FRASER RIVER ACTION PLAN

Technical Pollution Prevention Guide for Ready-mixed Concrete Operations in the Lower Fraser Basin

DOE FRAP 1997-13

Environment Canada Environnement Canada

TECHNICAL POLLUTION PREVENTION GUIDE FOR READY-MIXED CONCRETE OPERATIONS IN THE LOWER FRASER BASIN

DOE FRAP 1997-13

Prepared for:

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

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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.

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ABSTRACT

The guide gives a brief description of the ready-mixed concrete industry and identifies environmental issues unique to this industry. It then provides a study methodology to enable plant operators to carry out a disinterested review of possible sources of pollution within their own facilities. Lastly, the document offers suggestions to the industry for the development of pollution prevention programs.

Preparation of this guide was financed by the Fraser Pollution Abatement of Environment Canada.

RÉSUMÉ

Ce guide fournit une brève description de l'industrie du béton prêt à l'emploi et des problèmes environnementaux particuliers à cette industrie. Il propose également une méthode d'étude aux gestionnaires afin de les aider à mener à bien un examen objectif des sources de pollution potentielles à l'intérieur de leurs installations. Enfin, le document offre à l'industrie une série de suggestions sur la façon d'élaborer un programme de prévention de la pollution.

L'élaboration de ce guide a été financée par le Bureau de dépollution du Fraser d'Environnement Canada.

Highlights

of

Technical Pollution Prevention Guide

for Ready-Mixed Concrete Operations
in the Lower Fraser Basin

Identification of Pollution Prevention
in a
Normal Process Operation

Purpose:

- To review the entire ready-mixed concrete operation in order to identify all areas of waste generation and water use.

- To focus on areas with greatest potential for cost-benefits associated with pollution prevention.

Activities:

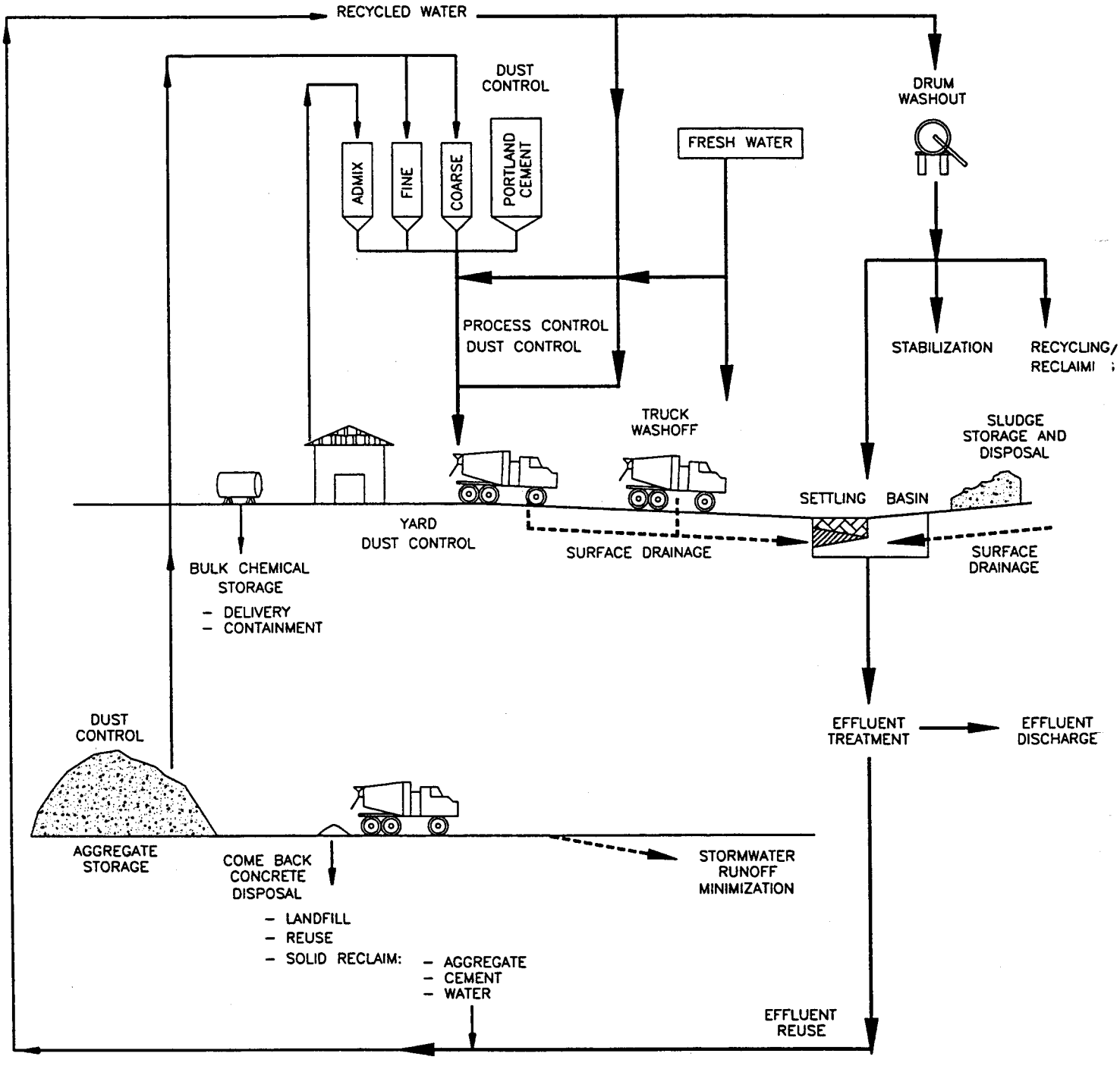
- Follow process from beginning to end to observe operating procedures and to identify all waste streams. Use Figure 2.2 as a guide.

- Using Worksheets 9 and 10, attempt to identify quantities of waste streams and evaluate existing recycling efforts.

- Use Worksheet 11 to identify potential pollution prevention areas relative to objectives stated in Appendix II.

Figure 2.2

Pollution Prevention Components for a Ready-Mixed Concrete Facility



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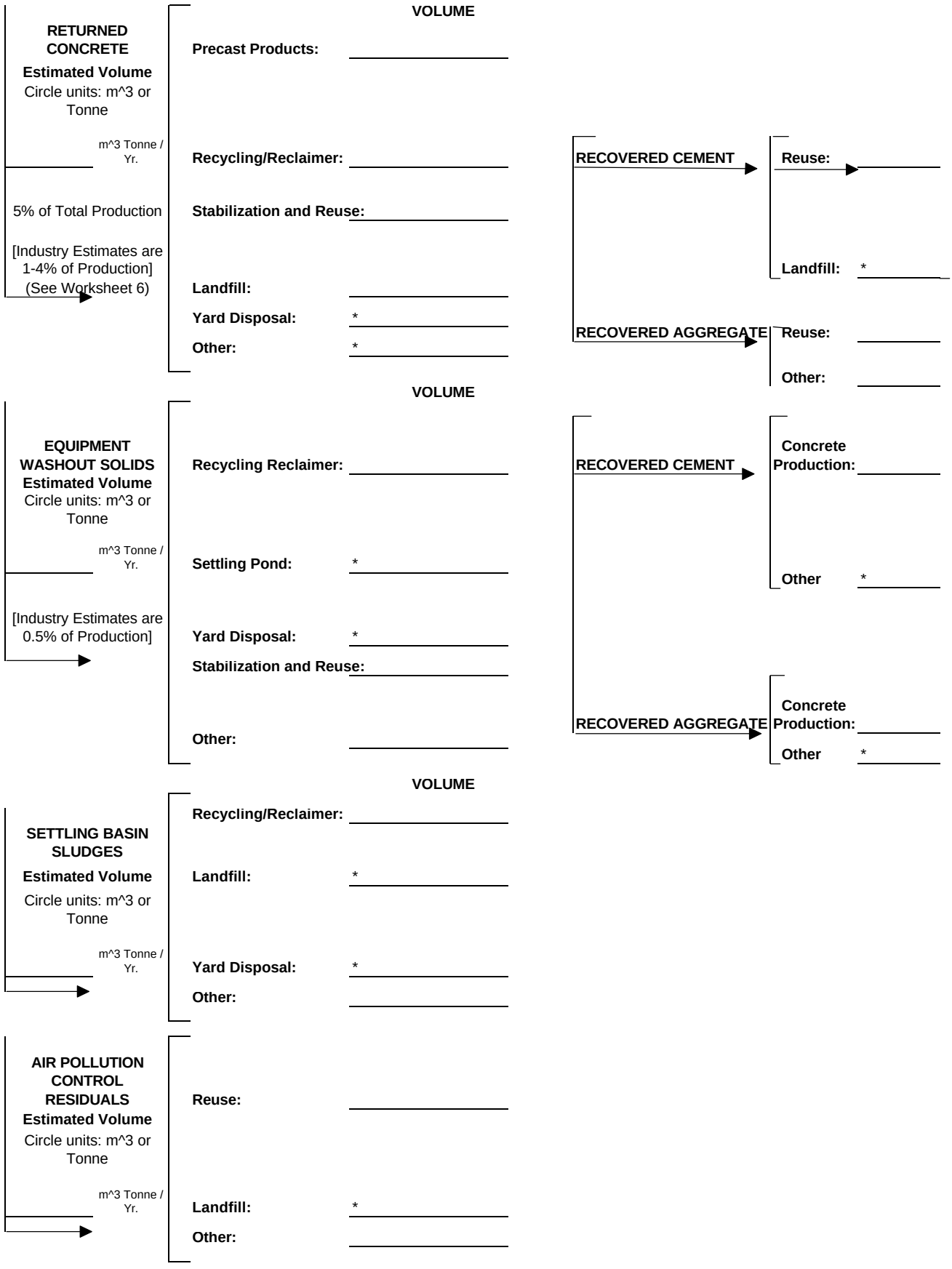
Worksheet 9

Completed By: Date:

Solid Waste Stream Diagram



MISCELLANEOUS SOLID WASTES

SLUDGES

Volume: _____

Disposal Method: _____

BATTERIES

Volume: _____

Disposal Method: _____

CHEMICAL CONTAINERS

Volume: _____

Disposal Method: _____

OTHER SOLID WASTES IDENTIFIED IN PLANT REVIEW (e.g., Chemical Residual)

Volume: _____

Disposal Method: _____

DISPOSAL COSTS:

(Annual)

CONCRETE SLUDGES $ _____

MISCELLANEOUS $ _____

Worksheet 10
Completed By: Date:

Assessment of Water Use and Recycling

ACTIVITY	% FRESH WATER	% RECYCLED WATER
Concrete production		
Truck wash		
Drum washout		
Point source dust control		
Other uses: boiler		
hot water production		
Total freshwater use:		
Stormwater: % controlled (into treatment system)		
% uncontrolled		

Worksheet 11
Completed By: Date:

Assessment of Current Pollution Prevention Measures

Objective: To evaluate current practices *versus* pollution prevention concepts outlined in Appendix 2.

Re: Concept 1	**Reduction of use of toxic substances, raw materials and non-renewables.**			
	1.1	Are preventive measures in place to avoid "off-spec" concrete, (e.g., periodic testing of scales, batch gate operation, etc.)?	No	Yes
	1.2	Is an operator's manual available?	No	Yes
	1.3	Is regular operator training provided?	No	Yes
	1.4	Is water conservation practiced by restriction of freshwater uses to purposes such as: · truck exterior washoff? · hot water production? · batch waters for high quality concrete?	No	Yes
	1.5	Are flow controls installed on freshwater sources?	No	Yes
Re: Concept 2	**Reuse of recovered raw material, products and hazardous substances.**			
	2.1	Are volumes of returned concrete minimized (i.e., less than 2.5% of total production volume)?	No	Yes
	2.2	Is all returned concrete either: · reused (precast products, road base, etc.); or, · recycled (reclaimed)?	No	Yes
	2.3	Are all air pollution control residues reused?	No	Yes
	2.4	Are all drum washout solids reused or recycled?	No	Yes
	2.5	Are settling basin sludges reused or recycled?	No	Yes
	2.6	Is 100% of the process water (drum washout, truck wash) reused?	No	Yes
	2.7	Is collected yard stormwater used for washdown, etc.?	No	Yes
Re: Concept 3	**Elimination or minimization of environmental releases.**			
	3.1	Are spills of cement and concrete cleaned up immediately?	No	Yes
	3.2	Is the process area paved and curbed to collect processing water for treatment and/or recycling?	No	Yes
	3.3	Is the pavement and curbing in good condition (i.e., no cracks)?	No	Yes

	3.4	Is the size of the processing area minimized and/or roofed to reduce exposure to rainfall?	No	Yes	
	3.5	Is yard stormwater diverted from the process area?	No	Yes	
	3.6	Are oil separators installed in truck wash areas and other areas where oil releases may occur?	No	Yes	
	3.7	Are measures taken to ensure proper dust control during transfer of cement and fly ash?	No	Yes	
	3.8	Are aggregate piles designed to minimize fugitive dust control (e.g., minimal surface area, storage bins, covers)?	No	Yes	
	3.9	Are high vehicle traffic areas paved?	No	Yes	
	3.10	Is the traffic system controlled (e.g., low speed limits, one-way traffic to separate dirty from clean vehicles)?	No	Yes	
	3.11	Are paved portions swept to remove accumulated dust?	No	Yes	
Re: Concept 4	**Recycling of recovered materials off-site.**				
	4.1	If all concrete and sludges are not recovered on-site, are the materials used off-site (e.g., road base)?	No	Yes	NA
Re: Concept 5	**Treatment of non-recoverable waste with a focus on recovery and minimization of residues.**				
	5.1	Is there a system (e.g., settling basin) for treatment of excess water?	No	Yes	
	5.2	Does the treatment system enable pH control?	No	Yes	
	5.3	Is the process area minimized (i.e., <10% of total yard area)?	No	Yes	
	5.4	Does routine monitoring of effluent quality occur?	No	Yes	
	5.5	Is the wastewater holding basin of sufficient volume to manage all effluent in high precipitation events?	No	Yes	
	5.6	Can concrete fines and aggregates be removed from the basins?	No	Yes	
	5.7	Is unusable sludge disposed of in approved facilities?	No	Yes	
	5.8	Are admixture and other chemical containers returnable to the supplier?	No	Yes	
	5.9	Are all chemicals no longer in use removed from the site?	No	Yes	

Re: Concept 6	**Safe disposal of wastes.**			
	6.1	Are lead batteries, solvents, waste oils, etc., stored in secure locations?	No	Yes
	6.2	Are lead batteries, solvents, waste oils, etc., recycled?	No	Yes
	6.3	Are operating procedures for waste disposal adequately defined?	No	Yes
	6.4	Has management confirmed that approved facilities are used for waste disposal?	No	Yes
	6.5	Is all documentation at hand for transport manifests, certification of destruction, etc.?	No	Yes
Re: Concept 7	**Safe handling of chemicals and products to ascertain that no site contamination or sudden releases occur.**			
	7.1	In addition to points in worksheet 8, are aboveground piping and valves visible and labelled?	No	Yes
	7.2	Are tank materials and designs as per all applicable codes and manufacturers' recommendations?	No	Yes
	7.3	Are spill response equipment, absorbents and personnel protection equipment provided?	No	Yes
	7.4	Is worker training for spill response provided?	No	Yes
	7.5	Are signs in place to identify contents of bulk tanks and drums?	No	Yes

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Acknowledgements

The preparation of this guide considered pollution prevention guides published by PCA Consultants Ltd. (1994), the U.S. EPA (1992), and the Oregon Department of Environmental Quality (1990), as well as other documents included in the bibliography. Ms. Betsy Gordon provided technical editing services.

1.0 INTRODUCTION

The purpose of this document is to provide a technical guide for the development of pollution prevention (P2) plans for ready-mixed concrete facilities in the Lower Fraser Basin of British Columbia.

Coarse and fine gravel aggregates, Portland cement, air, admixture chemicals and water are used to produce concrete for residential and commercial building construction. Portland cement reacts chemically with water to form a crystalline paste which solidifies and incorporates the aggregates into a stone-like mass with strength properties suitable for construction.

Fully hydrated cement in hardened concrete does not pose an environmental problem. However, waste waters and solids, which contain partially and/or non-hydrated cement particles are generated at ready-mixed facilities during the production of concrete. Environmental concerns may result if proper collection and treatment of these wastes do not occur. In addition, the industry utilizes bulk liquids such as fuels and muriatic acid which requires proper handling to prevent environmental releases.

1.1 Regulatory Initiatives

In June 1995, Ms. Sheila Copps, Federal Minister of the Environment announced the formal initiation of "Pollution Prevention - A Federal Strategy for Action" (Government of Canada, 1995). The intent in the words of the Minister is "to prevent, rather than control pollution"; "to eradicate the causes of pollution instead of just treat its symptoms". The Federal Government defines pollution prevention as:

> "The use of processes, practices, materials, product, or energy that avoid or minimize the creation of pollutants and waste, and reduce overall risk to human health or the environment."

The Federal action plan will incorporate many features, such as:

- the use of pollution prevention across all Federal Government activities;

- incorporation of pollution prevention into Federal Legislation; and,

- fostering a national pollution prevention effort with provincial governments in developing pollution prevention strategies.

P2 planning takes into account technical, environmental and economic factors in the identification of the best P2 opportunities for the site.

As part of the national pollution prevention effort and the Fraser River Ecosystem Initiatives Program, the Fraser Pollution Abatement Office has established a goal of reducing pollutants discharged to the Fraser River. One mechanism to achieve the goal is to develop a pollution prevention manual for industrial sectors so that voluntary environmental review programs can be conducted with the view of minimizing the creation of pollutants and wastes. The industries include wineries, dry bulk terminals, dairy processing, fruit and vegetable processing, fish processing, automobile recyclers and ready-mixed concrete facilities.

1.2 Objectives of Pollution Prevention Manual

Environment Canada contracted Envirochem Special Projects Inc. to prepare a Technical Pollution Prevention Guide for the Ready-Mixed Concrete Industry in support of the above mentioned national and regional initiatives.

This guide consists of two principal sections:

(1) Background information with respect to:

- an overview of the ready-mixed concrete industry in B.C.;
- a description of the ready-mixed concrete process;
- identification of potential pollution sources and releases;
- potential impact of releases;
- existing "best management practices"; and,
- status of existing control measures and pollution prevention performance.

This background information is provided in Appendices I and II.

(2) A detailed procedure to perform an environmental review and assessment of a facility in order to define possible pollution prevention opportunities at ready-mixed concrete plants.

As mentioned previously, pollution prevention is the use of processes, practices, or materials and energy that avoid or minimize the creation of pollution or wastes, and therefore, pollution prevention must utilize a holistic approach for reducing pollution by minimizing the generation of waste residuals rather than just treating residuals after they are produced. This guide, therefore, focusses on the following pollution prevention concepts identified within the Federal strategy and by BC Environment (1995):

- avoidance, elimination or substitution of polluting products;
- reduction of the use of polluting products;
- elimination and reduction of polluting by-products;
- treatment and containment of polluting residual by-products; and,
- remediation of contaminated sites.

This guide does not address:

- off-site manufacture of cement;
- off-site transport of concrete;
- off-site transport of raw materials, products, residues and wastes;
- off-site treatment of wastes;
- life cycle management of products;
- energy recovery;
- aggregate, admixture and cement production;
- noise;
- identification and recommendation of alternative concrete manufacturing materials; and,
- evaluation and cost-benefits of product substitution (e.g. metals or cementitious materials).

