences, approximately 1/4 kilometer away, are along the main access route, Williams Road/Triangle



LEGEND

ECOWASTE INDUSTRIES PROPERTY

PLAN

NOTE:
BASE DRAWING TAKEN FROM DRAWING ECO.2-94
PROVIDED BY GNH ENGINEERING

Reid Crowther
SUITE #300 - 4243 GLANFORD AVENUE
VICTORIA, B.C. V8Z 4B9
PHONE : 744-2100 FAX : 744-1700

POLLUTION PREVENTION PLAN

ECOWASTE INDUSTRIES ADJACENT LAND USE

DRAWN	DATE MARCH 1996
SCALE NTS	APPROVED
DRAWING NUMBER FIGURE 3.1	REVISION
	PROJECT REF. 35652

Road. There are also residences along No. 6 Road to the east, Westminster Highway and No. 7 Road to the north of the landfill.

3.3 CLIMATE

Richmond experiences a typical marine coastal climate characterized by a lack of extreme temperatures, consistently high humidity and wet winters. Owing to its proximity to the Coast Mountain Range and the predominantly westerly air flows, the region receives abundant amounts of precipitation. The majority of the precipitation occurs during the winter months, when over 89 mm of precipitation has been known to fall in a single 24 hour period. The climate of the area is recorded by Environment Canada at the Vancouver International Airport. The area experiences 1167 mm of precipitation per year (mean annual). Over 50% of the precipitation usually occurs in the months of November, December, January and February. The mean temperature in January is 3°C and is 17.2°C in July (Environment Canada - *Canadian Climate Normals, 1993)*.

3.4 AMBIENT WATER QUALITY

A number of ambient water quality surveys of the Fraser River have been carried out through the Fraser River Estuary Management Program (FREMP). Results from 1990 indicate that very few parameters (nutrients, metals and organic compounds) showed values that were above water quality criteria for aquatic life (FREMP, 1996). There is a general increase in nutrients and metals from Mission downstream which is partly due to salt water effects. However, below Mission there are a few non-point and point sources discharging elevated levels of pollutants. There is a monitoring location in the Fraser River just upstream of the landfill. Drinnan, et al, (1995) provided an extensive analysis of survey monitoring data collected between January, 1993 to March, 1994. The survey included: physical parameters, metals, anions, nutrients, microbiological, resins and fatty acids**,** chlorophenols, polycyclic aromatic hydrocarbons and pesticides. The water quality of the parameters analyzed met all BC Environment criteria developed for the protection of aquatic life except for aluminum and iron originating from natural sources and non-filterable residue indicating that the ambient water quality was, for the most part, good.

Surface water discharges from the Richmond Landfill include stormwater and treated landfill leachate. The treated landfill leachate is discharged to a drainage ditch (Nursery Ditch) located along the north boundary (BC Environment Permit 08036). The discharge from the treatment system is monitored and results indicate that discharge is currently within permitted levels (Ecowaste, 1995).

3.5 FISHERIES AND WILDLIFE

The Fraser River Delta is home to numerous species of birds. The Fraser River Delta provides important staging habitat for migratory birds between Eastern Russia and Alaska, and United States and South America. The habitat type covering the landfill and adjacent lands is generally classified as riverine and woodlot. Due to landfill operations and other past activities on site most of the trees on the property have been cleared and the site currently represents a small open water marshy habitat which is common in the area.

The most abundant types of birds are gulls and dabblers in riverine habitats and robins and sparrows in woodlots.

More than half of the freshwater species of fish in British Columbia are found in the Fraser River. Also, it is the most significant spawning river for salmon in British Columbia.

A fisheries assessment was conducted for the Nursery Ditch and No. 7 Road Ditch into which the treated landfill leachate is discharged (IRC Inc., October 1994). The fish populations included Threespine sticklebacks (99%), Carp and Brown bullheads during July and August. No salmonids were captured. The fish capture data was consistent with data collected in a similar study for the City of Richmond.

SECTION 4.0 ENVIRONMENTAL REVIEW

SECTION 4.0
ENVIRONMENTAL REVIEW

4.1 INTRODUCTION

4.1.1 Waste Stream Overview

The following waste streams enter the Richmond Landfill:

- soil and fill
- demolition waste and construction waste
- source separated gypsum
- concrete debris
- biosolids
- clean green (yard waste)
- dry MSW
- mill and pulp waste
- roofing and industrial

Clean fill and demolition and construction wastes make up the largest portion (over 60%) of waste materials received. In 1995, the Richmond Landfill accepted approximately 630,000 m^3 of DLC wastes. Table 4.1 summarizes the wastes received at the landfill over the past three years. The volume of materials received peaked in 1994 at approximately 670,000 m^3.

4.1.2 Primary Operations

The primary operations of the landfill are as follows:

- **Gatehouse:** (Wastes are received in trucks at the gatehouse. The loads are inspected, accepted and recorded or rejected at this point.);
- **Unloading:** (trucks are directed to the appropriate areas for unloading);
- **Salvaging:** (After unloading, salvagers and/or operators inspect the loads and recover recyclables. Loads can also be rejected at this point.);
- **Filling and compacting:** (Loads are incorporated into the active face);
- **Maintenance of vehicles and equipment**;
- **Composting:** (clean green, biosolids, dry MSW);
- **Leachate collection and treatment**;

Table 4.1: Waste Received for 1993 to 1995[1]

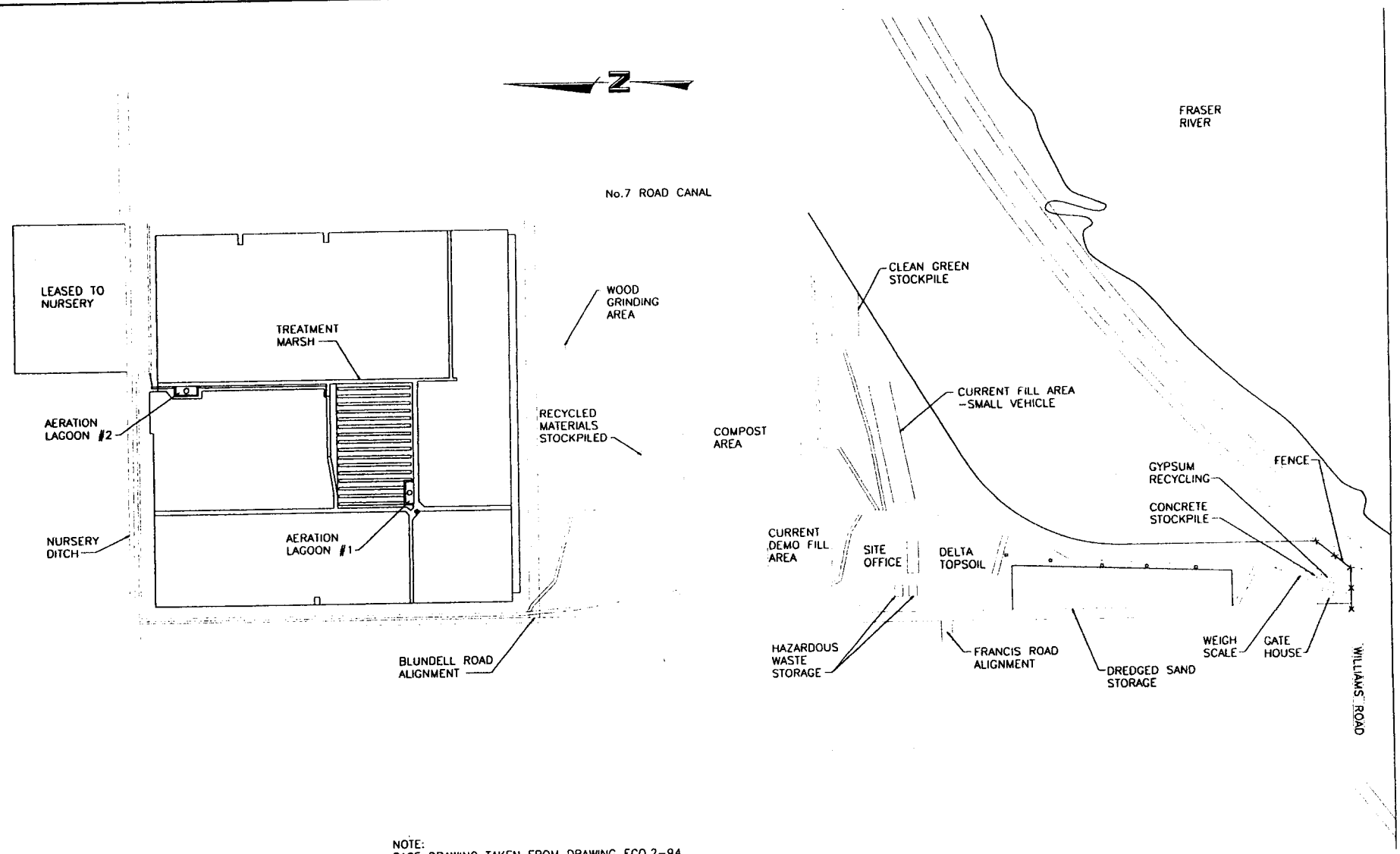
Type of Waste	No. of Trucks 1993	Volume 1993 (m^3)	No. of Trucks 1994	Volume 1994 (m^3)	No. of Trucks 1995	Volume 1995 (m^3)
Dry MSW[2]	0	0	289	6,700	97	2,200
Construction	4,982	68,600	4,469	61,500	5,254	72,300
Demolition	3,443	79,000	9,813	225,100	6348	145,600
Fill (Clean)	14,041	128,800	17,057	156,500	26,614	244,100
Inert Industrial	2,013	53,900	2,558	89,500	1,864	49,900
Mill Waste	595	13,700	123	2,800	166	3,800
Roofing	2,843	26,100	3,023	27,700	3,180	29,200
Yard Waste	2,349	36,000	2,699	41,300	671	10,300
Clean Green	4,363	40,000	4,445	40,800	6,400	58,700
Concrete	78	1,800	706	16,200	480	11,000
Totals	**34,707**	**447,900**	**45,182**	**668,100**	**51,074**	**627,100**

Note: 1 - Average volume and number of trucks supplied by Ecowaste Industries Ltd.
2 - Dry MSW consists of inert, dry separated solid waste from BFI transfer stations, not liquid or putrescible municipal wastes.
3 - Clean Green is a registered trade mark of Ecowaste Industries Ltd.

Primary operations continued:

- **Topsoil production**;
- **Hazardous waste disposal**;
- **Gypsum recycling**;
- **Concrete recycling**; and
- **Management and administration.**

The landfill layout includes separate areas for yard waste, fill, small vehicle loads, demolition and construction materials, concrete and biosolids. Clean yard waste is stockpiled, hogged and composted. Other yard waste is filled Concrete debris is stockpiled until it is crushed and used as road base. A site plan showing all of the operations and key areas of the landfill are shown in Figure 4.1.



NOTE:
BASE DRAWING TAKEN FROM DRAWING ECO.2-94
PROVIDED BY GNH ENGINEERING

Reid Crowther
SUITE #300 - 4243 GLANFORD AVENUE
VICTORIA, B.C. V8Z 4B9
PHONE : 744-2100 FAX : 744-1700

POLLUTION PREVENTION PLAN	DRAWN	DATE MARCH 1996
	SCALE NTS	APPROVED
ECOWASTE INDUSTRIES SITE PLAN	DRAWING NUMBER FIGURE 4.1	REVISION
		PROJECT REF. 35652

4.2 LANDFILL OPERATIONS

4.2.1 Gatehouse

The gatehouse is the first contact with the incoming waste stream for the inspection, acceptance and recording of wastes. The gatekeeper inspects loads to ensure that they meet acceptance criteria outlined in the company's operating permit. If accepted, the loads are directed to the appropriate unloading area. There are personnel on-site to inspect loads at the active face.

The gatekeeper records the weight, volume, type and hauler of wastes received by the landfill. The landfill has installed a weigh scale to better track the waste streams. This will facilitate tracking of P2 initiatives as well as provide data for the GVRD to better quantify the regional waste stream composition and the diversion of materials from being landfilled.

4.2.2 Unloading

Waste streams are segregated to allow for recycling. Loads are dumped above the active face and spread to allow the recyclable material to be salvaged. The remaining residual material is added to the face.