2.0 POLLUTION PREVENTION GUIDE

This guide is intended for use by the ready-mixed concrete industry to assist in the review of industrial ready-mixed operations and in the development and implementation of pollution control strategies. The guide consists of a series of worksheets which will aid the development of a pollution prevention plan.

Pollution prevention is the process of examining a facility to determine its pollution or residual generation, and then to identify, evaluate and implement options that will reduce the amount of pollution or residuals. The pollution prevention process is a multi-step process which is described in Table 2.1.

The key elements of this pollution prevention process are summarized on Figure 2.1. It is intended that Appendices I and II will provide adequate background information to assist in the understanding of the ready-mixed concrete process, the potential environmental concerns, and pollution prevention options.

Example worksheets are provided in this guide to illustrate the necessary detail required for a pollution prevention review and for the development of pollution prevention plans. All references to surnames, tradenames, locations, etc., on the examples are intended to be hypothetical. Technical details, including costs and industry status in the example worksheets, are included for illustration purposes only.

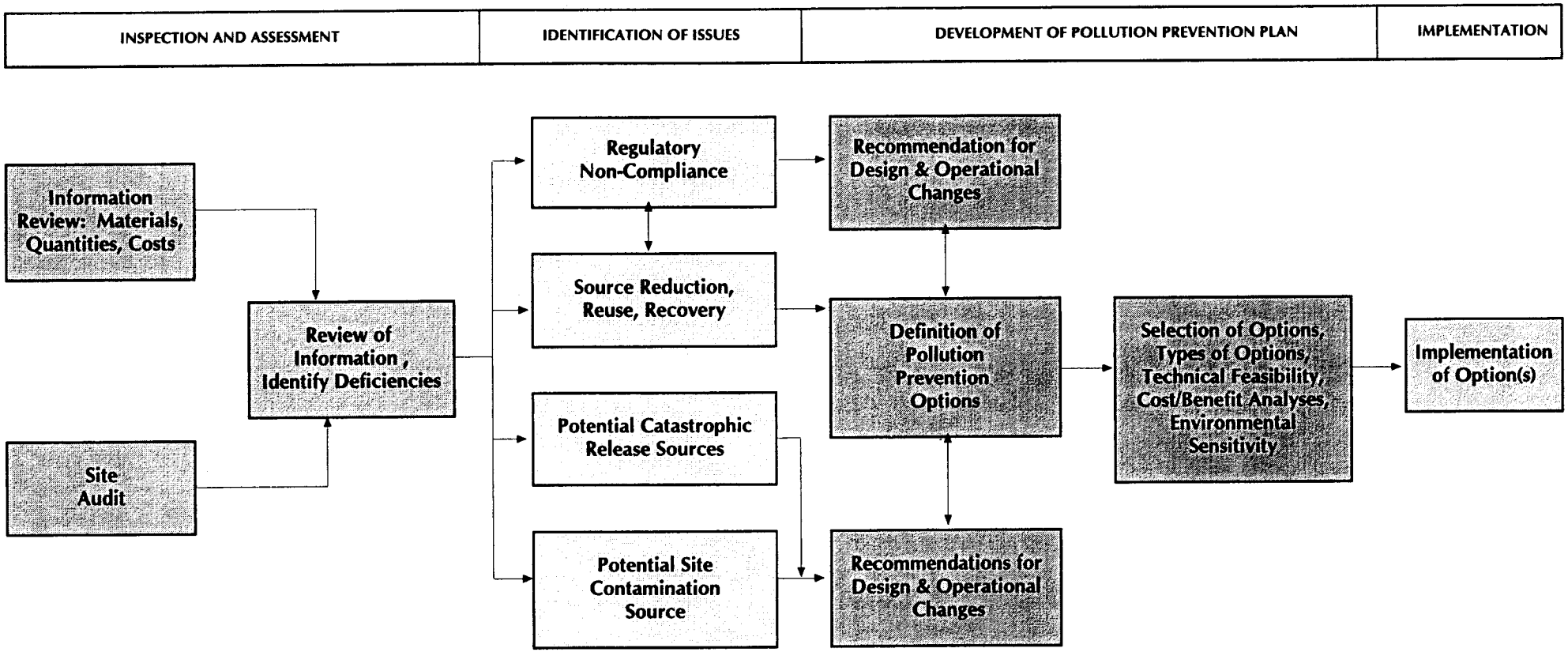
The Pollution Prevention Plan can be undertaken even if all information is not available. However, as much information as reasonably possible should be provided.

Table 2.1: Pollution Prevention Plan Development Overview

STEP	TASK DESCRIPTION/PURPOSE
1. Initial Planning and Organization	- Obtain management commitment for the program. - Develop pollution prevention goals. - Select team members to develop pollution prevention plans. - Establish timeline for development of pollution prevention plans. - Develop employee awareness of the program and its goals.
2. Team Member Pre-inspection Activities	- Review pollution prevention protocols. - Understand all industrial processes (including pollution control) used at site. - Identify site-specific environmental sensitivity characteristics. - Compile plant data (permits, raw material usage and costs, operating manuals, audits, etc.). - Identify and obtain missing information. - Understand the technical state of the art and best management practices.
3. Conduct Detailed Assessment	- Inspect facility. - Identify sources of existing and potential substance releases. - Compare operations to best management practices. - Determine existing waste generation and water consumption levels. - Identify causes and opportunities for pollution prevention. - Prepare summary of findings. - Revisit operation if necessary to verify any existing or potential concerns.
4. Develop Pollution Prevention Plan	- Rank the significance of the sources or releases. - Identify any non-compliance regulatory issues and report to management immediately. - Identify pollution prevention options. - Conduct financial and cost/benefit prevention options.
5. Write Pollution Prevention Plan	- Report results and obtain corporate commitment. - Determine appropriate schedule for pollution prevention options.
6. Implementation	- Implement pollution prevention options according to plan. - Implement worker training and education.
7. Assess Progress	- Monitor pollution prevention progress. - Provide for continuous improvement in product quality.

Figure 2.1

Implementation Process
Pollution Prevention



2.1 Step 1: Initial Planning and Organization

2.1.1 Task 1.1: Select Team Members

Purpose:

To select a team with sufficient technical, business and communication skills to develop a facility-specific pollution prevention plan.

Activities:

(1) Select team members responsible for the development of the pollution prevention plan.

(2) Appoint a team leader.

(3) Determine responsibilities of team members.

Comments:

In addition to substantial technical, business and communication skills, the team members should have thorough knowledge of the company. The key areas of expertise to consider include:

- process design;
- environmental;
- quality control;
- production and maintenance;

- engineering;

- health and safety; and,

- accounting and purchasing.

The pollution prevention team (P2 Team) leader and members, their areas of expertise, and their responsibilities should be indicated in Worksheet No. 1. The team should have at least one individual who represents company management. The first activities to be carried out by the P2 Team should include the development of pollution prevention goals and the establishment of a timeline to carry out all steps necessary to develop a facility-specific pollution prevention plan.

Worksheet 1

Completed By *R. Smith* Date: *March 30, 1996*

The Pollution Prevention Team

Company : *AAA Concrete Ltd.* Facility Name: *River Road Plant*

Team Leader: *R. Smith* Title: *Plant Superintendent* Phone *975 - 2681*

Member Names	Responsibilities		Phone
	Corporate	Team	
R. Smith	*Plant Superintendent*	*Leader*	*975-2681*
S. Lee	*Quality Control*	*Engineering - Process*	*975-2681*
A. Irving	*Environmental Consultant*	*Environment*	*541-8924*
J. Bure	*Accounting*	*Cost - Analyses*	*975-2681*

Responsibility of Pollution Prevention Team:

1. Inspecting facilities to assess how materials are used and to identify evidence of waste, particularly of hazardous waste.
2. Involving co-workers in identifying problems and suggesting possible solutions.
3. Preparation of a pollution prevention plan.

2.2 Step 2: Pre-Inspection Activities

Overall Purpose:

Data regarding the process and site must be collected in order to plan the field inspection and to familiarize the team with details of the facility's operations. The data would subsequently be used to assess the feasibility of the pollution prevention options identified by the team.

2.2.1 Task 2.1: Identification of Study Area (Worksheet 2)

Purpose:

Corporate information is required for basic documentation to ascertain the exact location of the site and scope of the review.

Activities:

Fill out Worksheet 2.

Comments:

In the case that neighbouring properties are also used for purposes such as: product storage; waste disposal; vehicle maintenance; or others, these properties should also be included within the assessment process and listed accurately within Worksheet 2.

Worksheet 2

Site Description

Completed By: *R. Smith* Date: *Mar. 30, 1996*

1. Facility Name: *River Road Plant*

2. Company Name: *AAA Concrete Ltd.*

3. Contact: *R. Smith*

4. SITE ADDRESS:

Street: *3100 River Way Road*

City: *Surrey* *Province:* *B.C.* *Postal Code:* *V8C 1W4*

5. LEGAL DESCRIPTION OF SITE LOCATION:

Lot 3, Plan 59346, District Lot 762, Group 2

New Westminster Group 1 Land District

6 ESTIMATED SITE SIZE: *2 Hectares*

7. MAILING ADDRESS:

Street: *3100 River Way Road*

City: *Surrey* *Province:* *B.C.* *Postal Code:* *V8C 1W4*

8. PHONE and FAX NUMBERS:

Phone: *(604) 975 - 2681* *Fax:* *(604) 975 - 2683*

Other:

2.2.2 Task 2.2: Identification of Environmental Site-Specific Factors (Worksheet 3)

Purpose:

- To identify sensitive environments in vicinity of the ready-mixed concrete operation.
- To provide information to aid in the definition of pollution prevention priorities.

Activities:

- Complete Worksheet 3;
- Review files for permit information; and,
- Compile all permits and contingency plans into one location for easy access.

Comments:

Although this pollution prevention program is confined to the property boundaries of the facility, the sensitivity of the environment in and around the facility must be evaluated.

The information provided in Worksheet 3 is brief. In some cases, data may not be directly relevant. For example, groundwater wells may not be present at any ready-mixed concrete plants in the Lower Fraser River basin. However, information on soil composition and groundwater depth may be important, particularly with respect to potential site contamination.

Worksheet 3

Environmental Site Specific Factors

Completed By: *R. Smith* Date: *April 3, 1996*

1. Distance to nearest water body: *Site Adjacent to Fraser River*

a. Name of waterbody:

2. Distance to other ecologically sensitive areas:

e.g., Waterfowl Breeding
Source: FREMP Habitat Inventory

Distance	Area Description
2 km	*Estuarine marsh*
3 km	*High production and diversity area*

3. Distance to nearest populated area: *5 km*

a. Name of Municipality: *Surrey*

4. Distance to nearest groundwater well: *Not applicable - Municipal water supply*

(Source: BC Environment Water Resources Branch)

5. Depth to groundwater at site: *2 m*

6. Composition of site soil: *Silt/Sand*

7. Average annual precipitation at site: *700 mm*

(Source: Environment Canada)

8. Is area in a 100 year flood plain? *Yes*

(Source: BC Environment Water Resources Branch)

9. Release point for stormwater discharge: *Fraser River*

10. Regulatory information

a. Liquid Waste: *BC Environment Pollution Control Permit. PE - 9675*

b. Air permit: *GVRD Air Discharge Permit. GVA - 9995*

c. Other (please list): *BC Environment Special Waste Permit. PS - 4844*

2.2.3 Task 2.3: Review of Records and Business Procedures (Worksheet 4)

Purpose:

- To provide background information for the P2 Team.
- To identify ongoing pollution prevention efforts.
- To provide information for the development of the pollution prevention plan.

Activities:

- Review corporate files.
- Collect data as outlined in Worksheet 4.

Comments:

A review of records and business procedures provides an initial basis for the pollution prevention review. For the activities of the review team, priority documentation which should be collected will include:

- process description;
- site-specific process flow diagrams;
- chemical inventory and related Material Safety Data Sheets (MSDS) records; and,
- environmental reviews.

All records, as listed in Worksheet 4, may not be available, such as material balance assessments. However such information, if available, would significantly aid in the development of a pollution prevention program.

Worksheet 4

Completed By: *R. Smith* Date: *April 3, 1996*

Pre-Survey Information Collection

1. Company Name *AAA Concrete Ltd.* Facility Name: *River Road Plant*

2. Operation type: ☐ Central Mix Process (Wet Batch) ☑ Truck Drum Mixing (Dry Batch)

Cement Type: *Portland*

Market: Commercial ☑ Residential ☑

3. Availability of Essential Documentation for Site Inspection:

DOCUMENT	AVAILABLE Y / N	DATE LATEST VERSION	LOCATION / COMMENTS
Company Literature (re: Products, Services, etc.)	*Y*	*1994*	*Central office*
Process Description	*Y*	*1985*	*R. Smith's files*
Diagrams, Blueprints, Drawings of Buildings, Process Areas, etc.	*Y*	*1985*	*R. Smith's files (Original design plans)*
Design Information including Equipment Lists, Equipment Specifications, Process Flow Diagrams	*Y*	*1985*	*R. Smith's files*
Operating Manuals	*Y*	*1995*	*S. Lee's files and at control room*
Water and Energy Use Record	*Y*	*current*	*J. Bure - water meter readings*
Inventory of Raw Materials	*Y*	*current*	*J. Bure*
Product Inventory (e.g., Loc-blocks)	*Y*	*current*	*J. Bure*
Material Balance Analysis	*Y*	*current*	*Control room*
Material Safety Data Sheets (MSDS)	*Y*	*current*	*Control room*
Pollution Monitoring Data	*Y*	*current*	*S. Lee's files.Not all files located.*
Hazardous Waste Manifests	*Y*	*current*	*S. Lee's files*
Environmental Audit Reports	*Y*	*1994*	*Environment Canada audit report. S. Lee's files*
Regulatory Permits & Correspondence	*Y*	*current*	*S. Lee's files*
Fire Inspection Reports	*Y*	*1995*	*S. Lee's files*
WCB Correspondence/ Records	*Y*	*1995*	*S. Lee's files*
Employee Training Records	*N*		
Operator Data Logs	*Y*	*current*	*Control room*
Site Contingency Plan	*Y*	*current*	*S. Lee's files and control room*

2.2.4 Task 2.4: Identification of Raw Material and Chemical Usage (Worksheet 5)

Purpose:

- To identify to the pollution prevention team all materials in use at the site.
- To aid in the assessment of cost analyses for the development of pollution prevention plans, e.g., cost savings in recycling and reduction of raw materials.

Activities:

- Review purchasing information.
- Complete Worksheets 5(a) and 5(b).

Comments:

All materials should be identified including cement, aggregates, admixtures, muriatic acid, vehicle fuel, lubricating oil, water, etc.

The required information for "components or attributes of concern" would pertain to products such as muriatic acid (e.g., 28% hydrogen chloride) and admixtures.

In the case that other products are used, Worksheet 5 should be modified to include those products.

Worksheet 5 (a)
Completed By: *R. Smith* Date: *April 6, 1996*

Process Raw Materials Input Summary

1. Facility Name: *River Road Plant*

2. Materials Summary

RAW MATERIAL	CEMENT	FLY ASH	AGGREGATE	WATER	AD-MIXTURES					OTHER
					1	2	3	4	5	
Trade Name	*Type 10*	*Pozzlanic*	*Fine/Coarse*	*NA*	*NBA - 99*	*428 - HB*	*B - 326N*	*Super - Acel*	*RP - 201*	*Calcium Chloride*
Chemical Name	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*Calcium Chloride*
COMPONENTS/ATTRIBUTES OF CONCERN										
Components and Concentration (Specify Units : %, PPM...)	*NA*	*NA*	*NA*	*NA*	*Tributyl phosphate 10%*	*Fatty - acids 25% KOH: !%*	*Ligno - sulfunates 85%*	*Calcium chloride: 30%; Triethanol-amine:1%*	*Borax 10%*	*40% solution*
ANNUAL CONSUMPTION RATE										
Overall (Specify Units: Kg, Tonnes, Lbs...)	*30,000 t*	*5,000 t*	*70,000 t (f) 70,000 t (c)*	*7,000 m^3*	*1, 000 L*	*50,000 Litres*	*40,000 Litres*	*2,500 L*	*1,000 L*	*1,000 L*
SUPPLIERS										
Supplier #1	*B.C. Cement*	*B.C. Cement*	*Save - On Aggregates*	*Municipal*	*Acme*	*Acme*	*Foster Chemicals*	*Foster Chemicals*	*Acme*	*Allied Chemicals*
Supplier #2	*Inland Cement*									
COSTS										
Purchase Price (Cdn. $/_____)	*150/t*	*65/t*	*8/t*	*0.23/m^3*	*2.00/L*	*1.25/L*	*1.50/L*	*3.00/L*	*3.00/L*	*0.75/L*
Overall Annual Cost	*4,500,000*	*325,000*	*1,120,000*	*1,750*	*1,600*	*62,500*	*60,000*	*7,500*	*3,000*	*750*

Worksheet 5 (a)

RAW MATERIAL	CEMENT	FLY ASH	AGGREGATE	WATER	AD-MIXTURES					OTHER
					1	2	3	4	5	
SHIPPINGAND STORAGE DETAILS					*NBA - 99*	*428-HB*	*B - 326N*	*Super Acel*	*RP - 201*	*Calcium chloride*
Delivery Mode	*Truck*	*Truck*	*Barge*	*Municipal*	*Truck*	*Truck*	*Truck*	*Truck*	*Truck*	*Truck*
Normal Order/ Delivery Size	*30 - 40 t*	*30 t*	*10,000 t*	*NA*	*2 drums 400 L*	*3,500 L*	*3,500 L*	*3,500 L*	*3 drums 600 L*	*1 Tote 1,000 L*
No. Shipments/Year	*4/day*	*25*	*12*	*NA*	*4*	*15*	*15*	*1*	*2*	*1*
Shipping Container (Size and Type)	*Bulk tank*	*Bulk tank*	*Open barge*	*NA*	*200 L Drums*	*Bulk*	*Bulk*	*Bulk*	*Drums*	*Bulk tank*
Storage Mode	*Silo*	*Silo*	*Open piles*	*NA*	*Drums*	*Bulk tank*	*Bulk tank*	*Bulk tank*	*Drums*	*Bulk tank*
Transfer Mode	*Gravity weighing*	*Gravity weighing*	*Belt Conveyer*	*Water meter*	*Pump meter*	*Pump meter*	*Pump meter*	*Pump meter*	*Pump meter*	*Pump meter*
Inventory Size (Max.)	*200 t*	*200 t*	*12,000 t*	*NA*	*600 L*	*5,000 L*	*5,000 L*	*5,000 L*	*800 L*	*2,000 L*
EMPTY CONTAINER MANAGEMENT	*All returned to suppliers*									

Worksheet 5 (b)
Completed By: *R. Smith* Date: *April 5, 1996*

Chemical Use Summary

1. Facility Name: *River Road Plant*

2. Materials Summary

RAW MATERIAL	FUELS		SOLVENTS	OIL/ LUBRICANTS	ANTIFREEZE	CLEANERS/ DETERGENTS	MURIATIC ACID	OTHER
	VEHICLE	BOILER						
Trade Name	*Diesel*	*Natural Gas*	*Solmel*	*Motor Oil*	*Prestone*	*Super Klen*	*Muriatic acid*	
Chemical Name	*NA*	*NA*	*Methylene chloride*	*NA*	*Propylene glycol*	*Trisodium phosphate*	*Hydrochloric acid*	
COMPONENTS/ATTRIBUTES OF CONCERN								
Components and Concentration (Specify Units : %, PPM...)	*NA*	*NA*	*100% Methylene chloride*	*NA*	*80% propylene glycol*	*40% Trisodium phosphate*	*10% Hydrochloric acid*	
ANNUAL CONSUMPTION RATE								
Overall (Specify Units: Kg, Tonnes, Lbs...)	*25,000 L*	*2,000 m^3*	*200 L*	*2,000 L*	*500 L*	*100 L*	*500 L*	
SUPPLIERS								
Supplier #1	*BP*	*BC Gas*	*Allied Chemical*	*BP*	*Allied Chemical*	*B.C. Cleaning Supplies*	*Allied Chemical*	
Supplier #2								
COSTS								
Purchase Price (Cdn. $/_____)	*0.40/L*	*2.50/m^3*	*5.00/L*	*2.50/L*	*6.00/L*	*8.00/L*	*1.75/L*	
Overall Annual Cost	*10,000*	*5,000*	*1,000*	*5,000*	*3,000*	*800*	*875*	

Worksheet 5 (b)

RAW MATERIAL	FUELS		SOLVENTS	OIL/ LUBRICANTS	ANTIFREEZE	CLEANERS/ DETERGENTS	MURIATIC ACID	OTHER
	VEHICLE	BOILER						
SHIPPING AND STORAGE DETAILS								
Delivery Mode	*Truck*	*Pipeline*	*Truck*	*Truck*	*Truck*	*Truck*	*Truck*	
Normal Order/ Delivery Size	*5,000 L*	*NA*	*1 Drum 200 L*	*5 Drums 1,000 L*	*3 Drums 600 L*	*5 Buckets 100 L*	*1 Drum 200 L*	
No. Shipments/Year	*5 - 6*	*NA*	*1*	*1 - 2*	*1*	*2*	*3*	
Shipping Container (Size and Type)	*Bulk 5,000 L*	*NA*	*Drums 200 L*	*Drums 200 L*	*Drums 200 L*	*Buckets 20 L*	*Drums 200 L*	
Storage Mode	*Underground tank*	*Pipeline*	*Drums*	*Drums*	*Drums*	*Buckets*	*Drums*	
Transfer Mode	*Fuel pump*	*Pipeline*	*Hand pump*	*Hand pump*	*Hand pump*	*Manual*	*Hand pump*	
Inventory Size (Max.)	*10,000 L*	*NA*	*1 Drum*	*5 Drums*	*4 Drums*	*6 Buckets*	*2 Drums*	
EMPTY CONTAINER MANAGEMENT	*All drums returned to supplier*							

2.2.5 Task 2.5: Product Summary Information (Worksheet 6)

Purpose:

- To provide information on production capacity of the facility.
- To assess amount of returned concrete and reuse.

Activities:

- Review production information as per Worksheet 6.
- Review corporate policy and efforts with regard to reuse of returned concrete.

Worksheet 6
Completed By: *R. Smith* Date: *April 9, 1996*

Product Summary Information

1. **Facility Name:** *River Road Plant*

2. **Product Summary:**

	ANNUAL PRODUCTION
PRODUCTS	
Residential Building Concrete	*30,000 m^3*
Commercial Building Concrete	*70,000 m^3*
Other:	
TOTAL PRODUCTION	*100,000 m^3*

RETURNED CONCRETE	*5,000 m^3*
• AMOUNT RECYCLED	
– Pre-Cast Products	*3,000 m^3*
– Reuse (next batch)	*1,000 m^3*
– Other	
• AMOUNT DISPOSED *Landfill*	*1,000 m^3*

2.3 Step 3: Conduct On-site Inspection

One of two approaches can be used to conduct an on-site inspection:

Option 1:

A detailed facility audit can be conducted which systematically reviews all aspects of the process from the time the process ingredients enter the facility site. The audit can be based on the Environment Canada "Environmental Code of Practice Facility Audit Compliance Checklist", which is provided in Appendix III. The information is then disseminated to develop a pollution prevention plan. The main advantage of this approach is that it simultaneously provides an assessment of compliance with the 1993 Environmental Code of Practice for the Ready-Mixed Concrete Industry.

Option 2:

A facility review can be conducted which focusses on identified aspects of pollution prevention. The review may not be as thorough as Option 1; however, sorting of data is minimized and the objective of a pollution prevention plan may be attained more easily.

It is proposed that the on-site inspections would focus on three areas in the following priorities:

- ***Compliance with existing regulatory requirements -***

  Compliance indicates the adequacy of existing pollution control efforts. Non-compliance can result in significant legal costs and fines, as well as a poor public image. Liability could be in the order of hundreds of thousands of dollars.

- ***Control of bulk liquids -***

  Release of bulk liquids may result in significant liability to an operation if a release to an adjacent water body occurs or if soil and groundwater becomes contaminated. The liability may potentially be in the order of millions of dollars.

- ***Pollution prevention during normal process operations -***

Objectives for pollution prevention are outlined in Section 1 of this report. In addition to minimizing environmental releases, it is anticipated cost-savings for the operation will also result.

2.3.1 Task 3.1 - Priority 1: Inspect Facility for Regulatory Compliance

Purpose:

- To ascertain that the ready-mixed concrete facility is in compliance with existing regulatory requirements.

Activities:

- From the corporate files, obtain all regulatory and monitoring information.

- Inspect existing pollution control equipment to ascertain that it is functioning and maintained.

- Complete Worksheet 7.

Actions:

- **Any "no" indication in Worksheet 7 requires immediate corporate actions to address the deficiency (or deficiencies).** The actions may be operational (e.g., attain more monitoring data) or require revision to pollution control equipment if regulatory limits are exceeded.

Worksheet 7
Completed By: *S. Lee* Date: *April 12, 1996*

Regulatory Compliance Essential Requirements

1. AIR EMISSIONS AND CONTROLS

a. Sources of controlled emissions *(circle)*

(Gas/propane/oil-fired broiler)
(Cement silo and/or baghouse)
(Fly-ash silo and/or baghouse)
(Bulk transfer system)

Aggregate storage and handling
(Vehicle traffic)
(Fugitive dust)
Bulk fuel handling
Solvent use

b. List permits and/or relevant regulation responsible agency:

GVRD Air Discharge Permit - GVA 9995

No monitoring requirements specified

c. Is pollution control equipment operational?	No	(Yes)	
d. If routine monitoring is required by regulatory agency:			
- Are monitoring results available?	No	Yes	(NA)
- Is monitoring frequency and analytical sensitivity in accordance to regulatory requirements?	No	Yes	(NA)
- Do results indicate compliance with regulatory limits?	No	Yes	(NA)
- Has the necessary reporting to regulatory agencies occurred?	No	Yes	(NA)

2. LIQUID EFFLUENT RELEASES

a. Sources of regulated effluent releases *(circle)*	TYPES	DISCHARGE LOCATION
	(Stormwater run-off)	*River*
	(Treatment System Discharge)	*Ground infiltration*
	(Other:)	*Septic tank - Ground infiltration*

b. List permits and/or relevant regulation responsible agency:

BC Environment Pollution Control Permit - PE 9675

c. Is pollution control equipment operational?	No	(Yes)	NA
d. If routine monitoring is required by regulatory agency:			
- Are monitoring results available?	No	(Yes)	NA
- Is monitoring frequency and analytical sensitivity in accordance to regulatory requirements?	No	(Yes)	NA
- Do results indicate compliance with regulatory requirements?	(No)	Yes	NA
- Has the necessary reporting to regulatory agencies occurred?	No	(Yes)	NA

3. SOLID WASTES

a. Sources of regulated solid wastes *(circle)*

Chemical sludges	(PCB equipment)
Settling pond sludges	Batteries
(Petroleum hydrocarbon sludges)	Contaminated Soil
	Other:

b. List permits and/or relevant regulation responsible agency:

BC Environment Special Waste Permit - PS 4844

c. Have solid wastes been evaluated to determine if they are Special Wastes?	(No)	Yes	NA
d. If Special Wastes are present, are storage and inspection in compliance with the Special Waste Regulation?	No	(Yes)	NA
e. Are licensed hazardous waste contractors used for disposal?	No	(Yes)	NA
f. Are shipping documents complete and available for review on-site?	No	(Yes)	NA

2.3.2 Task 3.2 - Priority 2: Inspect Control of Bulk Liquids and Gases

Purpose:

- To minimize the potential for sudden and accidental releases of bulk liquids.
- To minimize the potential for site contamination.
- To minimize potential for large scale financial liability to the company.

Activities:

- Inventory all bulk liquids and gases (e.g., acetylene, propane, etc.) in storage.
- Determine containment volumes.
- Assess condition of containment areas, tanks and transfer lines.
- Evaluate spill response capabilities.
- Complete Worksheet 8.

Actions:

Any "no" response in Worksheet 8 indicates a concern which should be addressed immediately.

Worksheet 8
Completed By: *S. Lee & R. Smith* Date: *April 18, 1996*

Control of Bulk Liquid and Gases

1. INVENTORY OF BULK LIQUID AND GASES

PRODUCT	STORAGE TYPE [UST or AST]* and VOLUME [Litres]	CONTAINMENT TYPE And VOLUME [Litres]	IS CONTAINMENT ADEQUATE? [See 2(c) below]
Diesel/Gasoline	*UST 10,000 L*	*None*	*No*
Admixtures: *MBA 90*	*Drums (2): 400 L*	*In contained area*	*Yes*
122 - HE	*AST: 10,000 L*	*In contained area*	*Yes*
P - 325N	*AST: 10,000 L*	*In contained area*	*Yes*
P - 20	*Drums (8): 1,600 L*	*In contained area*	*Yes*
Daraccel	*Drums (3): 600 L*	*In contained area*	*Yes*
Acid/Caustic	*Drums (2): 400 L*	*None*	*No*
Solvent	*Drum (1): 200 L*	*None*	*No*
Oil/Lubricants	*Drums (5): 1,000 L*	*In machine shop*	*Yes*
Antifreeze	*Drums (2): 400 L*	*In machine shop*	*Yes*
Cleaners/Detergents	*Buckets (5): 100 L*	*In machine shop*	*Yes*
Other: *Acetylene*	*Cylinders of various sizes*	*Chained to wall*	*N/A*

**Underground Storage Tank (UST); Above Ground Storage Tank (AST)*

2. ABOVEGROUND TANKS

a. Are all tanks and drums on top of an impermeable floor?	No	(Yes)
b. Is the floor sealed (e.g., absence of cracks)?	(No)	Yes
c. Are all containment volumes in excess of 110% of the largest tank or the volume of the largest tank plus 10% of the aggregate volume of all other tanks?	(No)	Yes
d. Are all tanks free of corrosion and physical damage?	No	(Yes)
e. Are all tanks securely mounted and protected from vehicle impact?	(No)	Yes

3. UNDERGROUND STORAGE TANKS

a. Is the underground tank less than 10 years old?	(No)	Yes
b. Are the underground tanks and piping leak tested annually and records kept?	(No)	Yes

4. ALL TANKS AND DRUMS

a. Are tanks and drums secured to prevent tampering?	No	(Yes)
b. Are tanks provided with overfilling protection and/or alarms?	(No)	Yes
c. Are bulk drains (including stormdrains) located away from chemical unloading area and bulk tank storage area?	No	(Yes)
d. Are non-gravity feed systems used for fuel supply/dispensing?	No	(Yes)
e. Are dispensing systems de-energized and locked between use?	No	Yes
f. Are dispensing areas provided with drip and spill containment?	(No)	Yes
g. Are spill kits provided at all bulk chemical storage and handling points?	(No)	Yes
h. Has a spill response plan been prepared.	(No)	Yes
i. Is the plan readily available?	(No)	Yes

2.3.3 Task 3.3 - Priority 3: Pollution Prevention Plan for Normal Process Operations

Purpose:

- To review the entire ready-mixed concrete operation in order to identify all areas of waste generation and water use.

- To focus on areas with greatest potential for cost-benefits associated with pollution prevention.

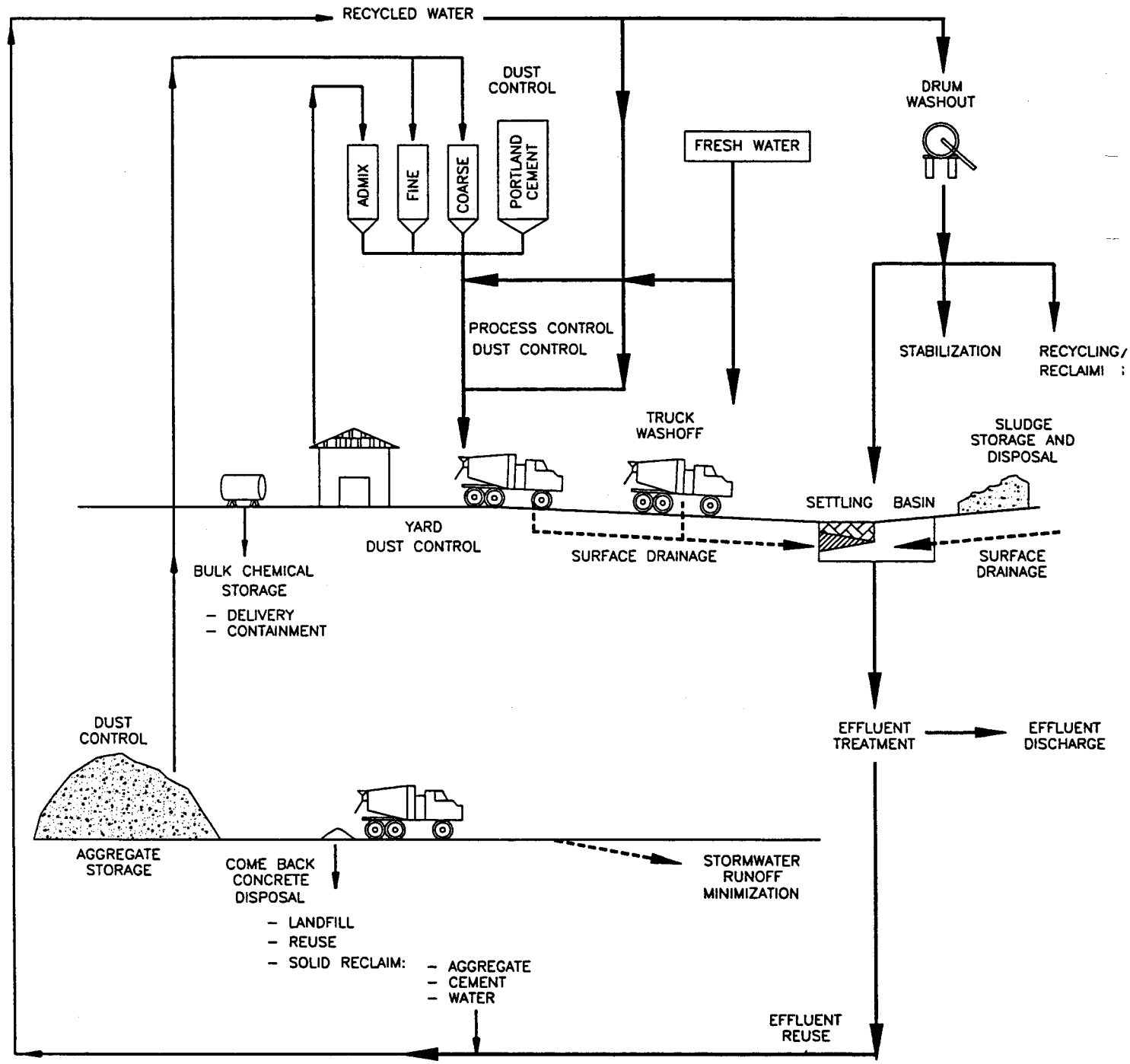
Activities:

- Follow process from beginning to end to observe operating procedures and to identify all waste streams. Use Figure 2.2 as a guide.

- Using Worksheets 9 and 10, attempt to identify quantities of waste streams and evaluate existing recycling efforts.

- Use Worksheet 11 to identify potential pollution prevention areas relative to objectives stated in Appendix II.

Figure 2.2 Pollution Prevention Components for a Ready-Mixed Concrete Facility



CAD: 1241-03.DWG

Worksheet 9

Completed By *R. Smith & S. Lee* Date: *April 15, 1996*

Solid Waste Stream Diagram

RETURNED CONCRETE
Estimated Volume
Circle units: (m^3) or Tonne
5, 000 m^3 Tonne / Yr.
5% of Total Production
[Industry Estimates are 1-4% of Production]
(See Worksheet 6)

	VOLUME
Precast Products:	*3,000*
Recycling/Reclaimer:	
Stabilization and Reuse:	*1,000*
Landfill:	*1,000*
Yard Disposal:	*
Other:	*

RECOVERED CEMENT → **Reuse:** ; **Landfill:** *

RECOVERED AGGREGATE → **Reuse:** ; **Other:**

EQUIPMENT WASHOUT SOLIDS
Estimated Volume
Circle units: (m^3) or Tonne
600 m^3 Tonne / Yr.
[Industry Estimates are 0.5% of Production]

	VOLUME
Recycling Reclaimer:	
Settling Pond:	*
Yard Disposal:	*
Stabilization and Reuse:	*600 m^3*
Other:	

RECOVERED CEMENT → **Concrete Production:** ; **Other** *

RECOVERED AGGREGATE → **Concrete Production:** ; **Other** *

SETTLING BASIN SLUDGES
Estimated Volume
Circle units: (m^3) or Tonne
40 m^3 Tonne / Yr.

	VOLUME
Recycling/Reclaimer:	
Landfill:	*
Yard Disposal:	*
Other:	*40 m^3*

AIR POLLUTION CONTROL RESIDUALS
Estimated Volume
Circle units: (m^3) or Tonne
5 m^3 Tonne / Yr.

Reuse:	*5 m^3*
Landfill:	*
Other:	

MISCELLANEOUS SOLID WASTES

SLUDGES

Volume: *2 Drums (machine shop - solvent sludge)*

Disposal Method: *Waste Management Inc. (Incineration - U.S.)*

BATTERIES

Volume: *20/Year*

Disposal Method: *B.C. Battery Recycling*

CHEMICAL CONTAINERS

Volume: *25 Drums*

Disposal Method: *Supplier*

OTHER SOLID WASTES IDENTIFIED IN PLANT REVIEW

(e.g., Chemical Residual)

Volume: *Two PCB transformers*

Disposal Method: *In storage - On-site*

DISPOSAL COSTS:

(Annual)

CONCRETE SLUDGES $ *50 / tonne (landfill)*

MISCELLANEOUS $ *250 / drum (machine shop wastes - incineration)*

Worksheet 10
Completed By: *R. Smith* Date: *April 25, 1996*

Assessment of Water Use and Recycling

ACTIVITY	% FRESH WATER	% RECYCLED WATER
Concrete production	*40*	*60*
Truck wash	*100*	*0*
Drum washout	*0*	*100*
Point source dust control	*0*	*100*
Other uses: boiler	*100*	*0*
hot water production	*100*	*0*
Total freshwater use:	*7,000 m^3/year*	
Stormwater: % controlled (into treatment system)	*(estimate) 50*	
% uncontrolled	*(estimate) 50*	

Worksheet 11
Completed By: *R. Smith* Date: *May 1, 1996*

Assessment of Current Pollution Prevention Measures

Objective: To evaluate current practices *versus* pollution prevention concepts outlined in Appendix 2.