Gypsum is unloaded in recycling bins near the gatehouse and separated concrete is stockpiled near the gatehouse. Small loads from cars and pick-up trucks are unloaded in an area separate from the commercial haulers. Clean organic soil and sand are unloaded at Delta Topsoil Ltd. to be processed into top soil. If the fill is not suitable for topsoil production it is filled or used as cover material. Clean green, biosolids, pulp waste and dry MSW are unloaded in separate areas. All other wastes are unloaded at the demolition fill active face, where recyclables are recovered.

4.2.3 Salvaging and Recycling

At the active face the salvagers and/or operators inspect the waste to ensure that it meets acceptance criteria, if not the load or a portion of the load is reassessed for tipping fee, redirected to proper disposal area or rejected and reloaded into the

truck and taken off the site. This happens when the salvagers find gyproc or food wastes mixed in with the accepted wastes. The salvagers and operator recover recyclable materials prior to landfilling. This includes ferrous and non-ferrous metals, cardboard, dimensional wood, tires, plant pots, mattresses and soft goods, refundable containers, batteries and other hazardous wastes and white goods.

The salvagers recover materials and stockpile them at the recycling area until they are shipped to recycling facilities. At the small load disposal area, there are bins for the recycling of mattresses, wood and metals. The salvagers also inspect the small load disposal area to recover any recyclable materials. Figure 4.2 shows the process flow schematics for these waste streams and Table 4.2 lists the quantities of materials recycled over the last three years.

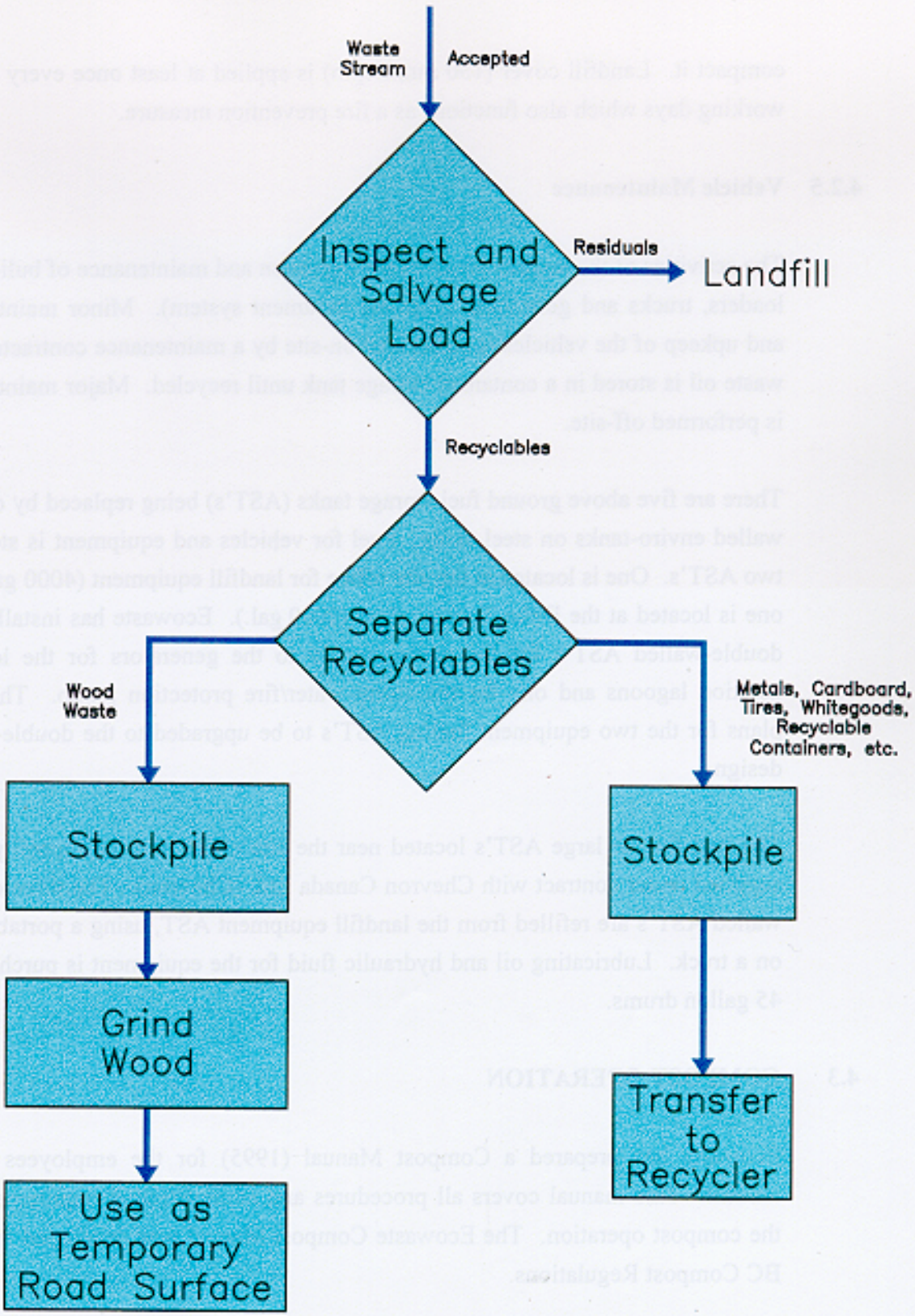
Table 4.2: Quantities of Recyclables from Active Face - 1993 - 1995

Year	Tires (#)	Recyclable Containers (#)	Ferrous Metals (tonnes)	Non-Ferrous Metals (tonnes)
1993	1,249	14,574	1,431	87
1994	0	0	1,806	70
1995	0	59,822	1,893	177

Year	Batt.(kg)	Cardboard (kg)	Plastic Pots (#)
1993	173	9,720	1,785
1994	2,172	940	0
1995	2,475	464 m^3	5,770

4.2.4 Landfilling of Residuals

The active landfilling area is restricted to about one half hectare to minimize wind blown debris and to encourage cellular burial of wastes (fire prevention measure). Once the wastes have been unloaded and recyclables removed, the remaining residuals are incorporated into the active face. The residuals are spread and compacted by a bulldozer. Residual materials are normally filled in lifts of approximately 0.6 meters, the bulldozer makes 3 to 5 passes on the material to



Reid Crowther

Figure 4.2
Salvaging and Recycling Process Flow
Richmond Landfill

compact it. Landfill cover (150 mm depth) is applied at least once every twenty working days which also functions as a fire prevention measure.

4.2.5 Vehicle Maintenance

The activities of the landfill involves the operation and maintenance of bulldozers, loaders, trucks and generators (leachate treatment system). Minor maintenance and upkeep of the vehicles is performed on-site by a maintenance contractor. All waste oil is stored in a contained storage tank until recycled. Major maintenance is performed off-site.

There are five above ground fuel storage tanks (AST's) being replaced by double-walled enviro-tanks on steel skids. Fuel for vehicles and equipment is stored in two AST's. One is located at the site office for landfill equipment (4000 gal.) and one is located at the Delta Topsoil plant (2000 gal.). Ecowaste has installed two double-walled AST's for the power supply to the generators for the leachate aeration lagoons and one for the storm water/fire protection pump. There are plans for the two equipment fueling AST's to be upgraded to the double-walled design.

The fuel for the large AST's located near the site office and the topsoil plant is supplied under contract with Chevron Canada Ltd. (Chevron). The three double-walled AST's are refilled from the landfill equipment AST, using a portable tank on a truck. Lubricating oil and hydraulic fluid for the equipment is purchased in 45 gallon drums.

4.3 COMPOST OPERATION

Ecowaste has prepared a Compost Manual (1995) for the employees of the landfill. This manual covers all procedures and administrative requirements for the compost operation. The Ecowaste Compost Manual was developed from the BC Compost Regulations.

4.3.1 Clean Green™

Clean yard waste is accepted by the gatekeeper, who inspects the load to ensure it meets specifications for Clean Green™ (Clean Green is a registered trade mark of Ecowaste Industries Ltd.). For individual small loads from Richmond and Delta, the drivers are directed to the clean green bins located near the entrance. Commercial clients are directed to the clean green stockpiling area to unload. The clean green material is stockpiled until a tub grinder is contracted to grind it for composting.

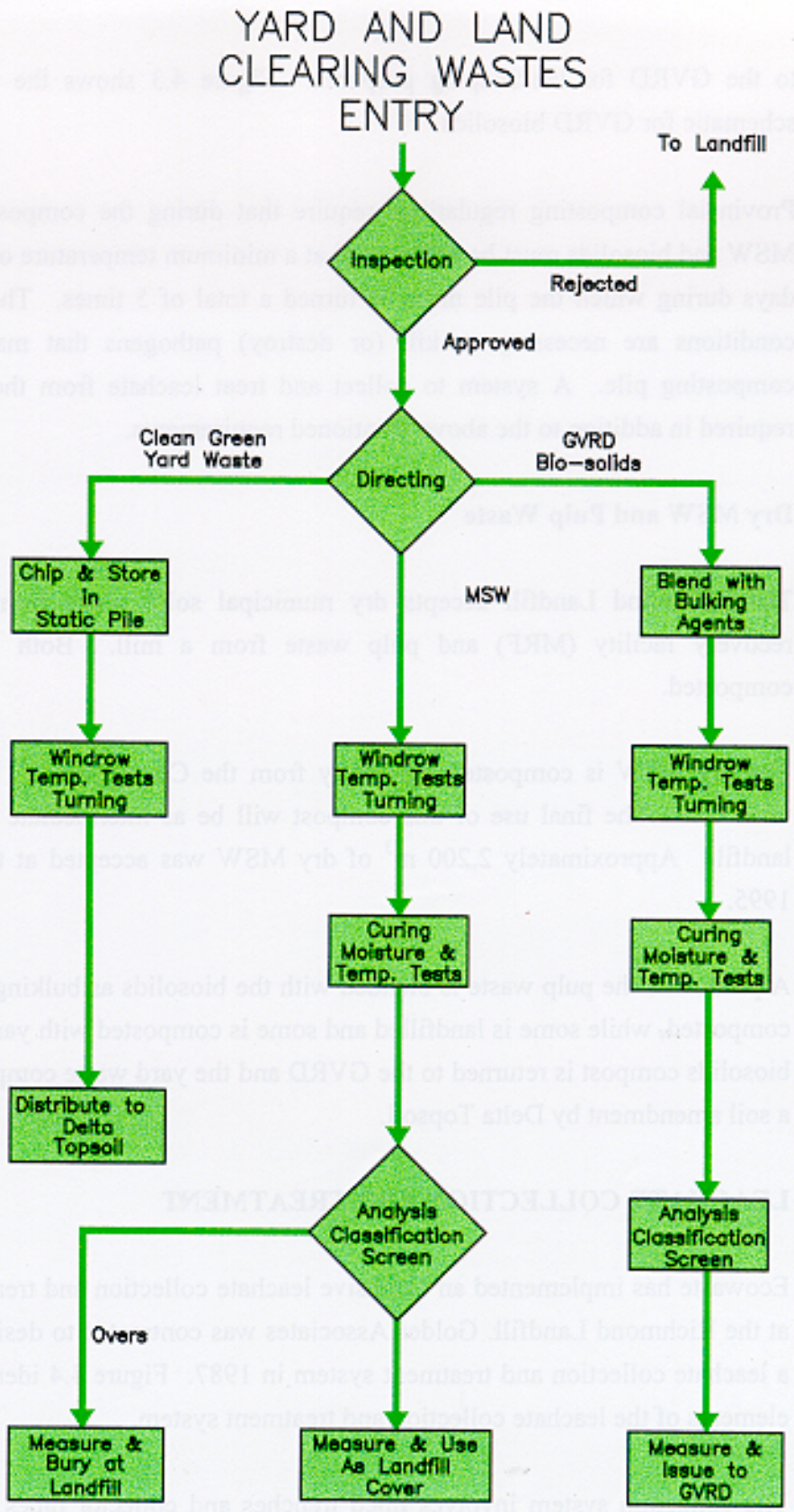
Once the clean yard waste is ground, it is formed into windrows for composting. The windrows are monitored for temperature, which is used to indicate the performance of the composting process. A logbook is kept of the temperature during composting. The windrows are turned (aerated) using an excavator with a rake attachment or with a specialized windrow turner. Once the compost has reached maturity, it is ready for use. Figure 4.3 shows the process flow schematic for clean green.

The final destination for the clean green compost (100%) is as a soil amendment in Delta Topsoil's operation which is subsequently sold to landscaping contractors.

In 1995, the landfill accepted approximately 69,000 m^3 of yard waste. Of this amount, approximately 59,000 m^3 (85%) was accepted as clean green and recycled as compost. The remaining yard waste is either: hogged and used for temporary road base or blended with biosolids or landfilled.

4.3.2 GVRD Biosolids

Ecowaste has been contracted by the GVRD for a demonstration program to process up to 10,000 tonnes of biosolids from sewage treatment plants over a two year period. The biosolids are composted in windrows similar to the clean green composting operation. Some of the pulp waste (high carbon content) is added to the biosolids (high nitrogen content) as a bulking agent to achieve a carbon:nitrogen ratio in the order of 30:1. The composted biosolids are returned



Reid Crowther

Figure 4.3
Compost Process Flow
Richmond Landfill

to the GVRD for landscaping purposes. Figure 4.3 shows the process flow schematic for GVRD biosolids.

Provincial composting regulations require that during the composting process, MSW and biosolids must be maintained at a minimum temperature of 55°C for 15 days during which the pile must be turned a total of 5 times. These operating conditions are necessary to kill (or destroy) pathogens that may be in the composting pile. A system to collect and treat leachate from the pile is also required in addition to the above mentioned requirements.

4.3.3 Dry MSW and Pulp Waste

The Richmond Landfill accepts dry municipal solid waste from a materials recovery facility (MRF) and pulp waste from a mill. Both materials are composted.

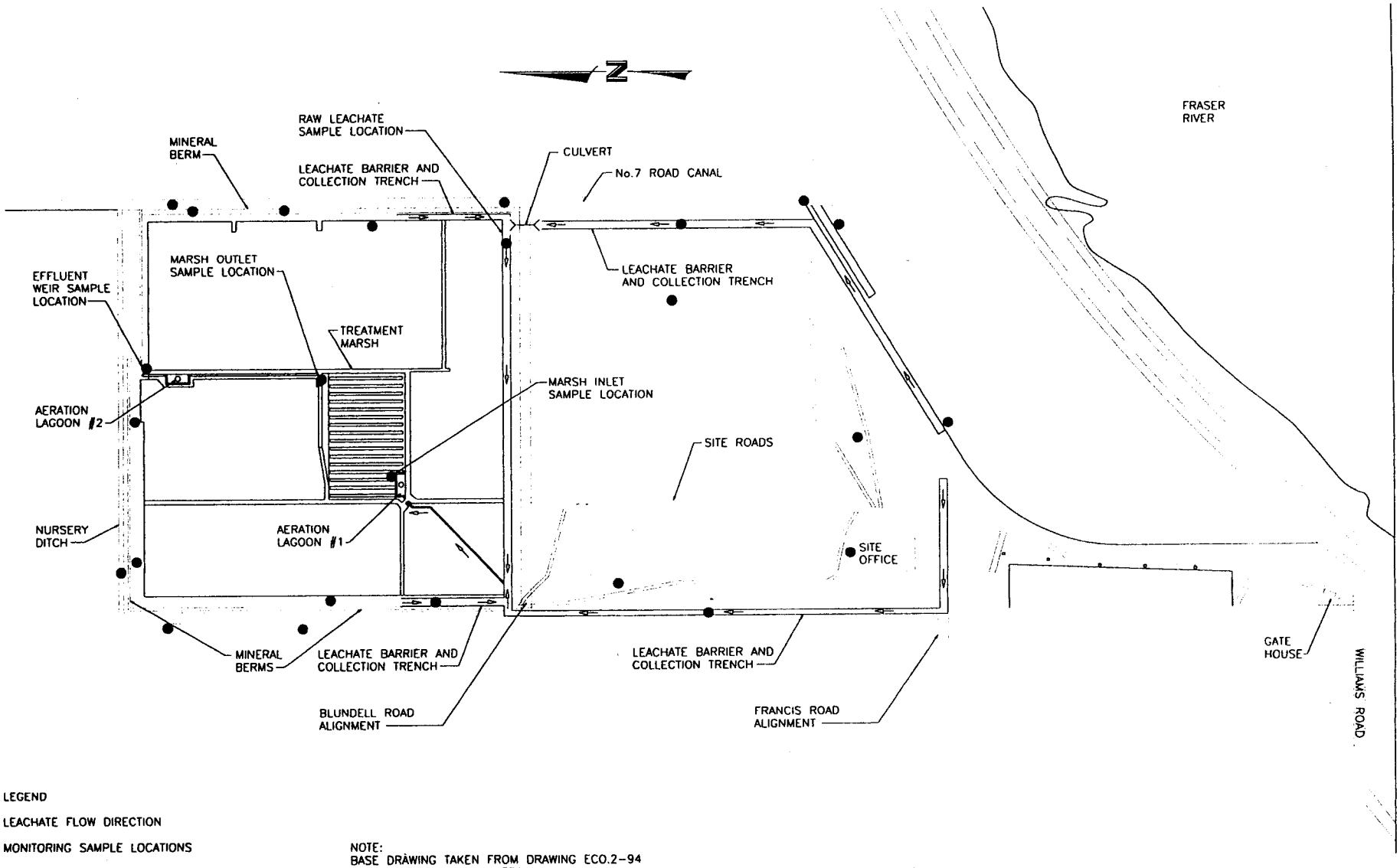
The dry MSW is composted separately from the Clean Green™ and biosolids windrows. The final use of this compost will be as intermediate cover for the landfill. Approximately 2,200 m^3 of dry MSW was accepted at the landfill in 1995.

A portion of the pulp waste is blended with the biosolids as bulking material and composted, while some is landfilled and some is composted with yard waste. The biosolids compost is returned to the GVRD and the yard waste compost is used as a soil amendment by Delta Topsoil.

4.4 LEACHATE COLLECTION AND TREATMENT

Ecowaste has implemented an extensive leachate collection and treatment system at the Richmond Landfill. Golder Associates was contracted to design and install a leachate collection and treatment system in 1987. Figure 4.4 identifies the key elements of the leachate collection and treatment system.

The collection system involves lined trenches and collector pipes which border the east and west boundary of the current landfill and along the Francis Road alignment. The leachate is conveyed to the first aeration lagoon, located in the



LEGEND

LEACHATE FLOW DIRECTION

MONITORING SAMPLE LOCATIONS

NOTE:
BASE DRAWING TAKEN FROM DRAWING ECO.2-94
PROVIDED BY GNH ENGINEERING

Reid Crowther
SUITE #300 - 4243 GLANFORD AVENUE
VICTORIA, B.C. V8Z 4B9
PHONE : 744-2100 FAX : 744-1700

LEACHATE COLLECTION AND TREATMENT

ECOWASTE INDUSTRIES POLLUTION PREVENTION PLAN

DRAWN	DATE MARCH 1996
SCALE NTS	APPROVED
DRAWING NUMBER FIGURE 4.4	REVISION
	PROJECT REF. 35652

northern expansion area. The leachate then passes through a treatment marsh before being aerated in a second lagoon. The treated leachate is then discharged to Nursery Ditch, which runs along the north boundary of the landfill. The Nursery Ditch empties into No. 7 Road Canal which eventually discharges into the Fraser River. The system appears to be successfully treating the effluent to below permit levels as specified in Permit PE08036 for the past three years (Ecowaste, *Water Quality Data Summaries*, 1995).

Conceptual design for the leachate collection system for the landfill expansion was developed by Golder Associates in the 1994 report (Golder Associates, 1994). A new leachate barrier and collection trench has been installed along the first 200 m of the east and west sides of the landfill expansion area. There are also mineral berms surrounding this area to control surface water. This system will be expanded over the next few years to handle leachate when the landfill expands into the northern portion of the site.

Most of the landfill is situated on top of 1.5 to 4.0 m of clayey silt liner with a low hydraulic conductivity ($3x10^{-6}$ to $2x10^{-7}$ cm/s, Golder, 1994) which minimizes leachate losses through the bottom of the landfill.

The leachate generated by the Richmond Landfill is typically lower in concentration of key indicator parameters, such as ammonia, BOD, total phenols, manganese and zinc, than other DLC and MSW landfills in the Lower Mainland (Golder, 1994). This is due to the fact that the landfill accepts relatively non-toxic inert materials which do not generally generate leachate.

4.5 TOPSOIL PRODUCTION

Delta Topsoil Ltd. accepts clean fill and sand to be recycled into topsoil. This diverts significant portion of fill material from the landfill. Also, clean green compost is used as an amendment in the production of topsoil.

Incoming materials are visually inspected to ensure that materials meet acceptance criteria. Delta Topsoil Ltd. accepts materials with high organic content or peat. Materials with high clay or silt content are not accepted and are redirected to the landfill. The topsoil operations, including blending, crushing, screening and

stockpiling, are powered by a diesel generator.. A process flow diagram is shown in Figure 4.5.

Delta Topsoil processes approximately 23,000 m^3/year for sale to landscaping contractors.

4.6 HAZARDOUS WASTE RECOVERY AND DISPOSAL

Hazardous wastes are not accepted at the landfill, however hazardous wastes such as lead acid batteries, paint and solvent cans are recovered from the active face and temporarily stored in hazardous waste storage facilities. Also used oil is generated from the maintenance of site equipment and vehicles. Periodically, the hazardous wastes are transported off-site by licensed hazardous waste disposal contractors. The volume of hazardous wastes disposed of are presented in the Table 4.3.

Table 4.3: Quantities of Recycled Hazardous Wastes

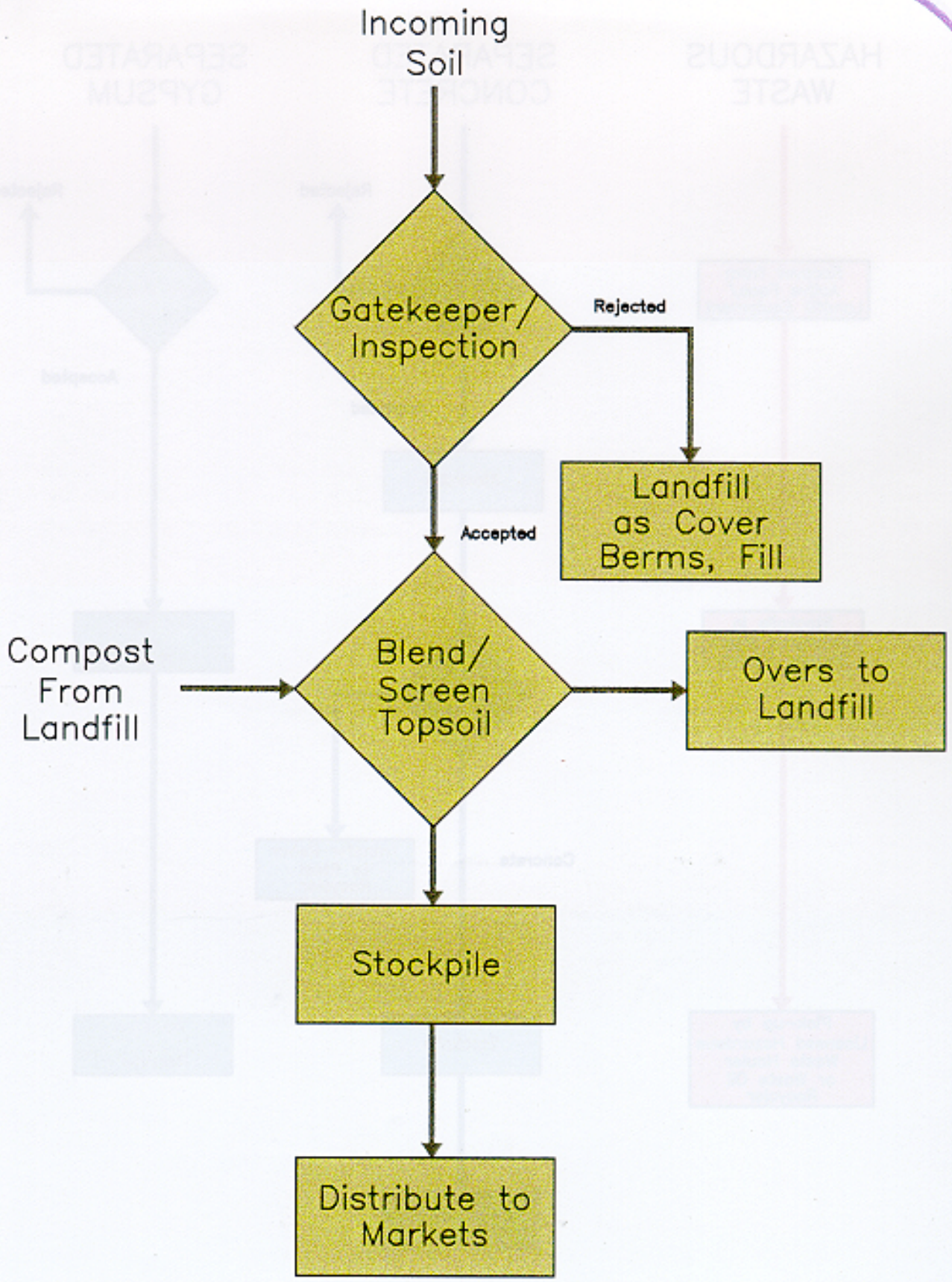
Waste	1993 (L)	1994 (L)	1995 (L)
Used Oil	2,000	1,800	2,000
Waste Paint	---	615	---
Waste Latex Paint	---	820	---

The hazardous waste storage facilities consist of an enclosed and locked structure with a concrete floor. In the case of the waste oil storage facility, there is also secondary containment. These measures minimize the risk of the hazardous wastes from impacting on the environment. Figure 4.6 shows the process flow schematics for the hazardous waste recovery and disposal.