Re: Concept 1	**Reduction of use of toxic substances, raw materials and non-renewables.**			
	1.1	Are preventive measures in place to avoid "off-spec" concrete, (e.g., periodic testing of scales, batch gate operation, etc.)?	No	(Yes)
	1.2	Is an operator's manual available?	No	(Yes)
	1.3	Is regular operator training provided?	No	(Yes)
	1.4	Is water conservation practiced by restriction of freshwater uses to purposes such as: • truck exterior washoff? • hot water production? • batch waters for high quality concrete?	No	(Yes)
	1.5	Are flow controls installed on freshwater sources?	(No)	Yes
Re: Concept 2	**Reuse of recovered raw material, products and hazardous substances.**			
	2.1	Are volumes of returned concrete minimized (i.e., less than 2.5% of total production volume)?	(No)	Yes
	2.2	Is all returned concrete either: • reused (precast products, road base, etc.); or, • recycled (reclaimed)?	(No)	Yes
	2.3	Are all air pollution control residues reused?	No	(Yes)
	2.4	Are all drum washout solids reused or recycled?	No	(Yes)
	2.5	Are settling basin sludges reused or recycled?	No	(Yes)
	2.6	Is 100% of the process water (drum washout, truck wash) reused?	No	(Yes)
	2.7	Is collected yard stormwater used for washdown, etc.?	No	(Yes)
Re: Concept 3	**Elimination or minimization of environmental releases.**			
	3.1	Are spills of cement and concrete cleaned up immediately?	(No)	Yes
	3.2	Is the process area paved and curbed to collect processing water for treatment and/or recycling?	No	(Yes)

	3.3	Is the pavement and curbing in good condition (i.e., no cracks)?	(No)	Yes	
	3.4	Is the size of the processing area minimized and/or roofed to reduce exposure to rainfall?	No	(Yes)	
	3.5	Is yard stormwater diverted from the process area?	No	(Yes)	
	3.6	Are oil separators installed in truck wash areas and other areas where oil releases may occur?	(No)	Yes	
	3.7	Are measures taken to ensure proper dust control during transfer of cement and fly ash?	No	(Yes)	
	3.8	Are aggregate piles designed to minimize fugitive dust control (e.g., minimal surface area, storage bins, covers)?	(No)	Yes	
	3.9	Are high vehicle traffic areas paved?	No	(Yes)	
	3.10	Is the traffic system controlled (e.g., low speed limits, one-way traffic to separate dirty from clean vehicles)?	(No)	Yes	
	3.11	Are paved portions swept to remove accumulated dust?	(No)	Yes	
Re: Concept 4	**Recycling of recovered materials off-site.**				
	4.1	If all concrete and sludges are not recovered on-site, are the materials used off-site (e.g., road base)?	(No)	Yes	NA
Re: Concept 5	**Treatment of non-recoverable waste with a focus on recovery and minimization of residues.**				
	5.1	Is there a system (e.g., settling basin) for treatment of excess water?	No	(Yes)	
	5.2	Does the treatment system enable pH control?	(No)	Yes	
	5.3	Is the process area minimized (i.e., < 10% of total yard area)?	No	(Yes)	
	5.4	Does routine monitoring of effluent quality occur?	No	(Yes)	
	5.5	Is the wastewater holding basin of sufficient volume to manage all effluent in high precipitation events?	(No)	Yes	
	5.6	Can concrete fines and aggregates be removed from the basins?	No	(Yes)	
	5.7	Is unusable sludge disposed of in approved facilities?	No	(Yes)	
	5.8	Are admixture and other chemical containers returnable to the supplier?	No	(Yes)	
	5.9	Are all chemicals no longer in use removed from the site?	No	(Yes)	

Re: Concept 6 **Safe disposal of wastes.**

6.1	Are lead batteries, solvents, waste oils, etc., stored in secure locations?	No	(Yes)
6.2	Are lead batteries, solvents, waste oils, etc., recycled?	No	(Yes)
6.3	Are operating procedures for waste disposal adequately defined?	(No)	Yes
6.4	Has management confirmed that approved facilities are used for waste disposal?	(No)	Yes
6.5	Is all documentation at hand for transport manifests, certification of destruction, etc.?	No	(Yes)

Re: Concept 7 **Safe handling of chemicals and products to ascertain that no site contamination or sudden releases occur.**

7.1	In addition to points in worksheet 8, are aboveground piping and valves visible and labelled?	No	(Yes)
7.2	Are tank materials and designs as per all applicable codes and manufacturers' recommendations?	No	(Yes)
7.3	Are spill response equipment, absorbents and personnel protection equipment provided?	(No)	Yes
7.4	Is worker training for spill response provided?	(No)	Yes
7.5	Are signs in place to identify contents of bulk tanks and drums?	No	(Yes)

2.4 Facility Status and Identification of Priorities for Pollution Prevention

To this point, extensive data has been gathered about the facility, including information on quantities and costs of raw materials used at the facility, environmental sensitivity of the site location, costs of existing waste disposal and treatment, and the results of a thorough review of the operation by an inspection team.

The objective of this section is to provide guidance on setting priorities on selecting processes and waste streams for pollution prevention projects. Priorities for pollution prevention activities at a ready-mixed concrete operation will be identified in the following order:

Priority 1: Sources which result in non-compliance with existing regulatory requirements must be addressed immediately. Incidents of non-compliance indicate that current pollution prevention control programs are not satisfactory.

Priority 2: Process designs and operations which may result in significant potential for catastrophic releases and/or for contamination of site soils and groundwater (e.g., improper bulk liquid storage and handling).

Priority 3: Measures which can be taken for improved source reduction, reuse and recovery.

Immediate actions should be taken for regulatory non-compliance and improper bulk liquid storage and handling. As shown in Figure 2.1, there may be overlap among the issues.

Using the solid and water stream diagrams shown in Worksheets 9 and 10, the assessments of best management practices for pollution control are then summarized in Worksheet 11 with respect to each identified pollution prevention concept. Any "no" indications in Worksheet 11 indicate the candidate processes and waste streams for pollution prevention projects.

Worksheet 12 provides a format for listing and identifying priorities for actions. The Pollution Prevention Team should be in a position to best identify the priorities. Guidance for the priority setting process is provided in Worksheet 12.

Worksheet 12
Completed By: *R. Smith & A. Irving* Date: *May 8, 1996*

Facility Status and Identification of Priorities

1. Facility Name: *River Road Plant*

2. Summary of Compliance with Regulatory Requirements (from Worksheet 7):

Regulatory Permit	Permit No.	Compliance Status
Liquid (Effluent Waste Permit)	*PE - 9675*	*No*
Air Permit	*GVA - 9995*	*Yes*
Solid Waste Permit		
Special Waste Permit	*PS - 4844*	*Yes*
Other (please list)		

Listing of "no" responses in Worksheet 7
[Any "no" will be a priority item and must be addressed immediately.]

· *Non - compliance liquid effluent re: suspended solid concentrations*

· *Sludges not evaluated with respect to Special Waste Regulation*

3. Summary of Potential ConcernsC**Catastrophic Releases and Site Contamination (from Worksheet 8):**

Listing of "no" responses in Worksheet 8	Pollution Prevention Team Priority and Basis of Decision[1]
· *No spill response plan; no spill kits*	*High priority - Liability, proximity to river*
· *No drip and spill containment - fuel dispensing*	*High priority - Area adjacent to river*
· *Acid drum not protected from vehicle impact*	*High priority - Impact probability high*
· *No containment for several drums*	*Medium priority - Liability, spills*
· *UST greater than 10 years old - not tested*	*High priority - Liability, site cleanup costs*
· *Fuel dispensing system not locked*	*Medium priority - Site quite secure*
· *Bulk tanks - no overfilling alarms*	*Low priority - Area contained*
· *Floor cracks in chemical storage area*	*Low priority - Liner installed below*

[1] Priorities may be based on aspects such as relative volumes of stored liquids, proximity to water bodies and storm drains, use of alternative control measures, etc.

4. Summary of Current Pollution Prevention Concerns (from Worksheet 11):	
Listing of "no@ responses in Worksheet 11	Pollution Prevention Team Priority and Basis of Decision[2]
· *Volume concrete returned >2.5%*	*High priority - handling and disposal costs*
· *Returned concrete not all recycled*	*High priority - disposal costs, waste of product*
· *No flow controls - freshwater sources*	*Medium priority - wastewater generation*
· *Minimal cleanup of concrete/cement spills*	*Medium priority - excessive spills noted*
· *Poor operating procedures for waste disposal*	*Medium priority - liability, regulatory*
· *No confirmation of disposal at approved facilities*	*Medium priority - liability, regulatory*
· *Curbing at process area cracked*	*Medium priority - stormwater flows in area*
· *No oil seporators*	*Low priority - water from truck wash area all recycled*
	- oil spills contained within machine shop
· *Minimal dust control*	*Low priority - no evidence of impact*
· *Poor traffic control to minimize dust*	*Low priority - but easily addressed*
· *No sweeping of paved portions*	*Low priority - easily addressed*
· *No pH control at treatment system*	*No priority - no pH problems noted*
· *Wastewater basin volumes - high precipitation events may cause overflow*	*Low priority - infrequent occurrences and overflow occurs to ground not to river directly*

[2] Priorities may be based on aspects such as: potential for high cost/benefits; relative volumes of wastes; local conditions such as proximity to water bodies; low rainfall conditions, etc.

2.5 Assessments of Pollution Prevention Status of Facility

At this point, the Pollution Prevention Team should review its findings and assess the degree to which the facility meets all pollution prevention concepts of the Federal Pollution Prevention Strategy, as described in Appendix II of this guide.

If the facility does not meet all concepts, then the process should continue as defined in this document. If the facility does meet all concepts, then:

- the process could stop, and the Pollution Prevention Team should provide a written report to management stating its conclusion that the facility meets the intent of the Federal Pollution Prevention Strategy; or

- the process could continue if the Pollution Prevention Team has reason to believe that some operational and/or design features, although meeting the intent of the Pollution Prevention Strategy, could be improved upon, for reasons such as cost-efficiency, technical reliability, etc.

2.6 Selection of Pollution Prevention Options

A review of examples provided in Worksheet 12 would recognize the obvious wide range in technical and cost complexities for the numerous pollution prevention options.

The Pollution Prevention Team may decide that some of the control options, although seemingly trivial (e.g., reduction of speed limits to reduce dust), can be implemented readily at minimal cost and with little need for further assessment. Other measures, such as underground storage tank (UST) testing, are so critical that action should be undertaken without additional deliberations. Such options would be listed in Worksheet 13.

The more difficult assessments would likely be associated with the major areas of recycling, reuse and control of solids, and process waters. As mentioned in Appendix I, it is estimated that the volume of returned concrete in B.C. is in the order of 125,000 tonnes per year, and the amount of concrete removed during cleaning of equipment is in the order of 25,000 tonnes per

year. Process water volumes from individual Lower Mainland facilities would range from 2,000 to 350,000 litres per day. Control of stormwater runoff is a significant issue in the Lower Mainland. Detailed assessments for pollution control options would likely be required to address such major issues.

The procedure for selection of more complex pollution prevention options will include the following steps:

(1) Define the pollution prevention concerns which require detailed assessment, and list possible response options (Worksheet 14).

(2) Evaluate each potential option for technical feasibility (Worksheet 15), including:
- chance of technical success;
- ease of implementation;
- availability of space and utilities;
- impact on production quality and services; and,
- non-disruption of production.

(3) Evaluate each potential option for economic effectiveness (Worksheet 16), including:
- direct and indirect operation costs;
- reduction in raw material costs; and,
- reduction in treatment/disposal costs.

(5) Provide a summary evaluation of each selected option and suggest whether the option should be accepted or rejected (Worksheet 17).

Worksheets 15 and 16 provide an example for only one reduction option. Similar worksheets would have to be completed for each reduction option listed in Worksheet 14.

Worksheet 13
Completed By: *R. Smith* Date: *May 16, 1996*

Identification of Easily Implemented Pollution Prevention Measures[1]

1. Facility Name: *River Road Plant*

2. Recommended measures for immediate implementation:

Measure	Priority	Type of Pollution Prevention Measure[2]
·UST Inspection	*High*	*Hire tank testing firm. Decommission immediately if leaks found.*
· Fuel drip spill containment	*High*	*Install containment facilities.*
· Prepare spill response plan, spill kits	*High*	*Prepare using internal or external resources.*
· Acid drum protection	*Medium*	*Move drum to contained area.*
· Ensure containment for all drums	*Medium*	*Move drums to contained area.*
· Concrete/cement cleanup	*Medium*	*Improve housekeeping practices.*
· Install flow controls - fresh water	*Medium*	*Install spring-loaded nozzles.*
· Prepare waste disposal procedures and evaluate wastes	*Medium*	*Review Special Waste regulation or hire*
· Confirmation of proper waste disposal	*Medium*	*Request formal letter from disposal company re: destination of wastes*
· Install fuel dispensing locks	*Medium*	*Investigate locking options.*
· Repair floor cracks in chemical room	*Low*	*Caulk cracks.*
· Repair cracked curbing	*Medium*	*Hire paving contractor or do in - house.*
· Minimize yard dust	*Low*	*Lower speed limit, change traffic route.*
· Bulk tank filling alarm	*Low*	*Investigate alarm system.*
· No oil separator	*Low*	*Ensure proper containment in machine shop.*
· Limited wastewater basin volume	*Low*	*Investigate frequency of problems and costs for extending.*

[1] No technical/economic analysis required
[2] Operating practice, maintenance, minor equipment change, minor process change, etc.

Worksheet 14
Completed By: *R. Smith* Date: *May 20, 1996*

Identification of Pollution Prevention Concerns which Require Detailed Assessment

1. Facility Name: *River Road Plant*

2. Identification of Pollution Prevention Concerns and Possible Response Options.

Pollution Prevention Concern (From Worksheet 12)	Possible Options (From Appendix 2)
1) *Returned concrete not all recycled*	· *Investigate additional uses for returned*
	concrete (e.g., other precast products)
	· *Installation of recycling/reclaimers*
	· *Hydration control by use of admixtures for reuse of concrete at later time*
	· *Do nothing*
2) *High volumes of returned concrete (i.e., >2%)*	· *Encourage better estimates by construction industry*
	· *Apply surcharge for returned concrete*
	· *Do nothing*
3) *Non-compliance of liquid effluent (suspended solid concentrations)*	· *Improve design of settling pond*
	· *Assess use of Apolisher@ at settling pond discharge*
	· *Improve housekeeping*

Worksheet 15
Completed By: *S. Lee & A. Irving* Date: *May 30, 1996*

Technical Feasibility

Instructions: Copy this form and use one form for each Reduction Option.

1. **Facility Name:** *River Road Plant*
2. **Pollution Prevention Concern:** *Returned concrete not all recycled*
3. **Description of option:**

Installation of recycling/reclaimer system

4. **Kind of option:**

- ☑ Equipment-Related
- ○ Process-Related
- ○ Raw Material-Related
- ○ Personnel-Related

5. **Describe potential personnel requirements (training, safety, etc.):**

Minimal - based on conversation with XYZ Concrete where a similar system is installed

6. **Are required space and utilities available? Explain:**

Yes. Typical size of reclaimer is 12 x 2 metres

7. **Will production quality or services be affected? Does the system create other environmental or health and safety problems? If yes, explain:**

No. XYZ concrete has had satisfactory experiences with its reclaimer.

Cement - slurry use limited to concrete for non-spec work such as driveways, sidewalks and other private work.

8. Technical Feasibility Scale:

Scale for technical feasibility

1) Easily Achievable—Regular Maintenance
2) Minor Equipment Piping Changes
3) Minor Process
4) Major Process Change
5) Require Process Development/ New Tech.
6) Currently Unfeasible. Requires Replacement of Process

9. Does the technical feasibility of the option warrant subsequent economic analysis? Explain:

Yes. Systems in use are reliable and claimed to be cost efficient.

Worksheet 16

Financial Analyses

Completed By: *J. Bure* Date: *June 15, 1996*

1. **Facility Name:** *River Road Plant*

2. **Description of Option: Installation of recycling reclaimer system for returned concrete.**

3. **CAPITAL COSTS**

Procurement Expenses:	Costs (A*)	Total
a. Recycle Equipment	*80,000.00*	
b. Materials (Piping, Pumps etc.)	*10,000.00*	
c. Installation	*5,000.00*	
d. Engineering	*5,000.00*	
e. Permitting	-	
f. Utility Connection	*2,000.00*	
Total Capital Costs:		***$102,000.00***

4. **ANNUAL COSTS FOR RECYCLE OPTION**

Year	Item	w/ Recycle	Total
1	a. Interest Expense (Capital Cost x Interest) ($102,000.00 x 12% =) (B*)	*12,240.00*	
	b. Depreciation Expense (C*)	*10,200.00*	
	c. Initial Training	*2,000.00*	
	d. Operating Expenses (Labour, Utilities, Maintenance)	*10,200.00*	
	e. Waste Disposal	-	
	Total - Year 1		*$34,640.00*
2	f. Interest Expense ($68,000.00 x 12% =)	*8,160.00*	
	g. Depreciation Expense	*10,200.00*	
	h. Operating Expenses (Assume 5% per year increase)	*10,710.00*	
	i. Waste Disposal (Assume 5% per year increase)	-	
	Total - Year 2		*$29,070.00*

Notation:

A* - For example only - Actual costs vary.

B* - As per U.S. EPA (1992). Assume money is borrowed for 3 years at 12% interest annually. Actual monies borrowed or repaid are neither revenues nor expenses and do not appear in financial analyses.

C* - Straight line depreciation is used at 10% each year (U.S. EPA, 1992).

5. **ASSESSMENT OF APPARENT COST SAVINGS**

Raw Material	Quantity	Cost	Total	
j. Amount of recovered product	*1,780 t*	-		*Of 1,000m^3 returned concrete, assume a density of 2.2 and 81% is gravel.*
k. Costs of recovered product	-	*$10/t*		
l. Total value of recovered product			***$17,800.00***	***Amount of gravel = 1,000 x 2.2 x 0.81 = 1,780 t***

Raw Material	Quantity	Cost	Total	
m. Amount of recovered product	*200 t*	-		*Of 1,000 m^3 returned concrete, assume a density of 2.2 and 9% is cement.*
n. Costs of recovered product	-	*$ 50/t*		*Assume slurry cement of less value*
o. Total value of recovered product			***$10,000.00***	

Water/ Solvent Reduction	Quantity	Cost	Total	
p. Amount of recovered water/ solvent	*154 t*	-		*Assume all 7.5% of water in concrete is recovered*
q. Cost per volume	-	*$ 0.25/m^3*		
r. Total value of water			***$40.00***	

Labour Reduction	Quantity	Cost	Total	
s. Amount of reduced labour	*30 Min/Day*	-		*Assume 1 trip per day to dump. Time to dump site and back: 30 minutes/driver/day.*
t. Cost Labour per Unit	-	*$15/Hour*		
u. Total Labour Savings			***$1,890.00***	***Annual time (for disposal) costs (252 days): 126 hr x $15/hr. = $1890/trip/truck/year.***

(Other Costs)	Quantity	Cost	Total	
Waste Disposal Costs:	*2,200 t*	*$ 20/t*	*$44,000.00*	***Mileage to dumpsite: 2 miles (4 miles return). Mileage cost: $1.00/mile. Mileage Costs (for disposal): 252 x $1.00 x 4 = $1,008/truck/year.***
Other Costs: Mileage	*4 Miles Rtn.*	*$1.00/Mile*	*$1,008.00*	
Change in Utilities Costs:		-		
Change in Insurance Costs:		-		
Subtotal - Other			*$45,008.00*	
Total Apparent Cost Savings:			***$74,738.00***	

6. **REAL COST SAVINGS = (Total Annual Costs - Total Apparent Cost)**

The estimated cost savings in the first year would be:

($76,738.00 - $34,640.00) = $40,098.00

THIS IS AN EXAMPLE ONLY TO SHOW METHOD OF CALCULATION. ACTUAL COSTS OF SAVINGS MAY BE SIGNIFICANTLY DIFFERENT.