4.7 OTHER RECYCLABLES

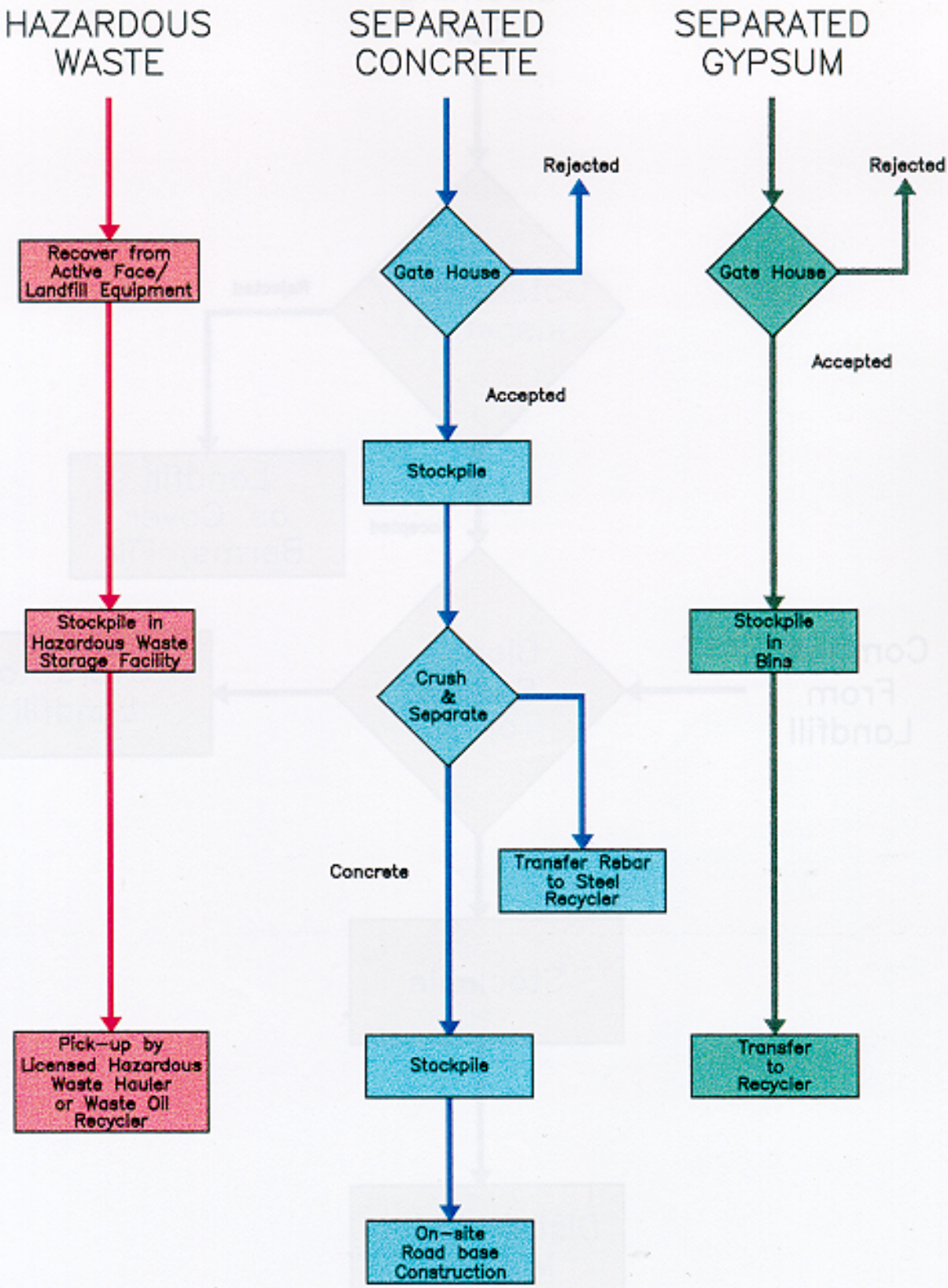
4.7.1 Gypsum Recycling

Gypsum is banned from landfills, however source separated gyproc is accepted in transfer bins by the landfill as a convenience to small contractors. This



Reid Crowther

Figure 4.5
Topsoil Process Flow
Delta Topsoil



Reid Crowther

Figure 4.6
Hazardous Waste and Other Recyclables Process Flow
Richmond Landfill

convenience helps mitigate the problem of illegal dumping. Ecowaste provides this community service at a break-even level. The gyproc is collected in bins near the gatehouse. Once the bins are full, they are transported to a gypsum recycler. Approximately 310 tonnes of gyproc is recycled annually. Figure 4.6 shows the process flow schematic for gyproc recycling.

4.7.2 Concrete Recycling

Concrete is stockpiled near the gatehouse. The concrete is crushed by a contractor to remove the reinforcing steel which is then recycled. The crushed concrete is then used for road construction or sold as fill material. Approximately 11,000 m^3 of concrete was used on-site in 1995. Figure 4.6 shows the process flow schematic for concrete recycling.

SECTION 5.0 ENVIRONMENTAL MANAGEMENT SYSTEM

SECTION 5.0
ENVIRONMENTAL MANAGEMENT SYSTEMS

5.1 SITE MATERIAL AND WATER BALANCES

5.1.1 Material Balances

An overall materials balance for the incoming waste stream is not feasible because incoming materials are recorded by volume and the volumes of the materials change during processing, such as yard waste. However, the recycled and reused materials can be identified to give an overall picture of the initiatives at the Richmond Landfill. The landfill received approximately 630,000 m^3 of materials in 1995. Of this, the following materials are salvaged, recycled or reused:

- all clean green yard waste is composted to be reused on and off site (59,000 m^3 which represents approximately 10% of the total);
- all separated concrete is crushed and used for road base construction (11,000 m^3 which represents approximately 2% of the total);
- MRF material is composted and is to be used as final cover of the landfill (3,000 m^3 which represents approximately 0.5% of the total);
- Biosolids is composted and recycled by the GVRD (2.0%);
- over 2,000 tonnes of metals were recycled;
- 460 m^3 of cardboard were recycled;
- tires, recyclable containers, plastic pots, mattresses were recycled; and
- dimensional wood is hogged for use on temporary roads.

With the installation of a weigh scale, it will be much easier to track the incoming waste stream and determine more accurately the fate of the materials.

5.1.2 Water Balance

An accurate site water balance for the Richmond Landfill is difficult to determine due to many complicating factors, however Golder Associates estimated the flows at 2200 m^3/day for design purposes of the leachate collection and treatment system

(Golder Associates, August, 1994). Golder also reported that most of the precipitation infiltrated the landfill rather than leaving the site as surface runoff.

The average daily flows from the effluent weir (discharge of treated effluent) was approximately 900 m^3/day for 1994. Effluent discharges typically from October to May, there is zero discharge during the summer months due to lack of precipitation.

5.2 ENVIRONMENTAL MONITORING PROGRAMS AND SYSTEMS

5.2.1 Solid Waste Discharge / Permit Requirements

The approved wastes received by the Richmond Landfill are listed in their refuse discharge permit PR-04922 issued by BC Environment. The characteristics of acceptable materials are inert solid waste. The permitted level of discharge is 350 tonnes per day, 365 days per year. Once the current landfill is completed, filling will occur in the area north of Blundell Road. At current filling rates, it is estimated that the Richmond Landfill will operate until 2016 (GNH Engineering, *1996*).

Incoming soil is sampled once a month for metals and petroleum contaminants to ensure that landfilled materials are not contaminated. Ash, sandblast and shotblast materials have to be tested by generators to ensure that materials meet acceptance criteria (below BC Environment Contaminated Sites Regulations), prior to being accepted by the landfill.

As mentioned the authorized works for the landfill operation include a leachate barrier, leachate collection drains, berms, buffer zones, landfill cover, weigh scales and related appurtenances.

5.2.2 Effluent Discharge / Permit Requirements

Ecowaste also has a permit to discharge treated leachate at an annual average rate of 2,000 m^3/day from the landfill under permit issued by BC Environment. Actual treated leachate volumes are approximately 900 m^3/day. The leachate is pre-treated by aeration and passed through a marsh, it is aerated in a second

lagoon prior to being discharged to Nursery Ditch and then No. 7 Road Ditch. Ecowaste is required to sample the effluent and surface water in Nursery Ditch, upstream and downstream of the effluent discharge. The samples are analyzed for conventional parameters (pH, Total Suspended Solids, BOD_5 and Dissolved Oxygen), metals, ammonia, petroleum hydrocarbons, dissolved sulphates, chlorophenols, PCB's, resin acids, phenols, toxicity and flow direction and rate. The monitoring data for the effluent weir indicates that the discharged effluent is currently in compliance. Ecowaste also monitors raw leachate in the landfill and groundwater at other locations shown in Figure 4.4 as part of landfill permit PR-04922. In addition, Ecowaste does additional testing of surface and groundwater not required by their permit. Table 5 outlines the permitted levels for the treated effluent discharge.

Table 5.1: Permitted Discharge Effluent Criteria

Parameter	Permitted Level (mg/L)	Parameter	Permitted Level (mg/L)
pH range	6.0 - 8.5	Copper - Diss.	≤0.05
Tot. Susp. Solids	≤40	Lead - Tot.	≤0.05
BOD_5	≤30	Manganese - Diss.	≤0.5
Diss. Oxygen	≥5.0	Mercury - Tot.	≤0.0006
Total Sulphide	≤0.5	Zinc - Diss.	≤0.2
Ammonia	≤10	Phenols	≤0.2
Aluminum - Tot.	≤2.0	Pentachlorophenol	≤0.0005
Cadmium - Diss.	≤0.005	Tetrachlorophenol	≤0.001
Chromium - Tot.	≤0.1	Toxicity 96h LC20	≥100%

5.2.3 Effluent Treatment Works

The authorized treatment works include an effluent treatment marsh, primary and secondary aeration lagoons, effluent weir, outfall structure and related appurtenances.

5.2.4 Landfill Gas Monitoring and Dust Generation

Golder conducted a preliminary landfill gas survey in 1994. The results of the survey indicate that two parts of the landfill are producing methane gas probably from the decomposition of woodwaste and also from peat decomposition. The two areas are: in the vicinity of the site office and small vehicle demolition fill area; and the area directly to the south of the Blundell Road alignment. The rest of the landfill produces little landfill gas as would be expected of a DLC landfill.

It is not anticipated that landfill gas will be a concern, however, Ecowaste plans to install settlement gauges which will also act as passive venting for landfill gas. These vents will be monitored to determine the extent of landfill gas generation and mitigative measures will be implemented if landfill gas generation is significant.

Due to its size of operation, the landfill should not have a significant impact on ambient air quality. Dust generated during the summer is not likely a problem at the property line. Also, during the summer, the roads are watered to minimize dust generation.

5.3 MANAGEMENT PRACTICES

Ecowaste Industries Ltd. takes a proactive approach in addressing environmental issues and concerns. Environmental issues are discussed at each management meeting. Ecowaste undertakes its commitment to the environment by ensuring that permit compliance is met and by making protection of the environment foremost in its activities. The following list identifies management practices for operations at the Richmond Landfill:

- Leachate monitoring over and above permit requirements to identify potential environmental impacts early to provide the opportunity to take mitigative measures.
- Gyproc recycling bins are located near the gatehouse to provide a convenient drop-off station for small contractors. The gyproc is then transferred to a gypsum recycler. The recycling bins are provided as a community service.
- Every two years, Ecowaste requests an independent environmental audit to assess environmental performance and identify concerns.

- The installation of a weigh scale to better track wastes.
- Ecowaste is developing an operations manual for the landfill. An operations manual for the compost operations has been developed.
- Separation of waste streams to improve recovery of recyclables.

5.4 ENVIRONMENTAL EMERGENCY PREPAREDNESS PLANNING

5.4.1 Spills

Ecowaste landfill has spill containment areas for the waste oil storage area capable of containing 110% of the waste oil storage tank. Also, all workers are WHMIS trained to be able to deal with minor spills if they occur.

The landfill has three double-walled above ground fuel storage tanks (AST's) to minimize the risk of a petroleum release. There are two other AST's which are planned to be upgraded to the double-walled design.

5.4.2 Fire

Due to the nature of the operations at the Richmond Landfill spontaneous fires have started in the past. Possible fire is a constant hazard. Ecowaste has formalized their fire prevention and control plan in their compost manual as well as their Preliminary Closure Plan. Fire prevention and fire protection procedures will also be included in the landfill operations manual.

Ecowaste prevents fires by segregating and minimizing material stockpiles to limit the spread of fires if they do occur. Employees are trained to identify and respond to fire indicators. Also, past fire events are reviewed in order to minimize future fire potential.

The Richmond Landfill is prepared to deal with fires if they occur. There are fire extinguishers in all site vehicles. Also, there are strategically located pumps and hoses for fire fighting. There are also formal procedures, such as smothering the fire with dirt. There is a filled water truck and water drums located at critical points around the landfill ready to extinguish fires. In addition, through discussions with the Richmond Fire Department, Ecowaste maintains a container

which houses a selection of nozzle adapters to enable the fire trucks to connect to the on-site fire fighting water system.

5.5 END USE OF LANDFILL

The current landfill area is zoned for industrial development and consists of 130 acres. The land is being filled and closed for future industrial land use. Specific end use plans for the current landfill have not been established.

The north portion of the site is part of the Agricultural Land Reserve and consists of 150 acres of undeveloped land. The land was previously mined for peat until 1970. The landfill will expand into the ALR area and is to be filled over the next 20 years at which time the landfill would be capped. The cap will consist of a 0.3 m layer of clay overlain by 0.6 to 0.8 m of river sand followed by a layer of 0.3 m of organic topsoil as a growing medium to reclaim the land for agricultural purposes.

SECTION 6.0 POLLUTION PREVENTION OPPORTUNITIES

SECTION 6.0
POLLUTION PREVENTION OPPORTUNITIES

6.1 POLLUTION PREVENTION OPPORTUNITIES

Opportunity No. 1 Prevention of Fuel Spills

Three aboveground fuel storage tanks (two aeration lagoon generators and a storm water/fire pump) have been upgraded to more environmentally safe double-walled tanks. There is an opportunity to upgrade two other aboveground fuel storage tanks (vehicle and equipment tanks) on site.

Opportunity No. 2 Enhance Recycling of Wood and Other Materials

There are opportunities to increase the amount of used wood, chips (wood fibre) and other materials recycled at the landfill through employee incentive programs and operational changes.

The Richmond Landfill currently recycles approximately 15% of the total waste material streams entering the landfill. The portion recycled is primarily organics (wood and yard waste materials) but also includes metals, tires, soft furniture and mattresses, cardboard and a number of miscellaneous materials. There is, however, a significant proportion of wood waste going into the landfill which may be retrieved and recycled.

Opportunity No. 3 Increase Recycling of Fill Material

There are opportunities to recycle soil and fill to increase the total amount of recycling occurring at the landfill through operational changes.

There are over 240,000 cubic metres of fill entering the landfill and yet very little of this material is reused or recycled at present. There are on-site needs for sand and gravel, Delta Topsoil has a need for sand and soil and with the southern portion of the landfill closing in the next year or two there will be a need for final cover and cap materials.

Opportunity No. 4 Improve Composting Program

There are opportunities to improve the composting program. Currently, the aeration of the compost windrows is typically carried out using an excavator with a rake attachment which is not the most efficient method. A windrow turner is contracted periodically to turn the rows, however, this also has some limitations.

Opportunity No. 5 Leachate Quality

There are opportunities to possibly decrease the volume of leachate being generated and improve leachate quality. These opportunities involve other aspects of the operation such as the type of materials landfilled and final landfill cover requirements upon closure.

Opportunity No. 6 Waste To Energy

There is an opportunity to evaluate the potential for recovering combustible materials from the landfill for possible use in local industrial operations or as fuel for a new cogeneration facility.

Opportunity No. 7 Improving Maintenance

There may be opportunities to improve vehicle and equipment maintenance schedules to ensure efficient operation and minimum fuel consumption.

Opportunity No. 8 Improve 3R's Through Education and Training

There are opportunities to improve the efficiency of landfill operations through further education and on-site training for the gatehouse and equipment operators to minimize hazardous and putrescible materials from entering the landfill and to maximize the recovery of recyclables.

6.2 P2 OPTIONS SCREENING CRITERIA

The pollution prevention options generated from the P2 opportunities are screened according to the technical, environmental and economic criteria described below. Each criterion is assessed a high, moderate or low benefit or impact and assigned a corresponding numerical rating between 1 and 5 as an assessment of their value. The numerical rating enables the options to be prioritized according to their total scored value. The evaluation criteria are summarized in Table 6.1.

The criteria are specific and may not apply to all the options. For example improvements in recycling granular fill materials will not affect reduction of hazardous materials or an increase in the number of salvagers will not involve equipment purchases and maintenance.

6.2.1 Technical Criteria

A. Recovery of valuable materials: Potential for the P2 option to increase the recovery of recyclable or reusable materials.

B. Compatibility of new equipment or procedures with current modes of operation: Potential for options to be compatible with existing equipment and current modes of operation. Significant disruptions or incompatibility could eliminate financial and other benefits. This criteria incorporates the degree of technical difficulty and training requirements for staff.

C. Availability and reliability of equipment: Assessment of the reliability of proposed equipment, and determine whether it is proven or non-proven (experimental) technology. Will it work right away or will it have to be modified to get it to work. This category also incorporates maintenance requirements and level of supplier service support.

D. Minimizing leachate discharges/contaminant loadings: Potential for the P2 option to decrease the quantity of leachate generated or improve leachate quality. For most of the P2 options proposed, leachate is not affected and it will not play a role in the evaluation. The options where

leachate is affected will be rated according to their potential to reduce the volume or the contaminant loading.

E. **Waste reduction quantities:** Potential for the P2 options to reduce the quantity of wastes landfilled on or off-site.

6.2.2 Environmental Criteria

A. **Compliance with current and anticipated government regulations or good corporate policy:** Potential for P2 options to comply with or exceed government regulations and any proposed or draft regulations and guidelines or corporate policies. The intent is for P2 options to take companies beyond regulatory standards.

B. **Reducing actual and potential impacts on the environment:** Potential for P2 options to reduce impacts on the environment. This include such things as water quality, drainage and runoff volumes, air emissions, noise and odours.

C. **Hazardous properties of the waste materials:** Potential for hazardous conditions to arise from the materials landfilled. This is assessed from the chemical characteristics of the waste materials and degradation by-products.

6.2.3 Economic Criteria

A. **Costs of waste management (capital and implementation costs):** P2 options will be assessed on the possible payback period, as follows: 1 - 5 years, 6 - 10 years and 11+ years.

B. **Operation and Maintenance costs:** This criteria is based on the estimated annual operational costs as follows: high costs over $50,000, moderate costs between $20,000 and $49,999 and low costs below $19,999.

C. **Potential financial benefits (Net Salvage Value):** Reported as savings in operational or maintenance costs and/or as improved revenues from recycled materials

Table 6.1: Evaluation Criteria

CRITERIA			
TECHNICAL	**HIGH**	**MOD.**	**LOW**
A - Recovery of valuable materials	5	3	1
B - Compatibility of new equipment or procedures	5	3	1
C - Availability and reliability of equipment	5	3	1
D - Minimizing leachate discharges/contaminant loadings	5	3	1
E - Waste reduction quantities	5	3	1
ENVIRONMENTAL			
A - Compliance with current and anticipated regulations	5	--	0
B - Reducing impacts to the environment	5	3	1
C - Non-hazardous properties of residual wastes	5	3	1
ECONOMIC			
A - Pay back period (shorter the better)	5	3	1
B - Low operating and maintenance costs	5	3	1
C - Potential financial benefits (net salvage value)	5	3	1

SECTION 7.0 POLLUTION PREVENTION OPTIONS

SECTION 7.0
POLLUTION PREVENTION OPTIONS

7.1 INTRODUCTION

In accordance with the GVRD's regional objective to reduce the landfilling of residuals by 50% by the year 2000 from the base year of 1990, it is the goal of the Richmond Landfill to optimize the recovery of materials from the materials entering the landfill.

The following P2 options have been developed to address the opportunities identified during the environmental review and assessment of the landfill operations. The evaluation of these options is presented in Tables 7A, 7B and 7C.

7.2 POLLUTION PREVENTION OPTIONS

OPTIONS TO ADDRESS OPPORTUNITY NO. 1
FUEL TANK REPLACEMENT

Option 1.1 Tank Replacement

The upgrading of the aeration generators and the stormwater/fire pump generator fuel storage tanks has been successful and will be extended to the road vehicles fuel tank and to the on-site equipment fuel tank. The upgrading is scheduled for 1997 and the double walled tanks will be a safeguard against potential spillage and leakage.

OPTIONS TO ADDRESS OPPORTUNITY NO. 2
ENHANCE RECYCLING OF WOOD AND OTHER MATERIAL

Option 2.1 Employee Initiatives

Enhance the employee initiatives reward program by formally reviewing ideas from the salvagers and others on a regular basis. The company currently places revenues from recycled materials into a bonus pool for the salvagers as an incentive for recovering recyclable materials. Some improvements have already been implemented from ideas put forward by the salvagers and the idea here is to improve upon this initial program by focusing on it and giving it more attention.

Option 2.2 Optimize Salvager Activities

Maximizing salvaging efforts by optimizing the level of staffing and the method of spreading the loads prior to salvaging to enhance recovery of more recyclables, particularly with respect to ferrous and non-ferrous metals, wood, cardboard and certain miscellaneous materials such as nursery plastic plant pots.

Options 2.3/2.7 Recovery of Wood Materials. The options to be address for this opportunity include alternative methods for separating and retrieving yard and wood wastes from the material being landfilled and the options for expanding the composting operations to utilize additional organic materials separated at the landfill. However, the Lower Mainland Area is not short of natural (peat) compost, thus, these options may be limited by the low demand for compost in the region. There are uses other than compost for wood waste, including agricultural uses, land reclamation, and fibre/fuel feedstocks.

Increased recovery of wood materials cab be achieved by implementing better segregation methods of incoming materials through both source separation and on-site separation. Separated wood waste is currently put through a grinder and either composted or used as road cover during the winter months. Clean lumber is salvaged and recycled in the construction industry and represents a very small quantity of the total organic waste stream arriving at the landfill.

The off-site reuse includes use as potential feedstock (fibre) for a local pulp mill or as fuel for industrial boilers, cement kiln or cogeneration plant. It can also be used for agricultural bedding and land reclamation purposes. The off-site use as feedstock for a pulp mill has considerable implications because typically the wood waste has impurities (concrete forms, soil and mud) which would have to be removed before it can be used. The specifications for it to be a source of fuel are less stringent than those for pulp mill feedstock.

Both on-site and off-site options noted above are further analyzed in Section 8.0.

Options 2.8/2.9 Recovery of Salvageable Materials

The landfill currently recovers many recyclable materials from the incoming materials stream. These materials include reusable materials such as ferrous and non-ferrous metals, concrete, wood, paper/cardboard, plastics and roofing wastes. Options to be investigated to improve salvaging activities include a central sorting area and/or increased manual salvaging.

Before committing to increased resources for additional recycling efforts it is important to know what is being landfilled and what market there is for the salvaged materials. For example, there is only a minimal market for compost in the Lower mainland Area. In addition, Ecowaste is in the business of land recycling and intends to fill the landfill so that it may be redeveloped as quickly as possible.