Worksheet 17
Completed By: *S. Lee* Date: *June 25, 1996*

Summary of Analysis of Pollution Prevention Option

1. **Facility Name:** *River Road Plant*
2. **Option Name:** *Installatiion of recycling/reclaimer system*
3. **Briefly describe the option:**
   Allows separation of aggregates and cement for reuse
4. **Waste Stream(s) affected:**
   Returned concrete
5. **Input Material(s) affected:**
   Aggregates, cement, water
6. **Product(s) affected:**
   Recovered cement can only be used for "non-spec" applications
7. **Indicate Type:**
   - ○ **Source Reduction**
     - ○ Equipment-Related Change
     - ○ Personnel/Procedure-Related Change
     - ○ Materials-Related Change
   - ☑ **Recycling/Reuse**
     - ☑ On-site
       - ☑ Material reused for original purpose
     - ☑ Off-site
       - ☑ Material used for lower quality purpose
       - ○ Material sold
8. **Financial analysis attached:** *Yes*
9. **Originally proposed by:** *S. Lee* **Date:** *July 15, 1996*
10. **Reviewed by:** *J. Bure* **Date:** *July 30, 1996*
11. **Approved by:** *R. Smith* **Date:** *July 30, 1996*
12. **Reason for acceptance/rejection:**
    Economics promising. Must seek market for non-spec concrete.
    Not accepted at this time. Will use hydration control for reuse of concrete in subsequent batches.

2.7 Final Report of Pollution Prevention Team

Following completion of the process of identifying priorities and assessment of options, the Pollution Prevention Team would provide a summary report for management for recommended actions (Worksheet 18).

A mechanism will be required to ensure that responses to management approved options do occur. The mechanism may include one or both of:

- designation of responsibility for completion of the options to an individual within the company; and,

- periodic meetings of the Pollution Prevention Team to monitor progress of actions.

Worksheet 18
Completed By: *S. Lee & R. Smith* Date: *May 20, 1996*

Summary of Approved Pollution Prevention Actions

Approved Easily Implemented Pollution Prevention Measures (From Worksheet 13)	Responsibility	Anticipated Completion Date
· *Move acid drum immediately to safer area*	*N. Kruse*	*July 15, 1996*
· *Move all drums to contained area*	*N. Kruse*	*July 15, 1996*
· *Immediately improve housekeeping for concrete spills*	*N. Kruse*	*July 15, 1996*
· *Install flow controls for freshwater hoses*	*N. Kruse*	*July 15, 1996*
· *Install fuel dispensing locks*	*N. Kruse*	*Aug. 01, 1996*
· *Immediately hire firm to test UST for leaks*	*S. Lee*	*Aug. 30, 1996*
· *Write to waste disposal company, re: destination of wastes*	*R. Smith*	*Aug. 30, 1996*
· *Hire consultant to prepare spill response plan*	*R. Smith*	*Sept. 30, 1996*
· *Evaluate fuel drip and spill containment options*	*S. Lee*	*Sept. 30, 1996*
- Install selected option(s)	*S. Lee*	*Dec. 30, 1996*
· *Evaluate bulk tank overflow alarm options*	*S. Lee*	*Sept. 30, 1996*
- Install selected option	*S. Lee*	*Dec. 30, 1996*
· *Evaluate oil contaminent in machine shop*	*S. Lee*	*Sept. 30, 1996*
- Make recommendation to R. Smith	*S. Lee*	*Dec. 30, 1996*
· *Investigate options for yard dust control*	*S. Lee*	*Nov. 30, 1996*
- Make recommendation to R. Smith	*S. Lee*	*Dec. 30, 1996*
· *Repair cracks in chemical room floor*	*N. Kruse*	*Dec. 30, 1996*
· *Repair curbing or suggest options to prevent yard stormwater runoff into process area*	*N. Kruse*	*Dec. 30, 1996*
· *Investigate wastewater basin overflow situation and report to R. Smith*	*S. Lee*	*March 30, 1997*

Approved Pollution Prevention Measures Following Detailed Analysis (From Worksheets 14 B 17)	**Responsibility**	**Anticipated Completion Date**
Re: *Recycling of all returned concrete* Recommendation: *Use of admixtures for hydration control to enable reuse of concrete at a later time.*	*S. Lee*	*To be implemented by Sept. 30, 1996*
Re: *High volumes of returned concrete*. Recommendation: *Application of 10% surcharge for each cubic metre returned.*	*J. Bure*	*To be effective immediately*
Re: *Non - compliance. Liquid effluent* Recommendation: *Install Apolisher@ at settling pond discharge*.	*S. Lee*	*Dec. 30, 1996*
Re: Recommendation:		
Re: Recommendation:		

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APPENDIX I

Background Industry Information

AReady Mix Concrete Industry
Environmental Code of Practice
1993 Update@

READY MIX CONCRETE INDUSTRY
ENVIRONMENTAL CODE OF PRACTICE
1993 UPDATE

Prepared for:

Conservation and Protection
Environment Canada
North Vancouver, B.C.

Prepared by:

Envirochem Special Projects Inc.
310 East Esplanade
North Vancouver, B.C.
V7L 1A4

March 1993

READY MIX CONCRETE INDUSTRY
ENVIRONMENTAL CODE OF PRACTICE
1993 UPDATE

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ENVIRONMENTAL CODE OF PRACTICE
1993 UPDATE

1.0 INTRODUCTION

1.1 Objective

This document is a revision of the 1990 Recommended Waste Management Practices for the Ready Mix Concrete Industry in British Columbia. The purpose of this document is to outline recommended operational practices that will minimize the impact of ready mix facilities on the receiving environment. This revision includes updated practices currently available to the industry and an indication of the expected quality of discharges that may result from state-of-the-art practices. In this way, this technical recommendations document (TRD) can be used by ready mix facility operators as a benchmark for new facilities or the upgrading of existing facilities. The recommendations generally represent good industrial practices that are realistic and economically achievable. In some circumstances, for example for facilities adjacent to very sensitive waters, additional measures may be necessary to further protect the environment.

Environment Canada has commissioned the preparation of this revised document to provide guidance to facility operators in British Columbia who wish to operate in an environmentally sound manner. This TRD also provides uniform guidance to the B.C. Ministry of Environment as they formulate and administer Waste Management Permits for ready mix concrete facilities. Although the recommendations of the document have no binding legal or regulatory status, they have been drafted in consultation with Environment Canada, the B.C. Ministry of Environment, and industry personnel (including the B.C. Ready Mixed Concrete Association, selected independent facility owners and operators, and chemical suppliers).

1.2 Background

Environment Canada Regional Program Report 88-03, "Overview of the Ready Mix Concrete Industry in British Columbia, Water and Waste Management Practices (June 1988)" is a detailed evaluation of the industry from which the original TRD was derived, including a description of wastewater treatment and recycling practices. The report included information gathered from visits to 17 plants in the Greater Vancouver area.

This revised TRD includes information from site visits to six sites, five of which were part of the original evaluations. These recommendations are supported by recent discussions with facility operators, industry associations in B.C. and the United States, admixture chemical suppliers, regulatory agency personnel in B.C.

1.3 Environmental Concerns

In the context of primary manufacturing industrial facilities, ready mix concrete plants do not generally pose significant problems in terms of environmental impact. However, concerns may exist at certain facilities, especially where process effluents or contaminated stormwater runoff are discharged into an environment with significant resource value. This may include sensitive fisheries streams or groundwaters used for irrigation or potable water supply. The TRD hopefully will provide guidance to facility operators so that conflicts with other resource stakeholders are minimized.

Table 1 outlines the specific concerns about wastewater and storm water discharges from permanent and portable ready mix concrete facility operations.

TABLE 1

Summary of Potential Environmental Concerns from Ready Mix Concrete Facilities

ISSUE	CAUSE	CONCERN	LEVEL OF CONCERN
pH	Soluble cement constituents will raise pH in effluent and/or stormwater runoff	- High pH is toxic to fish -High pH is corrosive to metal - High pH is undesirable in drinking water	- pH >10 will kill salmonid fish in minutes [1] - pH 6.5 to 8.5 recommended for drinking water supplies
Total Suspended Solids	Cement, sand and fines in effluent and/or stormwater runoff	- Can kill fish/shellfish through abrasive injury or clogging of gills and respiratory passages - May contain leachable toxic substances - Visible Plume in Receiving Waters - Screens light, contributes to oxygen depletion - Destroys fish habitat	- ambient suspended solids highly variable in fish bearing waters, 50 to 125 mg/l desirable
Admixture Chemicals	Spills carried off-site in effluent or stormwater runoff	- High concentrations may injure or kill aquatic organisms by causing high chemical oxygen demand (C.O.D.), high pH, and/or aquatic toxicity	- Specific to active ingredients - MSDS's may indicate aquatic toxicity
Mineral Oil & Grease	Drips off mechanical equipment contaminate stormwater runoff	- Toxic to aquatic organisms [2] - "Oil/grease" can include fuel, lubricants and hydraulic oil	- Highly variable with species - e.g., crude oil is extremely toxic at 0.3 mg/L [2]

References 1 D. McLeay and Associates Ltd., Toxicity of Portland Cement to Salmonid Fish, Vancouver, 1983.
2 Guidance Documents for Effluent Limitations and New Source Performance Standards for the Concrete Products Point Source Category, Effluent Guidelines Div., USEPA, Wash., D.C., Feb., 1978.

1.4 Regulatory Aspects

Ready mix facilities within British Columbia are generally regulated by Environmental Protection (formerly the Waste Management Branch) of the B.C. Ministry of Environment by the use of Permits issued under the Waste Management Act. These Permits are issued by the regional offices and contain operational and monitoring requirements that are determined on a site specific basis. An inter-agency referral process established by the B.C. Ministry of Environment ensures that input and recommendations from federal, provincial and municipal agencies are considered during permit preparation.

In 1975, the B.C. Ministry of Environment published the Pollution Control Objectives for Food Processing, Agriculturally Oriented, and Other Miscellaneous Industries of B.C. covering the ready mix industry. These Objectives stipulate effluent quality requirements and provide guidance to Ministry staff when issuing effluent permits. As of this date, these Objectives have not been revised and re-issued and now are of limited value as they no longer represent minimum achievable practices.

Facilities located on federal Crown lands, such as land leased from the Coast Guard or from a Harbour Commission, will fall under the jurisdiction of Environmental Protection of Environment Canada. These sites are not regulated by Permits but fall under the general conditions of the Canadian Environmental Protection Act and the Fisheries Act.

Discharges to fish-bearing streams or marine waters are subject to the general provisions of the federal Fisheries Act; Section 36(3) of the Act prohibits the "....deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water". Also, Section 35(1) of this Act states, "No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat", and is applicable due to the high concentrations of settleable solids in many ready mix plant effluents. This Section of the Fisheries Act is administered by the Department of Fisheries and Oceans (DFO) whereas Section 36(3) is co-administered by DFO and Environment Canada.

The most stringent operational and monitoring requirements are generally applied to facilities which discharge effluent to waterbodies. In such cases, a Waste Management Branch Permit may include limitations on effluent characteristics such as:

Total Suspended Solids or Non-Filterable Residue	50 - 125	mg/L
pH	6 - 10	
Temperature	< 25 - 32	ºC
Mineral Oil & Grease	< 5 - 10	mg/L
96 hour LC_{50} Bioassay	100 %	effluent concentration

Where discharge is to the ground, such as to an infiltration pit, or where total recycle is carried out, effluent contaminant concentration levels are normally not specified. Under these circumstances, Permits may require that effluents are "equivalent to or better than typical effluents from a ready mix concrete batch plant" as determined from monitoring results obtained by the Ministry staff. In addition, general operating conditions for the settling basin or other works may be stipulated. These might include prohibition of recycling basin overflow to the environment or the prevention of uncontaminated stormwater runoff entering the treatment works.

Waste Management Act Permits may include requirements for effluent monitoring and reporting. Generally, monitoring of effluents by the permittee is required quarterly, but in the case of sensitive environments, monitoring may be required monthly. Reporting is generally on a quarterly or annual basis.

The disposal of settling basin sludge may be addressed in the Permit by indicating that solids disposal must be in a manner or location approved by the Regional Waste Manager. In practice, disposal of sludge and solids are not closely monitored by the regulatory agencies and generally Permittees are not obligated in the Permit to report the volume or method of solids disposal.

As part of the regulatory approval process, a ready mix facility operator is advised to be fully aware of the operational and monitoring requirements in the discharge Permit. During the Permit review period, it is advisable for an operator to discuss the site specific features of their operation with the B.C. Ministry of Environment representative so that the Permit accurately reflects their operation. There is also a fee for holding a Waste Management Permit and this fee is based on the volume and quality of effluent released to the environment. Operators should ensure that this information is correct.

2.0 OVERVIEW OF READY MIX OPERATIONAL PRACTICES

2.1 Concrete Composition

The typical components of ready mix concrete are:

TABLE 2

Composition of Typical Air-entrained Concrete

INGREDIENT	TYPICAL COMPOSITION		
	kg/m^3	**% by wt. (1)**	**% by vol.(2)**
! Coarse aggregate	625	48	31 - 51
! Fine aggregate	410	31	24 - 28
! Portland Cement	174	13	7 - 15
! Water	104	8	14 - 18
! Admixture Chemicals (control characteristics such as air entrainment, water: cement ration, initial set, compressive strength)	0.26 - 0.28	< 0.01	-
! Air	-	-	4 - 8

References:
(1) Guidance Document for Effluent Limitations and New Source Performance Standards for the Concrete products Point Source Category, Effluent Guidelines Div., USEPA, Wash., D.C., Feb. 1978.
(2) Can. Portland Cement Ass'n. Design and Control of Concrete Mixtures, 1990.

2.2 Process Description and Waste Management Practices

This section summarizes the ready mix process and describes the main components of water use and wastewater generation. Figure 1 illustrates a typical batch mix plant, which uses the truck drum for mixing the concrete ingredients. The batch plant process differs from a central mix process in that a central mix plant uses a fixed hopper for mixing ingredients prior to loading the trucks. In a batch plant, the measurement of the ingredients is conducted by an operator
from a central control room. Solid components are accurately metered by weight and added to the truck from overhead silos. Water and chemical admixtures (generally liquids) are metered by volume. Ready mix truck capacities are quite variable depending on the expected use of the vehicle and capacity of the plant. Capacities typically range from 5-12 cubic meters, with larger capacities being more common in urban centres where larger construction projects take place.
With reference to the numbers shown in Figure 1, the main components of the ready mix batching process are:

(1) Concrete Mixing

Ingredients are added to the drum through a metal chute at the upper rear of the truck. Solid ingredients are added dry, and a rubber "sock" is normally used to minimize dust losses during loading.

(2) Exterior Truck Wash

After loading, the truck moves to a wash area, where overhead sprays or a driver-operated hose is used to wash down the truck exterior. The truck then delivers the concrete load to the customer.

In addition to the routine exterior truck wash described above, weekly (or as required) exterior washing is carried out using a dilute muriatic acid solution to remove persistent concrete residues.

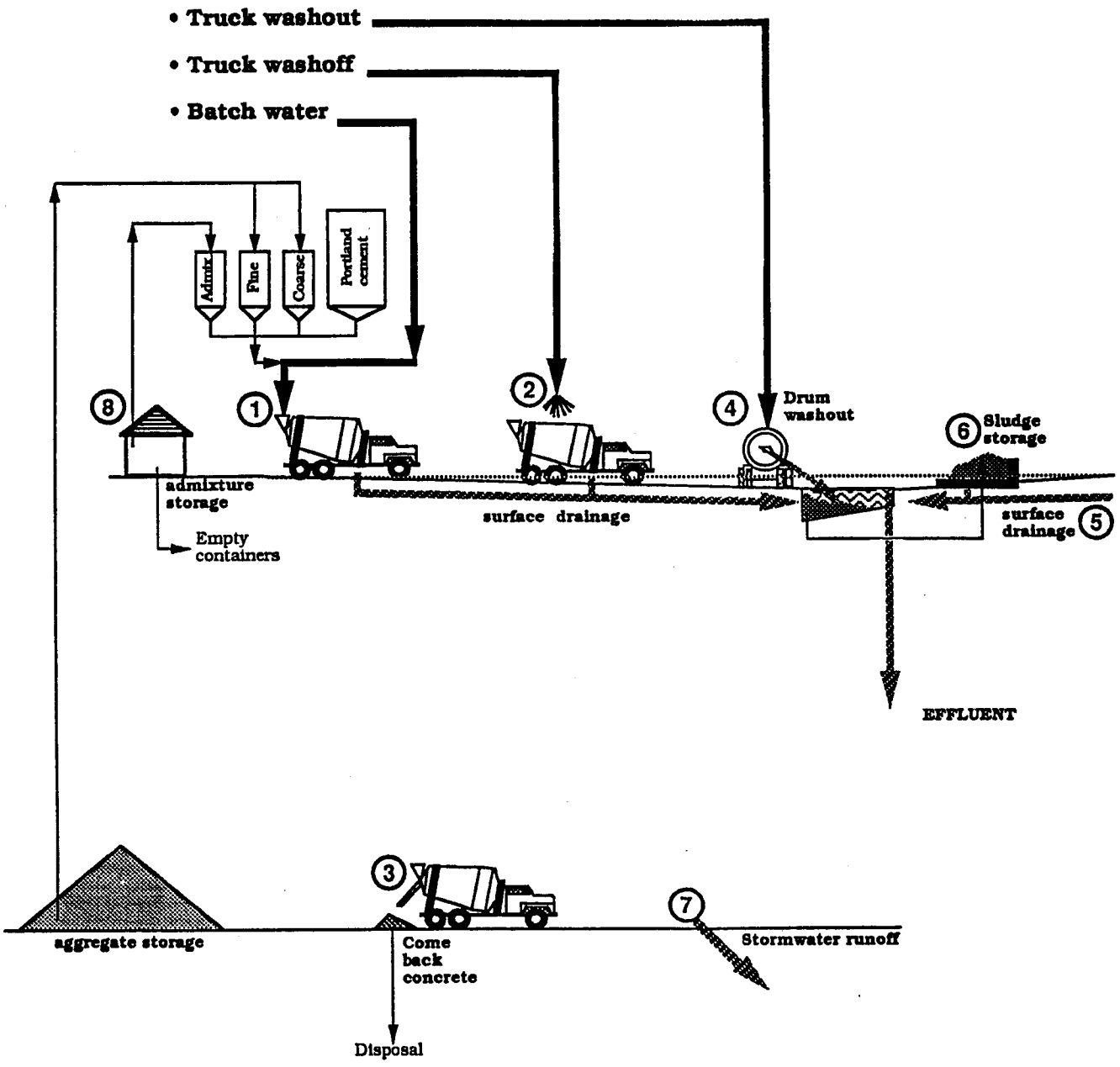


FIGURE 1: Typical components of batch ready mix concrete production

(3) Disposal of Returned Concrete

Some portion of the concrete load is often left in the truck following delivery. During operating hours, it is common practice for this residual concrete to remain in the truck drum and to be incorporated into the next concrete load. Where the next load may not be made until the following day, a few facility operators use retarding agents such as "Delvo" or "Recover" in the come back mix to slow hydration so it may be incorporated in the next day's batch.