The options to be further studied include a permanent central sorting area which has the potential to improve the salvaging of recyclable materials through mechanical or manual means, and increasing the number of salvagers at the active face to improve the current practice of salvaging.

Both of the options noted are further investigated in the detailed analysis in Section 8.0.

OPTIONS TO ADDRESS OPPORTUNITY NO. 3
ENHANCE RECYCLING FILL MATERIAL

Options 3.1/3.2 Recovery of Fill Materials

The options to increase the use of soil and fill materials requires the generation of clean product materials such as clay, silt and sand, gravel, cobbles and rocks. There is an ongoing need for gravel and cobbles at the landfill for road construction and maintenance and there will be a specific need for cover materials when the current landfill is closed.

Increased recovery of selected fill materials is possible through improved segregation methods of incoming materials. Segregation can be achieved both at source and on-site by screening the incoming material.

Delta Topsoil Ltd. (a division of Ecowaste Industries Ltd.) may be able to use recycled soil and sand in its operations although this may not be the least expensive source of these materials. Typically Delta Topsoil needs river sand for blending its soil mixtures, some of which is recycled from the landfill the rest of which is purchased. Loamy soils are also used in compost blending but typically the soils that arrive at the landfill are coarse and gravely, and not appropriate for compost blending. On the other hand the Richmond Landfill does not receive sufficient sand and gravel to be a competitive retailer of such materials.

Both on-site and off-site utilization options are analyzed in more detail in Section 8.0.

OPTIONS TO ADDRESS OPPORTUNITY NO. 4 IMPROVEMENT TO THE COMPOSTING PROGRAM

Options 4.1/4.2 Improve Composting Efficiency

Currently, the aeration of the compost windrows is carried out using an excavator with a rake attachment which has some difficulties (slow and cumbersome). In addition to the excavator, a windrow turner is contracted periodically to turn the rows. The excavator is used during the wet season, as the windrower experiences difficulty with mobility on wet soils. Also, the compost operation is carried out on top of the landfill and the soil interface makes turning difficult with the windrower in the wet season.

The options to improve the composting efficiency include paving the compost facility surface and/or purchase of a windrow turner. Paving costs are in the range of \$40/m^2 to \$50/m^2. The purchase of a used windrow turner costs in the range of \$75,000.

Both of the options noted above are investigated in more detail in Section 8.0.

OPTIONS TO ADDRESS OPPORTUNITY NO. 5
LEACHATE QUALITY

Options 5.1/5.2 Improve Leachate Quality

There may be options to improve the quality of leachate generated at the landfill. Options to investigate include methods to reduce the potential for materials that generate hazardous leachate from being landfilled, evaluation of the closure cap design for the landfill and the management of surface run-off.

The first option is to prevent or minimize the quantity of hazardous materials and material that potentially produce toxic by-products from being landfilled by educating suppliers and by improving sorting and salvage activities. This includes potentially hazardous materials such as used oil and grease, liquid paint and paint thinners from entering the landfill.

The second option addresses the landfill closure cap. The landfill has a history of compliance with its effluent discharge permit which suggests that entombment of the landfill, at closure, is not necessary and may even have the potential to create an adverse situation in the future by increasing the concentration and thus toxicity of the leachate. It appears that the current manner in which the landfill functions may be the best solution for closure.

Thus, at the time of closure it appears that there is no need to prevent migration of precipitation into the landfill. The cover layers of the closed landfill can be designed to be permeable. The effect of this will be to continue with the current amount of weak leachate being generated which should subsequently decrease even further over time until there is no need for future monitoring.

Both options are investigated in more detail in Section 8.0.

OPTIONS TO ADDRESS OPPORTUNITY NO. 6
WASTE TO ENERGY

Option 6.1 Reduce the Landfilling of Combustibles

There are beneficial uses for combustible materials diverted from the landfill. One option to investigate is the use of combustible material as an industrial fuel. The alternatives include fuel for a cement plant or future cogeneration plant.

These are unlikely options as use of waste wood as a fuel for cement plants is not approved and use in a cogeneration facility would require far more wood than that could be generated by the landfill and it would need to be located nearby the landfill to make the transportation costs reasonable.

Although unlikely, this option has been investigated in more detail in Section 8.0.

OPTIONS TO ADDRESS OPPORTUNITY NO. 7
IMPROVE MAINTENANCE PROGRAM

Options 7.1 Improve Maintenance Program

There were no options identified to improve the maintenance program as the current procedures appear to be completely adequate at this time. The vehicle maintenance program is based on manufacturers specifications for vehicle running time and cannot be improved upon. Oil and lube usage does not appear to be excessive at this time.

OPTIONS TO ADDRESS OPPORTUNITY NO. 8
IMPROVE 3R's

Option 8.1 Increase Education and Training

Continue education and training of gatehouse personnel, equipment operators and salvagers to improve landfill operations especially in regard to minimizing the potential for hazardous and putrescible materials from entering the landfill and to maximize the recovery of recyclables.

TABLE 7A Technical Evaluation of the P2 Options

P2 Opportunities	P2 Hierarchy	P2 Options	Technical Criteria					Comments
			A	B	C	D	E	
No. 1 - Upgrading Fuel Storage Tanks	Reduce	Option 1.1 Tank replacement. Purchase environmentally safe aboveground fuel tanks	-	5	5	-	-	Company already uses some Envir. safe tanks
No. 2 - Enhance Recycling of Wood & Other Materials	Recycle	Option 2.1 Employee Initiatives. Involves bonus rewards and soliciting ideas from salvagers	5	-	-	-	5	Enhancement of existing system
	Recycle	Option 2.2 Optimize salvager Activities	5	5	-	-	5	Optimize salvagers and spreading
	Recycle	Option 2.3 On-site use of wood fibre for expanded composting operation	5	5	-	1	5	use as soil amendment and road bed material
	Recycle	Option 2.4 Off-site use of wood for firewood	5	5	-	1	5	firewood
	Recycle	Option 2.5 Off-site use of wood fibre for agriculture/land reclamation	5	5	-	1	5	agricultural mulch/land reclamation
	Recycle	Option 2.6 Off-site use of wood for non-structural uses	5	5	-	1	5	non-structural wood
	Recycle	Option 2.7 Off-site use of wood fibre in pulp mill/cement kiln	5	5	-	1	5	ground fibre used for pulp supply
	Recycle	Option 2.8 Central Sorting Area to increase recovery of salvageable materials	5	1	1	1	5	materials are recycled
	Recycle	Option 2.9 Increase number of salvagers	5	5	-	1	5	materials are recycled
No. 3 - Enhance Recycling of Fill Material	Recycle	Option 3.1 Recovery of fill material - On-site use for road base, berms, cover (base case)	5	5	5	-	5	road base, berms, cover
	Recycle	Option 3.2 Recovery of fill material - Off-site use by Delta Topsoil	5	5	5	-	5	clean fill used by Delta
	Recycle	Option 3.3 Recovery of fill material - Off-site use for contractors	5	5	5	-	5	aggregate pit
No. 4 - Improve Composting Program	Reduce	Option 4.1 Improve composting efficiency - Purchase of new/used windrower	-	5	5	-	1	expand compost and Delta Topsoil production
	Reduce	Option 4.2 Improve composting efficiency - Pave windrowing area	-	5	-	4	1	expand compost and Delta Topsoil production
No. 5 - Leachate Quality	Reduce	Option 5.1 Improve leachate quality - Reduce hazardous materials from entering landfill.	1	3	-	5	5	remove materials which produce strong leachate from waste stream
	Reduce	Option 5.2 Improve leachate quality - Allow final cover to be permeable	-	-	-	3	5	Continue to flush leachate out of the landfill
No. 6 - Waste to Energy	Reduce/Reuse	Option 6.1 Reduce landfilling combustibles	5	1	-	3	5	recycle/reuse materials such as rubber, leather, wood fibre, cloth, etc.
No. 8 - Education & Training	5 R's	Option 8.1 Increase education and training	5	-	-	3	5	potential to improve all operations

Note: (-) signifies that the criteria is not applicable to the option.
Technical Criteria:
A - Recovery of Valuable Materials. B - Compatibility of New Equipment or Process. C - Availability and Reliability of Equipment
D - Minimizing Leachate Discharges. E - Waste Reduction Quantities

TABLE 7B Environmental Evaluation of the P2 Options

P2 Opportunities	P2 Hierarchy	P2 Options	Technical Criteria			Comments
			A	B	C	
No. 1 - Upgrading Fuel Storage Tanks	Reduce	Option 1.1 Tank replacement. Purchase environmentally safe aboveground fuel tanks	5	3	-	Reduces risk of soills
No. 2 - Enhance Recycling of Wood and Other Material	Recycle	Option 2.1 Employee Initiatives - bonus rewards and soliciting ideas from salvagers	5	1	5	Reduces risk by increasing removal of hazardous materials
	Recycle	Option 2.2 Optimize salvager Activities	5	3	5	Better chance to remove hazardous material
	Recycle	Option 2.3 Recovery of wood materials - On-site use for expanded composting operation	5	1	-	wood is recycled as soil amendment and winter road maintenance
	Recycle	Option 2.4 Recovery of wood materials - Off-site use for firewood	5	1	-	firewood
	Recycle	Option 2.5 Recovery of wood materials - Off-site use for agriculture/land reclamation	5	1	-	agricultural mulch/land reclamation
	Recycle	Option 2.6 Recovery of wood materials - Off-site use for non-structural wood	5	1	-	non-structural wood
	Recycle	Option 2.7 Recovery of wood materials - Off-site use for pulp mill/cement kiln	5	1	-	ground fibre used for pulp supply
	Recycle	Option 2.8 Recovery of salvageable materials - Central Sorting Area to increase recovery	5	2	3	improve recycling
	Recycle	Option 2.9 Recovery of salvageable materials - Increase number of salvagers	5	2	3	improve recycling
No. 3 - Enhance Recycling of Fill Material	Recycle	Option 3.1 Recovery of fill material - On-site use in landfill	5	1	-	inert, use for road base, berms and cover
	Recycle	Option 3.2 Recovery of fill material - Off-site use by Delta Topsoil	5	1	-	inert, use as landscaping soil
	Recycle	Option 3.3 Recovery of fill material - Off-site use by contractors	5	1	-	inert, use in construction
No. 4 - Improve Composting Program	Reduce	Option 4.1 Improve composting efficiency - Purchase of new/used windrower	5	1	-	minimal impact likely
	Reduce	Option 4.2 Improve composting efficiency - Pave windrowing area	5	3	-	positive impact
No. 5 - Leachate Quality	Reduce	Option 5.1 Improve leachate quality - Reduce hazardous materials from entering landfill.	5	3	5	reduce risks
	Reduce	Option 5.2 Improve leachate quality - Allow final cover to be permeable	5	3	3	impacts appear minimal
No. 6 - Recycle combustibles	Reduce/Reuse	Option 6.1 Reduce landfilling combustibles	5	1	-	potential to reduce environmental risk
No. 8 - Education & Training	5 R's	Option 8.1 Increase education and training	5	5	5	potential to reduce environmental risk

Note: (-) signifies that the criteria is not applicable to the option.