When incorporation in the next load is not possible during operating hours and returned concrete must be discharged from the truck, it is generally disposed of by one of the following methods:

- production of precast concrete products, such as highway dividers, lock-blocks or retaining wall blocks

- on-site use in paving yard surfaces or as site fill

- discharge to ground for drying and breaking, then transport to another site for fill

- recycle into cement manufacturing process, where available

Excess concrete is occasionally discharged to the wash water collection system if other disposal options are not available. In most instances, the insoluble concrete ingredients settle and are removed with the washwater sludge. Although mechanical solids reclaim systems are available, they are rarely applied to recover concrete ingredients in B.C. plants. A few plants use mechanical aggregate recovery systems (e.g. drag chains) to provide recovery of coarse aggregate.

(4) Drum Wash

At the end of the operating day, the truck drum must be washed of concrete. This wash is normally completed by the driver, using overhead water racks or hoses. Water is added to the drum, and the drum is rotated. The wash water is then discharged to the wash water collection basin.

(5) Surface Drainage and Wastewater Management

Ready mix concrete plants commonly have paved process areas in order to allow collection of contaminated process water and surface runoff from truck loading, truck washoff and drum washout areas. Some plants also provide collection of runoff/leachate from sludge storage and drying piles.

Practices vary with respect to effluent disposition. Removal of suspended solids is principally accomplished through the use of settling basins. At most plants, a primary settling basin will overflow to a second settling basin; in some cases, additional basins in series are used. It is common for waste waters to be recycled in some part of the process, but during high rainfall accumulations, some overflow discharge to a ditch or surface drainage system will occur. Where direct discharge to a receiving waterbody is not permitted because of environmental sensitivity, wastewater is often discharged to the ground via an infiltration basin. Only one facility evaluated in 1993 did not reuse the wastewaters and this operator must neutralize the pH of the effluent on an as-needed basis. Effluents with high pH may be classified as Special Waste and require special handling (see section 2.3.3).

Fresh water is normally used for exterior truck washes and for the production of hot water (for winter batching). Settled process water is used for drum washout. The proportion of fresh water to recycled water depends on the amount of recent rainfall, the quality of the settled effluent and on the concrete specification. Recycling is less common when there is a tight specification on the concrete made at the plant.

(6) Solid Waste Management

Most facilities periodically decant water from the collection basins and remove accumulated sludge to an on-site storage and drainage area for drying. Sludge storage is usually on unpaved ground, often in 3-walled bins constructed from large concrete blocks produced from returned concrete. Less frequently, sludge may be stored in uncontained piles.

Returned concrete may be dumped on the ground on site and broken into small pieces after it is fully hydrated. In urban areas, the sludge and concrete residue is allowed to dry and is periodically removed for use as fill. In remote operations, the amount of returned concrete is generally small with alternate use or disposal occurring near the construction site. Although landfill disposal of hardened cement solids has been used in the past, urban landfill operators generally will no longer accept these wastes since they needlessly consume available landfill volume.

(7) Stormwater Management

Practices to control surface runoff vary widely and are often determined by physical site constraints such as drainage, slope and access to storm runoff systems. At stationary plant sites, the process area is usually paved and sloped to direct process water and stormwater from these areas into the water collection system. In remote locations, it is common practice for the entire site to be unpaved. Segregation of surface runoff between process and wash up areas and aggregate storage and parking areas is helpful in minimizing the amount of contaminated runoff that must be managed; clean water can be discharged directly whereas contaminated water should be used for recycle.

(8) Chemical Delivery and Storage

Chemical admixtures used to control concrete characteristics are predominantly supplied as bulk liquids, although smaller 22 litre plastic containers are still used for specialty mixes and small, remote sites. Bulk admixture chemicals are generally stored in 2,200 - 4,400 litre tanks. Historically, steel tanks have been commonly used, although there is now a trend toward corrosion-free plastic tanks. It is still common to find bulk admixture storage tanks on a concrete pad without any curbed containment. Curbed containment would prevent the loss of spilled admixtures from entering the storm drainage system around the loading area.

Calcium chloride ($CaCl_2$) solution is a chemical admixture which is generally stored in exterior upright cylindrical tanks, normally located adjacent to the admixture storage area.

Concentrated muriatic acid (HCl) is used to prepare dilute acid rinse solutions for periodic exterior truck washes. Muriatic acid is supplied as a liquid in standard 205 L plastic drums, and is often

stored outside, adjacent to other chemical storage or in the truck wash area. Freezing of the liquid should not be a concern most of the year; the freezing point of 10% muriatic acid is -15EC.

Portland cement is stored in elevated silos (varying widely in size) which are located above the truck loading area. A large main cement silo may be located apart from the loading area and used to feed smaller loading silos. Baghouses are normally used to control cement dust emissions which occur when cement is loaded into the silos.

Aggregates (sand and gravel) are commonly stored in piles on unpaved areas of the site, or in automatic feeding hoppers.

2.3 Waste Management

2.3.1 Water Use

Environment Canada Regional Program Report 88-03 presents information on quantitative water use and wastewater generation in the ready mix industry. This update of the Technical Recommendation Document has found that little has changed since the preparation of the 1988 report with regard to water use by the industry. The data represents a wide range of water use practices, representing the typical variation expected within the B.C. industry. Batch water contained in the concrete product comprises only about 27% of the total plant water use and drum washout has the highest water demand.

2.3.2 Wastewater Volume

As with water use, there is high variation of wastewater generation from plant to plant. Recycling and reuse of process water greatly reduces the volume of waste water that must be discharged. Since drum washout uses a significant volume of water, recycling this water has the greatest overall benefit in terms of water use reduction.

Information on the current specific water treatment and reuse practices at B.C. ready mix facilities is not available on an industry-wide basis. Environment Canada's study summarized practices at 17

facilities (November 1987), and this information was updated in 1989 for 7 facilities which were surveyed for the 1988 evaluations. The 1993 evaluations assessed six facilities.

Discussions with B. C. plant operators, chemical suppliers and other industry personnel indicate that reuse of clarified water for drum washout is commonly practised. Most plants use some proportion of fresh water for exterior truck washing and batch water. Fresh water is used exclusively for hot water for winter concrete production.

Zero discharge batch plants are not common in B.C. A zero discharge facility collects all contaminated runoff and wash waters and recycles the water into the mixing water or into the wash process. A significant reason for the inability of the industry to meet zero discharge operations is the excess water that enters the system from precipitation at most locations in the province. Storage of all the accumulated runoff is often size and cost prohibitive for most operators. Only one plant in the Lower Mainland has attempted to operate as a zero discharge facility under normal rainfall conditions. The operator found no problems with the quality of the product or build-up of residuals in the drum occurred. During high rainfall events, even a zero discharge system will likely have a discharge, although the large dilution has the effect of minimizing any impact.

Waste Management Permits will limit the maximum volume of process and washwater discharged from a facility on a daily basis. In general, most facilities do not have flow measuring devices capable of accurately measuring the process discharge volume on a continuous basis. The volume can be determined by sampling the discharge volume over a short period of time. Since the total volume of discharge is greatly influenced by rainfall and catchment area, it is not useful to compare the discharge volume from site to site unless the effects of rainfall are excluded.

2.3.3 Wastewater Effluent Characteristics

Table 3 below summarizes the findings of the effluent quality evaluations undertaken as part of the 1993 Ready Mix Industry in the Lower Mainland. Samples were taken on two occasions at each of

the sites. The table indicates the sampling location, but in general the samples represent the process water supernatant present in the setting basin.

pH

Available data for pH of B.C. ready mix facility effluents are based on limited monitoring at individual plants. Determinations made during the 1987 site visits to B.C. facilities indicated that effluent from ready mix plants, including runoff from process areas, is frequently strongly alkaline. The 1993 data confirms this finding, with pH values generally over 10.5 for process water samples taken in the sedimentation basins. However, samples of effluent discharged to the environment showed pH values less than 9.0. Dilution by low pH rainfall and neutralization with hydrochloric acid (HCl) are responsible for the lower pH of these effluents.

The allowable pH of process effluents at B.C. ready mix facilities is normally stipulated in Waste Management Branch Permits for facilities which discharge to waterbodies. Although permits are written on a case-by-case basis, the specified allowable range generally falls within the range of pH 6.0 to 10.0. Discharges to ground may have a greater range, depending on the site. Effluents and slurries with a pH over 12.5 are considered to be Special Wastes and must be neutralized before discharge. The Waste Management Branch Permit also normally requires the permittee to monitor the pH of effluent at least once quarterly. This data is of limited use since there is no control over the sampling circumstances and the results can be greatly affected by dilution. Continuous monitoring producing hourly and daily averages would be necessary to produce environmentally significant data.

The previous site evaluations found that none of the facilities adjusted effluent pH prior to discharge. The 1993 evaluations found one facility monitoring and adjusting the effluent pH in order to maintain the pH less than 9.0.

Sites	Location Notes	pH		TSS		Temp EC		Oil & Grease		LC_{50}	
		1st	2nd	1st	2nd	1st	2nd	1st	2nd	1st	2nd
1	**a**	10.5	11.4	17	4	2	2	6	<5	60	40
2	**b**	11.9	8.4	42	39	5	7	5	5	7	18
3	**c/b**	12.2	12.4	660	24	5	6	25	<5	7	2
4	**d**	12.5	11.8	351	<1	7	3	6	<5	6	24
5	**e**	8.8	7.8	7	<1	2	1	<5	<5	>100	>100
6	**f**	7.7	-	48	-	2	-	<5	-	>100	-
CRM certified **CRM** found (avg)		9.1 9.0	9.1 9.0	47 48	47 46	- -	- -	spike 127%	spike 112%	control >100%	control >100%

TABLE NOTES:

pH = Hydrogen ion concentration; relative units
TSS = Total suspended solids; milligrams per litre
O&G = Oil & Grease; milligrams per litre
LC_{50} = 96 Hour Lethal Concentration for 50% fish mortality
CRM = Certified reference material
TEMP = Temperature of effluent sample. Temperature generally 2 - 3ºC above or below air temperature.

a = reclaim water; periodic discharge to environment
b = reclaim water; no discharge to environment
c = yard stormwater runoff; periodic discharge to environment
d = yard stormwater runoff & reclaim; no discharge to environment
e = yard & offsite stormwater runoff & reclaim; discharge to environment
f = yard stormwater runoff; discharge to environment

TABLE 3: SUMMARY OF READY MIX PLANT EFFLUENT SAMPLING RESULTS

SUSPENDED SOLIDS

The allowable level of total suspended solids in process effluents from B.C. ready mix facilities is normally stipulated in Waste Management Branch Permits for facilities which discharge to waterbodies. Permits are written on a case-by-case basis, and the specified allowable suspended solids concentrations range from 50 to 125 mg/L for surveyed permits in Lower Mainland facilities. As with other effluent characteristics, the Waste Management Branch Permit may also require the permittee to monitor the suspended solids level of effluent at least once quarterly. As with pH however, effluent suspended solids levels are not correlated with wastewater flow, thereby making the results of limited statistical value.

The results of the 1993 evaluation found a large range of suspended solids in the samples of settling pond supernatant. The samples representing discharges to the environment (Site 5) had suspended solids levels less than 50 mg/l.

A survey of permittee monitoring data for ready mix facilities in the Lower Mainland of B.C. indicates that some facilities discharge effluent within the terms for suspended solids imposed by their permit, while others discharge effluent which is well outside allowable levels. Measured suspended solids levels range from <5 to 205 mg/L.

OIL & GREASE

Mineral oil and grease are associated with both mobile and stationary equipment. Mobile equipment, including cement mixing trucks, delivery trucks and front end loaders has the potential to lose oil throughout the yard as small drips or as sudden, large volume losses from hydraulic system rupture. Spill response kits, containing booms, absorbent and other response equipment, should be available to address a mobile equipment spill.

Stationary equipment include the cement plant and air compressors. Containment of potential sources of oil can be provided around stationary equipment. Typical containment consists of a concrete slab under the equipment with a concrete curb high enough to contain 110% of the liquid in the equipment. Cover is necessary to maintain the containment free from precipitation.

Oil and grease are not evaluated as part of normal plant operations. However, regulatory limits are becoming more stringent with regard to the loss of oil in stormwater and to the sanitary sewer. The target oil and grease concentration for a facility should be less than 10 mg/l for all discharges from a site to the environment.

2.3.4 Waste Solids Disposal

Ready mix facilities produce sludges from the cleanout of settling basins, and waste solids from returned concrete. There are no available data for the quantities of sludges or solids generated by B.C. facilities.

Some Ministry of Environment permits for ready mix facilities specify that waste solids "shall be disposed of to a site" and/or "in a manner approved by the Regional Waste Manager." In general, the 1993 evaluations found that waste solids are being handled in an environmentally sound manner agreeable to the Ministry. Returned concrete is mostly used in the manufacture of secondary products, such as Lock-Blocks. Several of the ready mix operators have installed or are investigating aggregate recycling systems which will allow the reuse of returned concrete aggregate in fresh concrete. Few operators waste returned concrete in a landfill.

Settling basin sludge is generally allowed to dry and is broken up for construction fill or disposal in a landfill. It is important that the sludge be fully set (hydrated) prior to disposal. If the sludge is not fully hydrated, it is likely that the pH of the water will be above 12.5 and therefore the waste will be a Special Waste. Once fully hydrated however, the dried solids will generally not produce a high pH runoff once exposed to water and therefore are acceptable for landfilling.

Sites	1989 Audit	Concrete Market	Stabilizer Use	Solids Reclaim System	Effluent Reuse Batch Mix	Yard Runoff Collection	Best Treatment Technology solid	Best Treatment Technology liquid	Operation Type	Effluent Discharge to Watercourse
1	Y	R	Y	N	N	N	N	N	T	N[c]
2	N	R	Y	Y	Y	N	Y	N[b]	NT	N[c]
3	Y	C	N	N	Y	N	N	Y	T	Y
4	Y	R	Y	N	Y	Y	N	Y	NT	N
5	Y	R	N	N	N	Y	N	N	NT	Y
6	Y	C	N	N[a]	Y	Y	N[a]	Y	NT	Y

TABLE NOTES

BTT = Best Treatment Technology
N = No
Y = Yes
R = Residential
C = Commercial
T = Typical
NT = Not typical

a = treatment system installation planned for solids reclaim
b = treatment system installation planned for contaminated stormwater runoff
c = contaminated stormwater discharged to drainage ditch

TABLE 4: SUMMARY OF READY MIX PLANT ENVIRONMENTAL AUDIT INFORMATION

3.0 RECOMMENDED DESIGN AND OPERATING PRACTICES

Recommended design and operating practices are intended to minimize the environmental impact of the ready mix concrete industry. The recommendations have been developed from existing environmentally friendly practices demonstrated by the industry and include new and innovative waste minimization and recycling techniques that represent best practical technology. The application of the recommendations will depend on the specifics of each site. In some cases, the recommended practice may have to be modified to suit a particular operation. It is important to recognize that the main objective of good operating practice is the protection of the environment around a ready mix facility; hopefully this document will assist operators in meeting this objective.

3.1 Process Effluent Management

3.1.1 Minimizing Wastewater Volume

The most effective technique to reduce the cost of managing any waste is to prevent its generation in the first place. This rule of thumb is particularly applicable to the generation of waste waters from process effluents. In the ready mix concrete industry, preventing the generation of effluent includes minimizing the volume of water from washing truck exteriors and minimizing the volume of drum wash water that must be wasted. Practical solutions include flow restrictors on the fresh water supply and reuse of treated drum wash water for subsequent drum washing. Careful control of fresh water supply into a facility has the potential of producing a zero discharge operation under normal rainfall conditions. Table 5 summarizes some of the most practical approaches commonly used to minimize water use at an industrial operation.

For several years, ready mix plant operators have experimented with the use of recycled water for batch water. Although the use of settled, recycled water for drum washout is common at B.C. plants, reuse of water for batch water is less common. The main reason for this is likely the existing CSA standard that recommends against the reuse of this water in the batch. It appears that concerns relate to inferior product quality that may result from washwater reuse. Unfortunately, this recommendation is not consistent with the observed practice in the industry nor with current waste minimization techniques being implemented. If quality of the recycled water can be maintained by

eliminating unwanted contaminants, such as oil and grease, and by controlling the concentration of solids in the recycled water, it is good environmental practice that recycle water be considered for use as batch water, especially where a surplus of available recycled water exists at a facility.

Another option available to reduce the volume of waste water generated is through the use of chemical stabilizers in the drum wash water. These products are used at some facilities to hold the wash water overnight in the drum. This water is then incorporated into the mix at the start of the following day. This procedure has the potential to substantially reduce waste water and waste solids volumes that must be handled. However, during the 1993 evaluations, operators indicated that this practice is not possible in winter when freezing conditions exist unless the drum cleaning water is heated, or when the concrete specification is for a high strength mix. Based on this information, it would appear that the industry preference is to recycle the drum wash water through a treatment system rather than by holding it in the drum overnight.

3.1.2 Waste Water Collection and Treatment

Table 6 outlines the recommended operational practices for the collection and treatment of process effluents that have become contaminated by the ready mix process.

Efficient collection of effluents, with a minimum of inflow of uncontaminated water to the system, is important. Paving, curbing and sloping can be used individually or in combination to produce a catchment area for process effluents. A large catchment area will increase the amount of water that enters the system, generally as a result of precipitation, and which will have to subsequently be treated and/or recycled. Collection basins must be sized according to the catchment area and anticipated rainfall during the operational months so that sufficient storage is provided. A design rainfall event is based on historical data for the nearest weather station to the site. As a guide, a minimum 10 year return period, 30 minute duration storm should be used for the design storm. Environment Canada's Atmospheric Environment Service may have an Intensity-Duration-Frequency (IDF) curve, for the nearest station, that will give the design rainfall in millimetres per hour. For B.C., the range could be from 3 mm/hr to about 15 mm/hr, depending on the geographic location.

In the event of extreme rainfall events, there may be insufficient storage volume to contain the entire runoff volume. Normally this will not be a concern, however, since there will be sufficient clean water to dilute the contaminated water, rendering it relatively innocuous.

The main treatment strategy used for contaminated ready mix facility runoff is settling. Collected effluent is allowed to remain in a calm, low velocity basin for a period of time to allow the settleable solids fall out. The rate of settling is dependent on the size of the solids particle; the smaller the particle, the slower the rate of settling. While settling tests are recommended to determine the necessary basin size, generally over one hour settling or retention time will provide 80% to 90% reduction in settleable solids loadings. This type of effluent treatment is the most common in the industry.

An innovative approach to effluent management that greatly reduces the amount of settled solids that have to be cleaned out of the basin uses mixers to maintain the solids in suspension. Several techniques are available including using mechanical propeller-type mixers or using bubbling air. The solids are then incorporated into the mixing water for the next batch. This same system also incorporates a centrifugal separation aggregate recovery system as the initial treatment stage.

3.2 Solid Waste Management

The disposal of returned concrete and waste solids generated by wastewater settling systems is an expensive and troublesome problem for ready mix plant operators. This is particularly true for facilities located in congested urban areas. Appropriate disposal options are increasingly difficult to find, and the cost of concrete disposal has approached or exceeded the value of the concrete product in some areas. To address a pressing need for improved solids management, some facilities are installing a solids reclaim system while some others are utilizing chemical stabilizers or making alternative concrete products. Table 7 indicates acceptable methods for managing solid wastes.

TABLE 5

Minimizing Water Use at Ready Mix Facilities

WATER USE	OBJECTIVE: Minimize contaminated effluent by minimizing net water use
Minimize the need for wash waters	Minimize truck exterior contamination by controlling dust losses during loading by continuous metered water spray on loading chute opening. Minimize contamination of surfaces by controlling dust release (Section 3.5) and sludge storage pile drainage (Table 7).
Minimize net water use	Restrict fresh water uses to: - truck exterior washoff - hot water production - batch water Use recycled process water and stormwater from paved process areas for: - truck drum washout - miscellaneous washdown operations If possible, use recycled water for batch water, subject to operational and product quality constraints. Reduce truck exterior wash volumes by using a spray instead of hose wash Install flow controls on freshwater sources - install flow restricting nozzles/spring-loaded triggers at wash stations - eliminate uncontrolled and unattended discharge of water spray - consider mechanical control systems Employee training will minimize water use: - ensure workers understand proper water reduction techniques available at the site - monitor/supervise water use to reinforce the importance of controls and verify effectiveness
Minimize contaminant loadings	Minimize contamination of surface runoff by controlling dust release and sludge storage pile drainage. Control contaminant dispersal through good housekeeping and by minimizing vehicle traffic on contaminated site surface.
Maximize water reuse	Minimize drum washout water volume: - use reclaimed water - use multiple small-volume rinses rather than single large-volume rinses; series rinses are more effective and reduce total rinse volume - consider the use of stabilizers to minimize washes

TABLE 6

Waste Water Collection and Treatment

Waste Water Collection	**OBJECTIVE:** **Efficiently segregate and collect all contaminated waters**
Collect all wastewaters and contaminated surface runoff for treatment	Pave all site surfaces which are subject to contamination by concrete and ingredients, including truck loading, slump racks, washout racks, sludge storage areas. Aggregate storage areas should not normally require paving. However, surface runoff which is discharged to waterbodies from aggregate storage areas must meet regulatory suspended solids limitations. Curb and grade paved surfaces to collect all wastewaters and contaminated runoff. Direct all contaminated waters to a wastewater collection basin/treatment system. Prevent uncontaminated water from entering water treatment system catchment through the use of curbing, sloping or drainage channels. Segregate paved process areas from plant areas not subject to surface contamination Minimize traffic through contaminated waters by providing segregated drainage channels or by careful layout of traffic areas and collection basin location.
Provide adequate wastewater holding basins	Provide sufficient collection volume for contaminated waters to manage effluent in high precipitation periods. Design and construct basins to minimize subsurface leakage (except where exfiltration is intended).
Waste Water Treatment	**OBJECTIVE:** **Treat contaminated waters to effluent standards**
Treat uncontaminated effluents	Provide effective solids removal for collected wastewaters. This may include a sloped concrete settling basin overflowing into a second basin, or install solids suspension system and water reuse in the batch. Neutralize discharges to surface waters to meet regulatory requirements for pH. Provide equipment and training for effective routine pH monitoring. Discharge effluents to sewer rather than directly to the environment, where allowed.
Optimize treatment effectiveness	Properly design and operate treatment systems within effective operating limits for hydraulic and solids loading. Regularly clean treatment systems to ensure efficient operation. Monitor the performance of treatment systems to ensure effectiveness and compliance with regulatory requirements.
Contain and control stormwater	Control drainage (slopes, curbs) to collect contaminated stormwater in a separate, properly sized settling basin to provide settling for a maximum 10 year return, 30 minute duration precipitation event. Obtain actual data from IDF curve for the nearest weather station. Contain clarified stormwater and recycle. An engineered infiltration basin is an alternative to unavoidable discharge of contaminated stormwater off-site.

TABLE 7

Solid Waste Management Practices

Solid waste generation	**OBJECTIVE:** **Minimize solid waste volumes**
Management of Returned Concrete	*During daily operation:* Incorporate returned concrete in succeeding batches where consistent with product specifications and quality standards. *At day end:* - Use returned concrete for forming precast concrete products - Recycle returned concrete (dried and ground) as roadbed or other fill - If unavoidable, find approved disposal for returned concrete (see below).
Minimize Waste Solids	- Eliminate or minimize the discharge of returned concrete to water recovery systems. - Consider installing solids reclaim systems to recover solids from wastewater
Solid Waste Handling & Storage	**OBJECTIVE:** **Provide secure storage/handling for waste solids**
Sludge Storage	Contain sludge storage piles from cleanout of settling basins and aggregate recovery systems: - Locate in paved areas with controlled drainage. - Confine sludge piles with retaining walls such as walls constructed of pre-cast concrete blocks - Cover the piles to minimize drainage and leachate in regions of high precipitation. Design and operate sludge storage piles to prevent or minimize sludge dispersal by vehicle traffic. Collect leachate and drainage from sludge storage piles and return to process water recycle/treatment systems. Immediately collect and contain spilled solids in ready mix truck loading areas.
Solid waste disposal	**OBJECTIVE:** **Provide sound, approved disposal for waste solids**
Disposition of Sludge	Use only approved methods of sludge disposition. - Dispose of sludge as roadbed or other fill. - Find approved disposal for unavoidable sludge; do not contract for removal to unknown disposal sites.
Other Solid Wastes	Obtain regulatory approval for disposal of any residue/sludge from bulk admixture chemical tanks. Consult admixture/chemical suppliers for proper rinsing and disposal of chemical containers. Recycle containers via supplier or reputable container recycler. Do not discard contaminated chemical containers to conventional solid waste disposal bins without approval. Provide proper collection and storage of Special Waste. For example, lead batteries, solvent and waste oil must be properly contained and can be recycled. Provide conventional refuse containers as required to maintain a tidy site.

3.2.1 Solids Reclaim Systems

Commercially available systems range from simple aggregate recovery to complete solids reclaim units. A large variety of systems are in widespread use throughout North America. These include drag chain systems (generally no longer popular) and cyclone separation systems. While mechanical systems have high capital and operating costs, the financial benefit of reclaiming material has not always been given due consideration. The 1993 evaluations found that few facilities in British Columbia have formal solids reclaim systems in place. It would appear that the current practice of settling solids and recycling the water is the simplest and most effective method. The use of solids reclaim systems from wastewaters and returned concrete will increase as environmental discharge Permits become more difficult and costly to obtain and maintain. The existing CSA standard that discourages the use of recycled water from a solids reclaim system in the batch water may have to be re-evaluated.

The British Columbia Ready Mix Association has indicated that there have been discussions between the ready mix industry and the cement manufacturing industry regarding the recycling of settling basin solids into the manufacture of cement. This option was found to be impractical because of the large distance to cement manufacturing facilities from most of ready mix operations in British Columbia.

3.2.2 Chemically Stabilized Returned Concrete

Suppliers of admixture chemicals have developed procedures for stopping the set of returned concrete (with chemical stabilizers) to allow holding of the concrete in the truck for several hours. An activator can then be added to the mix to counteract the action of the stabilizer so the come-back concrete can be incorporated into the next batch. In practice, this is seldom done by ready mix plant operators. The 1993 evaluations found anecdotal evidence that incorporating stabilized concrete has caused quality problems with the subsequent batch. The procedure is sensitive to the quantity and characteristics of the stabilized concrete and requires careful control in the mixing process. Because of these difficulties, it is unlikely that the industry will adopt this practice on a large scale.

3.2.3 Manufacture of Secondary Products

Returned concrete, also known as come-back concrete, poses a problem for each facility operator. As indicated above, stabilizing the concrete for later use is not popular with the industry or their customers. Using the concrete as fill at the construction site or at another suitable landfill is one possibility for disposal of this material. Where possible, come-back concrete should be immediately incorporated into a subsequent batch.

Many operators are now using come-back concrete in the manufacture of other concrete products. Some of these products include precast parking lot barriers and curbs, lock-blocks for retaining walls and flat patio pavers. Generally the products are limited in size in order to allow the product to be completed before the concrete sets. The recommended practice is to manufacture secondary products since there is the potential for these products to be sold and provide the operators with some financial return for the concrete.

Another alternative product currently being developed is Controlled Density Fill (CDF). Essentially this is a low strength concrete mix that can be used to backfill trenches and excavations where settling may be a problem. Since strength is of minor importance, settled solids and stabilized come-back concrete may be suitable for use in CDF. This product can be manufactured at any ready mix facility, making it a practical alternative throughout the province. The manufacture of CDF is currently limited by market demand. However, industry expects the use of this product to increase in the future.

3.2.4 Disposal of Other Solid and Miscellaneous Wastes

The disposal of other waste solids, including empty chemical containers, paper, vehicle maintenance wastes and other refuse should be carried out consistent with typical waste management practices within that municipality or Regional District. Care is necessary to ensure that waste leaving the site is acceptable for disposal in local landfills. Some products used at ready mix facilities, such as waste oil, high pH solutions and automotive batteries, may qualify as Special Wastes and therefore must be handled accordingly.

Where recycling opportunities exist, it is recommended that efforts be made to utilize these services. For example, waste oil and solvent is now easily recycled through reputable recyclers. Paper and plastic can usually also be recycled. Chemical suppliers typically require a deposit on bulk chemical containers to encourage their return. Ready mix facility operators should encourage all their suppliers to accept returned empty bulk product containers. Table 7 provides some guidance with respect to general waste management techniques. For specific waste management issues, it is recommended that the facility operators contact their local municipal office or Ministry of Environment office.

3.3 Chemical Storage and Handling

In addition to Portland cement, ready mix facilities use a variety of admixture chemicals as ingredients in concrete. In general, these chemicals are liquids which are supplied in bulk and stored in tanks in the batching area of the plant. Although many of these chemicals present relatively low hazard to the environment and workers, some admixture chemicals do have high aquatic toxicity and/or require worker protection and precautions in the event of spills or direct worker contact. Furthermore, concentrated muriatic (hydrochloric) acid is commonly used at facilities for preparing dilute acidic wash solutions. Consequently, careful attention to chemical storage and handling of these chemicals is important.

Table 8 represents recommended design practices for the admixture chemical storage areas at ready mix facilities, based on good practices commonly applied for chemical handling and storage areas at other industrial facilities. The provision of adequate containment volume for stored liquids is fundamental to a good design. However, worker training in spill response according to an established contingency plan are other ways to protect the site from accidental release. Every site should be equipped with emergency spill response equipment designed to address potential spills of products in use at the site.

TABLE 8

Chemical Storage and Handling

Design Features	**OBJECTIVE:** **To provide proactive spill prevention and spill containment features for stored admixtures**
Tanks	- Select strong corrosion resistant materials of construction (consult with chemical suppliers). - Immediately reinforce or replace damaged tanks - Mount tanks in stable position and anchor securely. - If possible, locate storage tanks inside a structure - Protect tanks from vehicle impact. - Calibrate tanks and install accurate fluid level indicator - Install shut-off valves on all rupturable lines and tank gages. - Identify the contents of all tanks and indicate hazards. - Provide good lighting in tank storage areas.
Spill Containment	- Tanks should be installed within structurally sound, paved containments - Containment should contain 110% of one tank liquid volume or 25% of total volume of tanks, whichever is greater - Eliminate floor drains from tank containment areas (to prevent release). - Ensure that incompatible chemicals are not placed in the same containment area. - Ensure that chemical release to a containment area will not damage equipment, tankage or piping - If required, provide protection from freezing for chemical storage tanks.
Piping	- Design according to all applicable codes. - Select materials of construction in consultation with chemical suppliers. - Use above ground, visible, permanent piping throughout chemical delivery systems. - Provide impact protection for vulnerable piping. - Clearly label piping systems and valves for each chemical. - If required, provide protection from freezing for piping.
Operating Practices	**OBJECTIVE:** **Use operating practices which protect worker health and the environment**
Personnel training	- Provide appropriate training for supervisors and designated personnel who handle chemicals. - Provide Material Handling Data Sheets for all hazardous chemicals stored and used on site. - Provide explicit written safety and handling procedures for chemical storage and handling practices.
Security	- Provide security precautions to prevent vandalism or access by unauthorized persons. - Install locking valves on all side or bottom drain/fill valves.
Emergency Response	- Prepare a written contingency plan for chemical spill response. - Train and rehearse personnel to implement the contingency plan. - Ensure appropriate spill response and personal protection equipment is readily available on-site. - Advise local fire department of the location and contents of chemical storage areas.
Chemical Delivery	- Provide a curbed, impervious loading pad which drains to a containment area and/or which can be blocked from releasing spills to water collection systems. - Locate chemical loading areas away from high yard vehicle traffic areas. - Restrict access to loading area during chemical delivery. - Use dripless camlock connections for lines between delivery vehicles and tanks. - Provide good visibility of the delivery system from the point of delivery (to avoid overflow). - Require that chemical delivery is undertaken only by personnel who are trained and qualified in chemical handling and emergency response procedures.
Housekeeping	- Define and practice good housekeeping practices for keeping the site clean and free of debris. - Routinely inspect the chemical storage area for leaks or spills. Daily inspection is recommended. - Immediately contain leaks and repair the source.

3.4 Stormwater Management

Table 9 contains recommendations for managing stormwater at ready mix facilities. The main objective is preventing the contamination of clean runoff. This is accomplished by directing clean surface water off the site via drainage systems, site sloping or by curbs and avoiding any mixing with contaminated wash waters or processing area runoff.

Where stormwater and other surface runoff has become contaminated by the ready mix facility operations, it should be collected into the recycling system for treatment and reuse. The volume of contaminated water that will have to be managed will depend directly on the size of the catchment area. Therefore, operators should attempt to minimize the size of the process area to minimize volume. Also, operators should provide frequent clean up of areas outside of the area catchment to ensure non-recycled runoff is not contaminated.

Where aggregate has been washed prior to storage on site, stormwater from the aggregate storage areas should not contain high levels of suspended solids. Unpaved aggregate storage areas will improve stormwater management on site by allowing some of the runoff to infiltrate the ground. However, if paving is necessary, operators should take care to ensure that suspended solids discharge criteria are met.

TABLE 9

Stormwater Management Practices

Stormwater Management	**OBJECTIVE: Minimize stormwater contamination**
Isolate Contaminants from Stormwaters	- Pave all process areas where concrete ingredients are stored or handled, including truck loading, slump racks, washout racks and sludge storage. - Segregate and collect drainage from the process area with curbs or drains. - Prevent or promptly control releases of portland cement, concrete fines, and admixture chemicals to avoid dispersal. Minimize and promptly clean up spills
Minimize Stormwater Volume	- Divert uncontaminated stormwater from the process areas of the site with perimeter ditches. - Minimize the size of the process area of the plant. - Where possible, allow infiltration of uncontaminated stormwater into the ground to minimize discharge volume.

3.5 Control of Dust Emissions

Poor control of dust emissions at ready mix facilities can create a nuisance air emissions problem which will also contribute to the contamination of washwater and surface runoff. Plant operators should strive to reduce both point source and non-point source dust emissions throughout the facility. The recommended measures are outlined in Table 10.

Point source emissions are typically controlled by baghouse. A baghouse is a dry dust collection system that typically recycles collected dust into the product. The baghouse must be engineered relative to the exhaust gas flow rate and particulate concentration for efficient removal to be achieved. An properly sized and maintained baghouse should be able to produce a particulate emissions better than 50 mg/m^3.

It is also recommended that plant operators take measures to prevent dusts or solids from being dispersed throughout the plant site by vehicular traffic. Permanently sited ready mix facilities or facilities in close proximity to residential development should have high-traffic areas paved. Immediate clean-up of spilled solids and frequent sweeping of the yard to collect accumulated dust.

The allowable dust releases from a ready mix facility will depend greatly on the location of the facility. Within the Greater Vancouver Regional District, point source particulate emission limits are becoming more stringent; a limit of 120 mg particulate/m^3 air discharged is standard and a limit of 50 mg/m^3 is becoming more common for general industry. In areas under the jurisdiction of the B.C. Ministry of Environment, emissions limits range from 120 mg/m^3 to 230 mg/m^3. The more stringent level is applied in developed areas with a potential for impact on adjacent properties whereas the less stringent level may be applied for remote sites.

Often, it is difficult to accurately measure emissions from a silo or baghouse because the size and shape of the vent does not permit sampling according to the specified sampling methodology. A proper sampling location will be at least 2 stack diameters downstream of a disturbance (such as an elbow or venturi) and at least 0.5 stack diameters upstream of the discharge or another disturbance.

Ambient dustfall levels are measured using simple dustfall canisters or with high volume samplers and filters. The regulatory limits for dustfall also depend on the location of the facility. For remote areas, the ambient air quality limit is normally 25 tons per square mile per month and is reduced to 15 tons per square mile per month for urban areas. In future, there will be increasing use of more sophisticated dust measuring techniques, including measuring for inhalable particulate. Commonly called PM_{10}, inhalable particulate is less than 10 microns in size, and is felt to be the particulate size of greatest concern to human health. Although there are currently no limits on PM_{10}, it is likely that limits will be developed and implemented in the future.

TABLE 10

Air Emissions Management Practices

Air Emissions Management	**OBJECTIVE:** **Minimize dust emissions on and off site**
Control Point Source Emissions	- install an effective dust removal device, such as a baghouse, on vents from pneumatic or mechanical transfer systems. - use curtains or socks for truck loading operations. - use water sprays to remove fugitive emissions during truck loading operations.
Control Fugitive Dust Production	- minimize the surface area of aggregate storage piles. - use aggregate storage bins or covers where possible. - locate storage piles in area of site sheltered from wind. - pave high vehicle traffic areas of the yard. - sweep paved portions of yard frequently to remove accumulated dust.

4.0 CONCLUDING REMARKS

The 1993 update of the ready mix industry environmental code of practice provided an opportunity to examine the state of the industry five years after the first edition. The industry was found to be well aware of the potential environmental problems inherent to the ready mix process and have made improvements in some areas of wastewater and solid waste management. In general, however, the industry as a whole has been inconsistent in meeting the recommended design and operational practices set out in the original code.

Waste water management remains the most significant issue of environmental concern. Preventing contamination of stormwater and the collection and treatment of contaminated stormwater and process waters is now much more common in the industry. Minimizing wastewater generation is the area where additional improvements will be made.

Solid waste management appears to be generally acceptable at the facilities evaluated. Progress is being made to minimize the generation of solid waste through the manufacture of secondary concrete products with come back concrete and through the use of aggregate recovery systems.