Technical Criteria:

A - Recovery of Valuable Materials. B - Compatibility of New Equipment or Process. C - Availability and Reliability of Equipment

D - Minimizing Leachate Discharges. E - Waste Reduction Quantities

TABLE 7C Economic Evaluation of the P2 Options

P2 Opportunities	P2 Hierarchy	P2 Options	Technical Criteria			Comments
			A	B	C	
P2 Opportunity No. 1 Upgrading Fuel Storage Tanks	Reduce	Option 1.1 Tank replacement. Purchase environmentally safe aboveground fuel tanks	3	5	1	Company willing to purchase new tanks
No. 2 - Enhance Recycling of Wood and Other Material	Recycle	Option 2.1 Employee Initiatives. Involves bonus rewards and soliciting ideas from salvagers	5	5	5	No out of pocket costs involved
	Recycle	Option 2.2 Optimize salvager Activities	-	5	5	May involve extra time and effort
	Recycle	Option 2.3 Recovery of wood materials - On-site use for expanded composting operation	3	3	5	not economical at this time
	Recycle	Option 2.4 Recovery of wood materials - Off-site use for firewood	1	1	1	not economical
	Recycle	Option 2.5 Recovery of wood materials - Off-site use for agriculture/land reclamation	3	3	3	contrary to business plan
	Recycle	Option 2.6 Recovery of wood materials - Off-site use for non-structural wood	3	3	3	not cost effective
	Recycle	Option 2.7 Recovery of wood materials - Off-site use for pulp mill/cement kiln	1	1	3	not cost effective
	Recycle	Option 2.8 Recovery of salvageable materials - Central Sorting Area to increase recovery	1	1	3	very exoensive
	Recycle	Option 2.9 Recovery of salvageable materials - Increase number of salvagers	3	5	3	not cost effective
No. 3 - Enhance Recycling of Fill Material	Recycle	Option 3.1 Recovery of fill material - On-site use for road base, berms, cover (base case)	3	3	3	cost effective
	Recycle	Option 3.2 Recovery of fill material - Off-site use by Delta Topsoil	3	3	5	cost effective
	Recycle	Option 3.3 Recovery of fill material - Off-site use for contractors	1	3	1	not cost effective
No. 4 - Improve Composting Program	Reduce	Option 4.1 Improve composting efficiency - Purchase of new/used windrower	3	3	5	expensive
	Reduce	Option 4.2 Improve composting efficiency - Pave windrowing area	1	1	5	expensive
No. 5 - Leachate Quality	Reduce	Option 5.1 Improve leachate quality - Reduce hazardous materials from entering landfill.	3	3	1	low cost option
	Reduce	Option 5.2 Improve leachate quality - Allow final cover to be permeable	3	4	-	no cost option
No. 6 - Recycle combustibles	Reduce/Reuse	Option 6.1 Reduce landfilling combustibles	3	5	3	very difficult, expensive
No. 8 - Education & Training	5 R's	Option 8.1 Increase education and training	3	5	3	minimal costs

Note: (-) signifies that the criteria is not applicable to the option.

Technical Criteria:

A - Recovery of Valuable Materials. B - Compatibility of New Equipment or Process. C - Availability and Reliability of Equipment

D - Minimizing Leachate Discharges. E - Waste Reduction Quantities

SECTION 8.0 DETAILED ASSESSMENT

SECTION 8.0
DETAILED ASSESSMENT AND PRIORITIZATION

8.1 INTRODUCTION

The options selected to be incorporated into the P2 plan have been further reviewed to prioritize their implementation. The overall evaluation and prioritization of the options is presented in Table 8.1.

8.2 DETAILED ASSESSMENT

Several of the options described in Section 7.0 are currently implemented or in the process of being implemented at the landfill and therefore did not receive further assessment. However, some of the options did require further evaluation, as follows:

Options 2.3 to 2.7 Recovery of Wood Materials

These options involve the recovery of a greater percentage of the wood and yard waste material accepted at the Richmond Landfill. The recovery can be enhanced by increased source separation techniques and better on-site separation through sorting and salvaging. Source separation may be achieved through differential tipping. This is currently in place for Clean Green™ yard waste and clean loads of other materials. The on-site separation may be achieved by directing wood-only and mixed yard waste only loads to separate areas for salvage and grinding.

The on-site uses for the recovered wood material include composting and road cover. The off-site uses include non-structural lumber (concrete forming) and fibre for pulp mills or fuel in boiler/cogeneration plant.

<u>On-Site Uses</u> The landfill currently processes (grinds/composts) enough yard waste (Clean Green™) and wood material to satisfy the demand for such materials by Delta Topsoil and for use as temporary road cover during the winter. The opportunity to expand the volume of soil amendments provided to Delta Topsoil is

not likely at current demand for topsoil. As this is the only feasible end use identified for recycling wood waste if it does not make economic sense then there are no feasible P2 options.

The situation is also complicated by the fact that the City of Vancouver has recently developed their own composting facility to handle yard waste and the GVRD composts biosolids for their regional landscaping needs. Compost has little market value and the current market size available to Ecowaste appears to be declining. There does not appear to be new markets for additional commercial compost. A major expansion of the compost operations at the Richmond Landfill is unlikely to be feasible considering that there is an over supply of compost in Richmond and the Lower Mainland Area in general.

Off-Site Uses The off-site uses for firewood, non-structural lumber and fibre/fuel supply for the pulp/cogeneration industries is not feasible. The costs to salvage, stockpile and administer the sale of firewood is prohibitive considering the local underground market for this product. Also the creation of new air emissions appear to make this option unacceptable. The market for non-structural wood is small and the source recycling of non-structural wood by developers and contractors is eliminating what market now exists. On the positive side, as a consequence, less and less of this waste stream is being sent to the landfill.

The use of waste wood as feedstock (fibre) at a pulp mill is marginal as the material must meet strict cleanliness specifications (no abrasive contaminants such as dried concrete). In order to meet the specifications the ground wood would have to be washed, dried and separated. It is not economically feasible to clean the wood as less expensive sources of clean fibre are available.

The use of waste wood as a feedstock for a boiler/cogeneration plant or cement kiln are less stringent and could be met by the landfill. However, again there are numerous larger sources of feedstocks available in the Lower Mainland Area to make this not economically feasible at this time. The use of wood waste as fuel for cement kilns is in the experimental stages in Canada. There is currently a test burn

planned for a cement kiln in Quebec. The results from this burn may influence future use of wood waste at cement kilns in the Lower Mainland Area.

It is recommended that these options be reviewed in the future to determine their ongoing feasibility, either individually or in combination with one another.

Options 2.8 and 2.9 Recovery Of Salvageable Materials

This opportunity involves the enhanced recovery of traditional recyclables. Recovery could be enhanced by increasing the number of salvagers and/or the construction of a central sorting area. The increased recovery could be extended to non-traditional salvageable materials once they have been identified in the waste stream and recycling methods developed.

The three options assessed include increased number of salvagers, manual central sorting area and a mechanized central sorting area.

The option to increase the number of salvagers was found to be marginally uneconomical. The option of constructing a central sorting area was not economically feasible over a 15 year time horizon. The largest unknowns (assumption) in the economic analysis were the revenues which could be generated by each of the options.

The option to construct a central sorting area requires building a concrete or asphalt pad with associated features to make sorting and recycling more efficient. This requires a proper foundation design and an engineered sorting structure. There are a range of options from a simple manually operated facility to a complex automated mechanical sorting facility. The planning, design, construction and commissioning of a simple to moderately mechanized facility could take upward of one year to implement.

Options 3.1 to 3.3 Recovery of Fill Materials

The recovery of fill can be enhanced by source separation but this is not likely considering the source of these materials. The primary method of segregation is on-site screening.

The landfill currently accepts and processes materials for on-site uses and there is room for expanding these activities. Future projects at the landfill (eg. expansion of the northern portion of the landfill) may create further needs for certain fill materials (clay, soil/sand and gravel). The need for these types of materials for closure and road construction will drive their recovery from the landfill.

If Delta Topsoil requirements increase and other demands increase it may be economically feasible to construct a temporary sorting and screening facility to process more fill materials into end products. This is not the case at the moment and the operation of an aggregate plant is not feasible due to the low quantities available at the landfill.

It is recommended that the first two options be implemented when the need arises.

Options 4.1 and 4.2 Increase Efficiency of Composting

These options involve increasing the efficiency of the compost operation to increase production. The operation could be made more efficient by paving the compost facility surface and/or using a windrow turner to aerate the windrows year round. These options are evaluated in Table 8.

The landfill currently produces enough compost for all on-site uses. The only feasible option to increase compost production and warrant increasing the efficiency of the compost operation is increasing the production of Delta Topsoil. The market outlook for increasing production is unknown, therefore production at Delta Topsoil should be left as is and be driven by market demand. As with the recovery of wood waste, this opportunity is affected by future competition from the City of Vancouver Compost Facility, the GVRD biosolids compost program and other private compost operations.

There is potential for these options to be feasible depending on the market for compost. If revenues from the sale of compost could be increased, these options

would become feasible. It is recommended these options be reviewed in the future to assess demand.

Options 5.1 and 5.2 Improve Leachate Quality

These options involve minimizing the landfilling of materials that generate hazardous by-products. This can be achieved by improving sorting and additional salvaging activities.

The option of identifying the materials and educating salvagers to remove these items from the active face is most economical considering the very small quantities of these materials (incidental) entering the active face. There is no benefit in increasing the number of salvagers for this alone, considering the potential limited benefits and there are no benefits identified with making changes to the current operating procedures (such as landfilling strategies or developing a central sorting area). However any information which can improve leachate quality should be formally transmitted to all employees. Education of landfill employees is an on-going process and is the best way of identifying and preventing hazardous materials from entering the landfill.

Due to the current effluent compliance with the permit conditions and the current operational standards in place at the landfill there does not appear to be any reason why the landfill should not continue to generate leachate after closure. There appears to be no rationale for entombment of the landfill at closure. Upon closure, the landfill cap should be permeable. In addition, surface runoff does not have to be diverted away from the landfill and can continue to migrate into the site as it does now.

The recommendation that the landfill cap at closure be permeable is consistent with section 6.3 of the B.C. Ministry of Environment's "Landfill Criteria for Municipal Solid Waste" which states that the cap design (or final cover) may be approved based on leachate generation potential. In this case the current leachate is non-toxic and operational procedures are better now than they were in the past resulting in a better quality leachate. Thus the landfill should be allowed to continue to flush naturally. This has significant implications for designing the

leachate treatment system for closure and the post-closure costs and monitoring requirements. This option should be a central feature of the final closure plan.

Option 6.1 Reduce Landfilling of Combustibles

This option involves the recovery of combustible materials from the landfill and stockpiling them for future use at an industrial plant or cogeneration facility. It is not likely that there is enough material at the landfill to meet the needs for a cement plant or cogeneration facility, however, future supply and demand is unknown. However, as material bans are implemented by current and future regulations, this option may gain more value. There may also be opportunities to reduce landfilling combustible materials on a regional basis (as a waste disposal and/or power generation alternative for the Greater Vancouver Regional District), however it is beyond the scope of this P2 planning study.

This option could be implemented in the future by the Richmond Landfill if it becomes economically feasible. This option should be reviewed in the future as regulations change.

8.3 PRIORITIZATION

The technical, environmental and economic criteria ratings applied to the options of each P2 opportunity have been added together to provide a total for each category as shown in Tables 8. These totals have been recorded in relation to the total possible score for each category and normalized into a decimal fraction for each criteria category. These fractions are added together to get a total score and are again normalized. The normalized decimal fraction enables the P2 opportunities to be prioritized according to their total normalized score.

TABLE 8.1: Pollution Prevention Options Ranking

P2 Opportunities	P2 Options	Evaluation					Comment
		Tech.	Env.	Eco.	Score	Rank	Rank
No 1 - Fuel Tank Replacement	Option 1.1 - Purchase environmentally safe aboveground fuel tanks	10/10	8/10	7/10	0.77	6	2 tanks to replace
No. 2 - Enhance Recycling	Option 2.1 - Bonus pool and soliciting ideas from salvagers	10/10	11/15	15/15	0.90	2	Already implemented
	Option 2.2 - Optimize salvaging operations	15/15	13/15	10/10	0.95	1	Implemented
	Option 2.3 - On-site use for expanded composting operation	16/20	6/10	11/15	0.73	9	Compost Market Study may identify areas of opportunity
	Option 2.4 - Off-site use for firewood	16/20	6/10	3/15	0.56	18	Not feasible
	Option 2.5 - Off-site use for agriculture/land reclamation	16/20	6/10	9/15	0.73	9	Market Study
	Option 2.6 - Off-site use for non-structural wood	16/20	6/10	9/15	0.73	9	Not feasible
	Option 2.7 - Off-site use for pulp mill/cement kiln	16/20	6/10	5/15	0.60	17	Market Study
	Option 2.8 - Central Sorting Area	13/25	10/15	5/15	0.51	19	Not feasible, revenue study may identify areas of opportunity
	Option 2.9 - Increase number of salvagers	16/20	10/15	11/15	0.74	7	Not feasible, revenue study may identify areas of opportunity
No. 3 - Recovery of Fill Materials	Option 3.1 - On-site screening	20/20	6/10	9/15	0.78	5	Implement when needed
	Option 3.2 - Off-site use by Delta Topsoil	20/20	6/10	11/15	0.82	4	Implement when needed
	Option 3.3 - Off-site use for contractors	20/20	6/10	5/15	0.69	13	Not feasible
No. 4 - Improve Composting Program	Option 4.1 - Purchase windrower	11/15	6/10	11/15	0.70	12	Compost market study may identify areas of opportunity
	Option 4.2 - Paving of Windrowing area	10/15	8/10	7/15	0.63	16	Compost market study
No. 5 - Leachate Quality	Option 5.1 - Reduce hazardous materials from entering landfill	14/20	13/15	7/15	0.68	15	Implement as needed
	Option 5.2 - Allow final cover to be permeable	8/10	11/15	7/10	0.74	7	Review option in future, implement if needed
No. 6 - Waste to Energy	Option 6.1 - Reduce combustible material from being landfilled	14/20	6/10	11/15	0.69	13	Not feasible at this time
No. 8 - Education and Training	Option 8.1 - Training and communications	13/15	15/15	9/15	0.87	3	Enhance existing education and training

SECTION 9.0 POLLUTION PREVENTION PLAN

SECTION 9.0
POLLUTION PREVENTION PLAN

9.1 IMPLEMENTATION

The prioritization and implementation schedule for each P2 option selected as being both feasible and economically viable at this time is shown in Table 9.1. A number of options were deemed not to be feasible in Section 8.0, some of which may become feasible in the future.

Option 2.2 Optimize Salvage Operations

The first item in the P2 plan is optimization of salvaging activities. Improvements to the salvaging program has been a focus over the past few years. Improvements to spreading the loads has improved the recycling of materials. This will continue to be a focus at the landfill.

Option 2.1 Bonus Pool and Salvager's Suggestions

The second item in the P2 plan is the option to formalize the bonus pool and salvager's suggestions to improve the recycling activities at the landfill. A program currently exists whereby the revenue from selling recycled materials is placed into a bonus pool to be shared by the company (to cover costs) and the salvagers. This option is an attempt to enhance this program as much as possible.

Option 8.1 Education and Training

The third item in the P2 plan involves continuing education and training. Education and training will be formalized into routine operating procedures when the operations manual is developed so that it becomes a part of the landfill procedures. It is believed that this will maintain the high standards currently in place at the landfill. The operations manual is to be prepared in 1996.

Option 3.1 On-site Screening of Fill Material

The forth item in the P2 plan involves the segregation of fill materials into their constituent components (soil, sand, gravel, cobbles, rocks and miscellaneous debris) for on-site use. The primary method of segregation will be on-site screening. There will be a high demand for sand and soil (cover materials) when the landfill closes in late 1997 and/or 1998.

The screening plant would be required to segregate overs (rocks and boulders over 6 inches), soil and sand (0.25 minus), gravel (3.0-0.25 inch) and cobbles (6-3 inch).

Implementation would require installation of a leased portable screening plant with its associated machinery and conveyor systems. This is not a major capital project and would take one month to mobilize and be ready to operate. Costs are approximately $10,000/month to lease the screening plant plus O&M plus labour to operate.

Option 3.2 Off-site Use by Delta Topsoil

The use of soil from the landfill by Delta Topsoil is currently economical only if they are delivered as clean loads that require not additional processing. Fill that requires additional processing to remove overs is too expensive at present.

The implementation schedule for this option is dependent on market demand. AS the demand rises the feasibility for this option improves.

Option 1.1 Double Walled Fuel Tanks

The fuel tank replacement program for the equipment and Delta Topsoil will continue this year and be completed in 1997.

Option 2.9 Increase Number of Salvagers

It is not anticipated that this option would be implemented until there are changes to the regulations requiring additional recycling of specific materials to be mandatory.

Option 5.2 Leachate Quality

We believe that making the cover for the closed landfill permeable is beneficial in the long term. However, there is a requirement for research to better present the case for a permeable cover upon closure. This research should be carried out in 1997.

Option 2.3 Increase the On-site Use of Compost

At the time of closure of the existing portion of the landfill there will be a need for topsoil to be applied to the landfill cap. This presents the landfill with an opportunity to use compost materials on-site. This will be a short term demand for compost and the production of additional compost should begin in 1997.

We do not foresee any long term demand for the use of compost on-site other than at the completion of the next phase of landfilling at approximately 2020.

Option 5.1 Reduce Hazardous Material Entering the Landfill

Ecowaste currently conducts inspections to look for potentially prohibited materials and requires soil testing on materials that are suspected of being contaminated. It is important to know the breakdown products of certain construction materials to ensure that materials landfilled today wont one day become hazardous or generate a hazardous leachate. This will require continual education of salvagers and others who have responsibilities for inspections and approval of landfill materials.

9.2 OPTIONS NOT PURSUED

There are a number of options that were not feasible at this time due to a variety of reasons. Markets may change in the future to make these options feasible or regulations may change to demand their implementation. At this time, however, the following options are not scheduled for implementation.

The volume of wood suitable as fire wood (option 2.4) or for agricultural uses or land reclamation (option 2.5) or industrial uses (options 2.6, 2.7 and 6.1) that is generated by the landfill is too small to warrant the marketing initiatives that would be required to make this profitable for the company. There are simply too many other sources of cheaper wood residues in the Lower Mainland Area to make these options feasible for Ecowaste in the foreseeable future.

A central sorting facility (option 2.8), whether mechanically driven or labour intensive is not warranted at this time because it is uneconomical and provides no tangible benefits to the environment. Again, due to the size of the landfill, the types of materials entering the facility and the location in Richmond this option does not appear that it will be feasible in the future as well. These options will not be pursued until the market for wood residues improves.

Increasing off-site use of compost (options 3.3, 4.1 and 4.2) produced by the landfill by landscape contractors is limited because there are cheaper alternatives and there is an abundance of topsoil in the Lower Mainland Area. There is simply no free market for compost. With the GVRD and the City of Vancouver generating their own compost these markets are declining. Again, until the market for compost improves these options will not be pursued.

TABLE 9.1: Pollution Prevention Plan

P2 Opportunities	P2 Options	Schedule	Comments
No. 2 - Enhance recycling	Option 2.2 - Optimize salvage operations	1996/97	Continual improvement
	Option 2.1 - Bonus pool and salvager's suggestions	1996	Formalize existing program
No. 8 - Education and Training	Option 8.1 - training and communications	1996	Will help maintains high standards of operation
No. 3 - Recovery of Fill	Option 3.1 - On-site screening	Implemented when needed	Review option when material is needed for landfill closure
	Option 3.2 - Off-site use by Delta Topsoil	Implement when needed	Review option if topsoil market expands
No. 1 - Fuel tank replacement	Option 1.1 - Environmentally safe aboveground fuel tanks	1996/97	To be purchased as soon as possible
No. 2 - Enhance recycling	Option 2.9 - Increase number of salvagers	Not feasible at present	Regulatory changes could make this feasible
No. 5 - Leachate quality	Option 5.2 - Allow final cover to be permeable	Implement at closure, 1997/98	Best ecological option for closure
No. 2 - Enhance recycling	Option 2.3 - On-site use for expanded composting operation	Implement when revenues make sense, 1998/1999	Market needs to improve for this to be feasible
No. 5 - Leachate Quality	Option 5.1 - Reduce hazardous materials from entering landfill	Implement, 1997	Continue to educate salvagers

SECTION 10.0 TRACKING AND MONITORING

SECTION 10.0
TRACKING AND MONITORING

10.1 INTRODUCTION

The following section describes the monitoring program for tracking the progress of the P2 Plan. The monitoring plan will provide for both qualitative and quantitative measures of progress. Due to the nature of the industry, it is difficult to set specific quantifiable goals. Changes in the incoming waste stream are uncontrollable, therefore so is the amount of recyclable material. However, any changes implemented will be measured on a normalized basis to try and remove this bias. The evaluation of the P2 options will be based on the quantities of materials and operating conditions of 1995, presented in the Stage I Report.

Monitoring programs have been developed for all P2 options, however some of the options will not be implemented unless the economics of the option warrant their implementation.

10.2 MONITORING PROGRAM

10.2.1 Employee Recycling Incentive

This option can be directly quantified by total volumes received at the landfill and the quantities of salvaged and recycled materials per salvager. This option is controlled by the incoming waste stream, therefore the waste stream will have to be monitored to determine any events which may have significant impact on the amount of recyclables actually in the waste stream. The review of incoming wastes will be used to provide a qualitative evaluation of the actual volumes and quantities of recycled materials. This option falls under the category of optimizing recycling efforts.

10.2.2 Increase Number of Salvagers

The effectiveness and efficiency of increasing the number of salvagers can also be directly quantified by volumes and quantities of salvaged and recycled materials per salvager. This option will be optimized by determining the incremental increase in quantities of recyclable materials per salvager. This option is also controlled by the incoming waste stream, therefore the waste stream will have to be monitored to determine any events which may have significant impact on the amount of recyclables actually in the waste stream. The review of incoming wastes will be used to provide a qualitative evaluation of the actual volumes and quantities of recycled materials. This option falls under the category of optimizing recycling efforts.

10.2.3 Recovery of Wood Waste

Improvements made to the process of wood waste recovery can be monitored as an increase in the production and use of compost. The 1995 baseline of compost production will be used as a benchmark to evaluate this initiative. The use of compost is influenced by Delta Topsoil production which is driven by market demand for compost. These influences may make the evaluation semi-quantitative.

10.2.4 Recovery of Fill Materials

This option can be evaluated by determining the changes in production at Delta Topsoil (direct diversion of fill from active face) and use of fill materials for certain operations at the landfill. These include stockpiling cover materials and road materials. The 1995 baseline production of Delta Topsoil will be used as a benchmark to evaluate this initiative. The need for fill materials is dependent on market demand for topsoil and may make the evaluation semi-quantitative. The quantities of fill materials diverted from the active face for other on-site use will also be used to evaluate progress. This will be influenced by specific site needs for screened material.

10.2.5 Recovery of Salvageable Materials

This option can be directly quantified by volumes and quantities of salvaged and recycled materials per salvager and optimized with the start-up costs of a central sorting area and/or level of staffing. This option is also dependent on the incoming waste stream, therefore the waste stream will have to be monitored to determine any events which may have significant impact on the amount of recyclables actually in the waste stream. The review of incoming wastes will be used to provide a qualitative evaluation of the actual volumes and quantities of recycled materials. This option falls under the category of optimizing recycling efforts.

10.2.6 Increase Efficiency of Composting Operation

The progress of this option can be observed directly through total production and processing time, and these will be optimized with production costs including capital and operating costs. The 1995 baseline of compost production will be used as a benchmark to evaluate this initiative. The progress will be influenced by Delta Topsoil production as well as market demand. These influences may make the evaluation semi-quantitative.

10.2.7 Reduce Leachate Generation and Contaminant Loading

This option will be implemented upon closure of the existing landfill and the reconfiguring of the leachate treatment facility. The final plans for leachate treatment have not been developed, due to the extended timeline and uncertainty of requirements at closure. This option will be directly measured as any reduction in leachate or contaminants to be treated. The goal for this option is to optimize the cost of the leachate treatment facility and the volume of leachate to be treated.

REFERENCES

REFERENCES

BC Environment, *A Guide to Preparing a P2 Plan - Draft*, June, 1995.

Ecowaste Industries Ltd., *Compost Manual*, Richmond, BC, 1995.

Ecowaste Industries Ltd., *Richmond Landfill Operations Manual - Draft*, Richmond BC, unpublished.

Ecowaste Industries Ltd., *Water Quality Data Summaries*, Richmond, BC, January, 1995.

Fraser River Estuary Management Program, The Fraser River Estuary, Environmental Quality Report, October, 1996.

GNH Engineering, *Preliminary Closure Plan - Richmond Landfill*, Delta, BC, January, 1996.

Golder Associates Ltd., *Site Investigations and Conceptual Designs Proposed Ecowaste Landfill Expansion Richmond, BC*, Burnaby, BC, August, 1994.

Integrated Resource Concultants Inc., *East Richmond Landfill Fisheries Assessment*, Richmond, BC, October, 1994.

Khevin Development Services, *Application by Ecowaste Industries Ltd. to Agricultural Land Commission Under the Soil Conservation Act*, Richmond, BC, July 16, 1992.

Ministry of Environment, Lands and Parks, *Permit PR-04922*, Environmental Protection, Surrey, BC, amended March, 1995.

Ministry of Environment, Lands and Parks, *Permit PE08036*, Environmental Protection, Surrey, BC, amended June, 1993.

PCA Consultants Ltd., *Reference Workbook: Pollution Prevention Plans*, Environment Canada - Fraser River Action Plan, North Vancouver, BC, December, 1994.