APPENDIX II

Pollution Prevention and Waste Minimization
at
Concrete Ready-Mixed Operations

POLLUTION PREVENTION

AND

WASTE MINIMIZATION

AT

CONCRETE READY-MIXED OPERATIONS

TABLE OF CONTENTS

A1.0 POLLUTION PREVENTION AND WASTE MINIMIZATION

A1.1 General

The potential routine pollutant releases and waste generation from ready-mixed concrete facilities have been described in Appendix I. Several pollution prevention concepts have been outlined by the Federal strategy and by the Canadian Council of Ministers of Environment (CCME). Within the terms of reference for this guide, the following concepts are included and excluded within this pollution prevention plan for the ready-mixed concrete industry:

Pollution Prevention Concepts Presently Not Considered Applicable for Ready-Mixed Concrete Industry	**Pollution Prevention Concepts Selected as Applicable for Ready-Mixed Concrete Industry**
- replacement of hazardous or toxic materials by less toxic substances	- reduction of use of toxic substances, energy, raw materials and non-renewables
	- reuse of recovered raw materials, products and hazardous substances
	- elimination or minimization of environmental releases
- elimination of the need for hazardous pollutants, or waste substances by process modification	- recycling of recovered substances off-site
- recovery of energy where byproducts cannot be reused or recycled	- treatment of non-recoverable waste with a focus on recovery and minimization of residues
	- safe disposal of residues
	- safe handling of chemicals and products to ascertain that site contamination does not occur

A1.2 Potential Pollution Prevention Measures

Based on a review of best management practices in the European, North American and British Columbian ready-mixed concrete industry, this section outlines potential measures which can be used to achieve each of the pollution prevention (P2) concepts selected as "applicable" in Section 2.0 of the main report.

A1.2.1 P2 Concept: "Reduction of Use of Toxic Substances, Energy, Raw Materials and Non-Renewables"

Within a ready-mixed concrete operation, control of raw materials can achieve this pollution prevention concept. Control can be achieved by:

- assuring that no "off-spec" batches are produced;
- water conservation by restriction of freshwater uses to:
    - truck exterior washoff,
    - hot water production,
    - batch waters for high quality concrete;
- water conservation by installation of flow controls on freshwater sources; and,
- switching to more environmentally friendly products (i.e., cleaning agents).

A1.2.2 P2 Concept: "Reuse of Recovered Raw Materials, Products and Hazardous Substances"

As noted previously, approximately 1 - 4% of concrete production is returned and another 0.5% is removed from mixing plants and vehicles during cleaning of equipment.

Various options have been used for reduction and reuse of returned concrete to ready-mixed facilities:

- minimize volume of returned concrete by encouraging better estimates by the construction industry;

- reuse returned concrete for purposes such as precast product manufacture or preparation of road bases;

- recycle concrete by recovery of aggregates, water and cement (as fines) to produce new concrete batches;

- apply hydration control by use of admixtures to stabilize returned concrete and enable its reuse at later times;

- reclaim fines from settling basins for use in preparation of concrete;

- reuse settling basin sludges as road base material;

- reuse fines from bag filters and cyclones;

- chemically stabilize truck washwater for reuse in concrete batching; and,

- use of truck washwater and stormwater from paved process areas for truck drum washout, miscellaneous washdown operations, and/or batch mixture preparation.

A1.2.3 P2 Concept: "Elimination or Minimization of Environmental Releases"

A1.2.3.1 Wastewater Control

Water is a major carrier of pollutant releases from ready-mixed concrete operations. Best management practices which may be used for elimination or minimization of wastewaters include:

- provision of paving and curbing of process area to collect all wastewater and contaminated surface runoff for treatment;

- minimization of surface area of process area to reduce stormwater discharge volumes;
- roofing of all or part of process area to minimize exposure to precipitation;
- diversion of yard stormwater from process area;
- diversion of off-site stormwater away from plant site;
- slope yard so stormwater is directed to a settling basin;
- provision of good housekeeping practices to clean up spills of cement and concrete immediately;
- installation of oil separators in truck wash areas; and,
- employee training to assure understanding of control program.

A1.2.3.2 Air Emission Control

Air emissions are a potential means of pollutant transport from ready-mixed concrete facilities. The results of a U.S. EPA study (summarized in Table 4, Appendix 1) indicated that vehicle traffic is a major contributor of dust at a ready-mixed concrete facility, followed by dusts generated during transfer of aggregates, sand and cement.

Best management practices to control air emissions include:

Point Source Emission Control:

- installation of effective dust removal devices, such as a baghouse on vents from pneumatic or mechanical transfer systems; and,

- use of curtains or socks for truck loading operations;

Fugitive Dust Control:

- minimizing surface areas of aggregate storage piles;

- use of aggregate storage bins or covers where possible;

- paving high vehicle traffic areas;

- reduction of speed limits;

- use of one-way traffic system to separate dirty from clean vehicles; and

- routine sweeping of paved portions of yard to remove accumulated dust.

A1.2.4 P2 Concept: "Recycling of Recovered Materials Off-Site"

To meet this pollution prevention objective, the options for a ready-mixed concrete operation would likely focus on the handling of returned concrete and settling pond sludges. Off-site options include:

- use of returned concrete and settling pond sludges for roadbased materials; and,

- use of returned concrete for precast products.

A1.2.5 P2 Concept: "Treatment of Non-Recoverable Waste With a Focus on Recovery and Minimization of Residues"

Many of the "wastes" at a ready-mixed concrete operation are recoverable. Non-recoverable wastes and options for best management practices include:

Excess water which cannot be used within the process -

- Options for minimization and treatment include:
  - freshwater use control;
  - minimization of yard surface area; and,
  - treatment of excess water by pH control and suspended solid reduction (e.g., settling basins).

Settling basin residues -

- Options for minimization and handling include:
  - recovery of concrete fines and aggregate from basins;
  - disposal of sludge as roadbed; and,
  - use of approved disposal sites for unavoidable sludge (do not contract for removal to unknown disposal sites).

Other solid wastes -

- Options include:
  - return of admixture and other chemical containers to suppliers;
  - provision of proper collection and storage of lead batteries, solvents and waste oil for recycling; and,
  - maintenance of a strict housekeeping program.

A1.2.6 P2 Concept: "Safe Disposal of Wastes"

Corporate policy should assure that non-recoverable wastes should be disposed by approved contractors in approved facilities. The lack of such assurances may result in future financial and legal liabilities to a company.

A1.2.7 P2 Concept: "Safe Handling of Chemicals and Products To Ascertain That No Site Contamination Nor Sudden Releases Occur"

Site contamination has become a major financial issue to companies. A sudden release of a product into a receiving environment can also result in major regulatory implications. Best management practices to reduce the potential for such liabilities include:

- assurance of proper spill containment volume for bulk liquid storage (e.g., 110% of the largest on-site bulk tank);
- sealed surface floors for bulk storage areas;
- protection of bulk liquid tanks from mechanical impact, vandalism and freezing;
- provision of visible and labelled aboveground piping and valves;
- use of materials and designs as per all applicable codes and manufacturers' recommendations;
- provision of spill response equipment, absorbents and personnel protection equipment;
- provision of worker training for spill response;
- provision containment at fuel and chemical handling areas;

- provision of signage to identify contents of bulk tanks; and,

- use of lined sludge basins to prevent groundwater contamination.

APPENDIX III

Ready-Mixed Concrete Industry

Environmental Code of Practice

Facility Audit Compliance Checklist

READY-MIXED CONCRETE INDUSTRY

ENVIRONMENTAL CODE OF PRACTICE

FACILITY AUDIT

COMPLIANCE CHECKLIST

Prepared for:

ENVIRONMENT CANADA

North Vancouver, B.C.

April 15, 1996

CHECKLIST COVER PAGE AND INSTRUCTIONS

How to use this Checklist

This checklist has been developed specifically for the evaluation of the environmental performance of a ready-mixed concrete facility relative to the 1993 Environmental Code of Practice for the Ready-mixed Concrete Industry. The checklist has been designed for use by regulatory authorities but will also be useful for self-evaluation by facility operators. Once completed, the checklist will provide an indication of the degree of compliance with the Code and will highlight the areas where improvements are required. For questions with technical content, explanatory notes are included at the end of the questionnaire to assist the auditor.

The checklist is broken down into sections reflecting a typical ready-mixed concrete facility. The checklist is intended as an empirical evaluation but to assist in the ranking of the facility, each section has a potential maximum score. After completing the checklist, the areas where no score was obtained are areas where improvements are necessary. It is also possible to use the score to rate the performance of a facility against a previous evaluation.

Assigning a Score

To assign a score, award one point for each answer in the right hand box of a yes/no question. If a point score is already in the right hand box, award that point value. Some questions have no score but are important to the understanding of the overall environmental performance of a facility or are necessary in the evaluation of the adequacy of design of effluent treatment works. It is important to complete the checklist in an objective manner. When the checklist is completed, fill in the scoring summary table on the next page. In the comments column, highlight areas of good or poor performance for that section, especially for non-scoring questions.

Interpretation of Checklist Score

The sectional scores are weighted by the number of questions in each section to provide an indication of the relative importance of one section relative to the overall facility score. For example, Section 7, Chemical Delivery, Storage and Management has a maximum score of 25 points or 22% of the total score, representing the most important section relative to on-site environmental control. Sections 1 and 2 have no score since they are background information only and Section 11 is only a monitoring record. The environmental status of the site will be based on both the numerical score and the empirical observations of the reviewer.

Sections with a low percentage of the maximum score are areas where improvements are necessary to reduce environmental risk. The score will provide some measure of environmental priorities of one section relative to another which must be taken into account by the operator in the planning and budgeting process. Once corrective measures are taken, the checklist should be completed again to assess the degree of completion.

READY-MIXED CONCRETE INDUSTRY
ENVIRONMENTAL CODE OF PRACTICE
FACILITY AUDIT COMPLIANCE CHECKLIST

READY-MIXED FACILITY NAME:_____

FACILITY LOCATION:_____

SCORING SUMMARY

Section #	Section Description	Max Score	Score Obtained	% of Max	Comments
1	Operator Information	0		-	
2	Facility Description	0		-	
3	Water Supply & Control	12			
4	Process Effluent Collection & Treatment	32			
5	Stormwater, Effluent Collection & Treatment	22			
6	Solid Waste Management	24			
7	Chemical Delivery, Storage & Management	15			
8	Fuel Delivery & Storage	22			
9	Spill Contingency	18			
10	Air Emissions & Control	14			
11	Site Housekeeping	12			
	TOTALS	171			

OVERALL ENVIRONMENTAL PERFORMANCE OBSERVATIONS:

Part 1: BACKGROUND INFORMATION

1.0 OPERATOR INFORMATION

Site Number (if applicable):
Parent Company Name:
Parent Company Street:
Parent Company City:
Parent Company Province:
Parent Company Postal Code:
Parent Company Phone #:
Parent Company Fax #:
Contact Person:
Title:
Site Company Name:
Site Street:
Site City:
Site Province:
Site Postal Code:
Site Phone #:
Site Fax #:
Site Contact Person:
Title:
Type of Ready-mixed Facility: Mobile (on-site) or Permanent (off-site)
Information Last Updated:

Auditors:
Audit Date:
Company Representative(s) at Review:

Part 1: BACKGROUND INFORMATION

2.0 FACILITY DESCRIPTION

Site Plan Available: Yes ( ) No ( )
(Indicate all drains and outfalls on site plan)

Number of Permanent Buildings:

Estimated Lot Size:

Description of Site Security:

Distance to Nearest Receiving Waterbody:

Description of Surrounding Environment:
(residential, industrial, rural, remote)

General Description of On-Site Industrial Activity:

Production Capacity of Facility:
(tonnes/day or m^3/day)

Production Rate at Time of Audit:
(tonnes/day or m^3/day)

Typical Period of Operation:
(hrs/day and days/week)

Part 2: FACILITY EVALUATION

Water, Supply and Control:

Is process water supplied by (select one):	- operator's surface water supply? - operator's groundwater supply? - municipal force main? - none of the above.	
Is operator in possession of water supply licence or permit, if required?	No=0 Yes=2	☐
Is water supply metered?	No=0 Yes=2	☐
Frequency of metre recording - _____		
Date of last measurement and value - _____		
Does operator use an on-site water reservoir?	No=0 Yes=2	☐
If yes, describe reservoir (tank, pond, cistern)?		
Is fresh water used for (select appropriate):	- drum washwater? - point source dust control? - process batch water? - site hot water? - vehicle washwater? - yard dust control? - none of the above.	
Control mechanisms in place:	- nozzles on hoses? - shut-off valves at consumption points? - flow restrictors? - none of the above.	
Any additives that would prevent water reuse?	No=0 Yes=2	☐
Observed uncontrolled water consumption during audit?	No=0 Yes=2	☐
Are daily shut-down procedures in place?	No=0 Yes=2	☐
	Section Total:	☐
	Section Maximum: 12	

Part 2: FACILITY EVALUATION

Process Effluent Collection and Treatment:

Sources of process effluent:	- drum washout? - yard washdown? - vehicle exterior washing? - solids reclaim system? - non of the above.		
Identify additives to washwater and process effluent:	soap? solvent? acid?		
Estimated volume of process effluent produced:	- in litres/min and in cubic metres/hour (1)		
Estimated volume of reused effluent as process water (in %): (2)	- greater than 90%? - less than 50%? - 50% to 70%? - 75% to 90%? - none of the above.	4 1 2 3	☐
Is processing area paved?		No=0 Yes=2	☐
Is pavement in good condition (free of cracks and breaks)?		No=0 Yes=2	☐
Is process water prevented from running off the site by curbs, drains, ditches or grading?		No=0 Yes=2	☐
Process effluent collection system (select):	- no collection system present? - subsurface pipe with catchbasins? - surface flow? - none of the above.		
Does process effluent collection system lead to on-site treatment works?		No=0 Yes=2	☐
If process effluent collection system leads to in-site treatment works, do these treatment works include (select):	- exfiltration basin or engineered filter bed? - solids resuspension and effluent reuse? - pH neutralization? - primary settling tank or basin? - oil/water separator? - secondary settling tank or basin? - none of the above.		
Is all contaminated water collected for treatment?		No=0 Yes=2	☐

For settling systems, estimated volume of basin(s) in cubic metres - _
_____

Part 2: FACILITY EVALUATION

Process Effluent Collection and Treatment Cont'd.

From process volume, calculate settling basin retention time (in minutes) and duration of process effluent treatment basin retention time? (Select appropriate time and add corresponding score). (3)	- less than 10 minutes? - 10 to 30 minutes? - 30 minutes to 1 hour? - greater than 1 hour? - none of the above.	1 2 3 4	
Are settling basins designed to facilitate sludge removal? (4)		No=0 Yes=2	
Is regular maintenance conducted on pollution control equipment? (5)		No=0 Yes=2	
Is there discharge of process effluent (treated or untreated) to:	- direct discharge to surface receiving waters? - infiltration basin? - sanitary sewer? - storm sewer, open ditch? - none of the above.		
Are process effluents monitored for site, if required?		No=0 Yes=2	
List permits and issuing agencies -			
Is operator aware of required effluent monitoring for site?		No=0 Yes=2	
Are monitoring requirements being met?		No=0 Yes=2	
Are monitoring records kept on-site?		No=0 Yes=2	
Is facility in compliance with permits?		No=0 Yes=2	

Section Total: ☐

Section Maximum: 32

Part 2: FACILITY EVALUATION

Stormwater, Effluent Collection and Treatment:

Does site have necessary grading or curbs to contain runoff?		No=0 Yes=2	
Does surface grading or diversion ditches prevent ingress of clean stormwater to site? _____ _____		No=0 Yes=2	
Catchment area feeding stormwater collection system (in square metres)(6) - _____			
Design rainfall event (10 year return period, 30 minute duration) in mm/hr (7) - _____			
Calculated stormwater volume for design event (in cubic metres/hour) (8) - _____			
Is stormwater runoff from process areas collected for on-site treatment?		No=0 Yes=2	
If stormwater runoff is collected, for on-site treatment, the treatment includes:	- solids resuspension and effluent reuse? - primary settling tank or basin? - secondary settling tank or basin? - exfiltration basin or engineered filter bed? - pH neutralization? - oil/water separator? - none of the above.		
For settling systems, estimated volume of basin(s) (in cubic metres) - _____			
From stormwater volume, calculate settling basin retention time (in minutes) - _____			
Duration of stormwater treatment retention time (select appropriate time and add corresponding score):	- greater than 1 hour? 4 - 30 minutes to 1 hour? 3 - less than 10 minutes? 1 - 10 to 30 minutes? 2 - none of the above.		
Are contaminated stormwater and process effluents combined for treatment? (10)		Yes No	
Are stormwater settling basins designed to facilitate sludge removal? (11)		No=0 Yes=2	
Is regular maintenance in place for pollution control equipment, pumps, settling ponds?		No=0 Yes=2	

Part 2: FACILITY EVALUATION

Stormwater, Effluent Collection and Treatment Cont'd.

Discharge of stormwater (treated or untreated) to:	- stormwater system? - sanitary sewer? - surface receiving waters? - infiltration basin? - none of the above.		
Are necessary stormwater discharge permits and authorization in place?		No=0 Yes=2	
List permits and issuing agency: _____ _____ _____ _____			
Are monitoring results available on-site?		No=0 Yes=2	
Are monitoring requirements being met?		No=0 Yes=2	
Is facility in compliance with permits?		No=0 Yes=2	
		Section Total:	
		Section Maximum:	22

Part 2: FACILITY EVALUATION

Solid Waste Management:

Reuse of come-back concrete:	- other products? - controlled density fill? - concrete lock blocks? - in next batch? - none of the above.			
Is there a solids recovery system in place?		No=0	Yes=2	
Is received aggregate reused in batch?		No=0	Yes=2	
If there is a solids recovery system in place, is the solids recovery system effluent treated or incorporated into batch?		No=0	Yes=2	
Does site have sludge-dewatering facility?		No=0	Yes=2	
Does site have sludge dewatering facility with containment?		No=0	Yes=2	
Does site have sludge-dewatering facility with cover?		No=0	Yes=2	
Does site have sludge-dewatering facility with water collection to treatment system?		No=0	Yes=2	
Is sludge reused?		No=0	Yes=2	
Authorization or permit to dispose of sludge and come-back concrete, if required?		No=0	Yes=2	
Is the site generally free of accumulation of wastes, containers, scrap metal, tires, etc.?		No=0	Yes=2	
Are all chemical drums and plastic pails recycled or reused?		No=0	Yes=2	

Section Total: ____

Section Maximum: 24

Part 2: FACILITY EVALUATION

***Chemical Delivery, Storage and Management*:**

Inventory (12)

Product & State (L or S)	**Storage Type (UST or AST) & Volume (1)**	**Containment Type & Volume (litres)**	**Containment Adequate Y/N/M**	**Status of Storage Area**
Diesel/Gasoline				
Cement Powder				
Aggregates				
Acid/Caustic				
Solvent				
Oil/Lubricants				
Antifreeze				
Cleaners/ Detergents				
Batteries				
Other				
Add Mixtures				

Part 2: FACILITY EVALUATION

Chemical Delivery, Storage and Management Cont'd.

Are delivery procedures in place?	No=0	Yes=1	
Does loading/unloading area has impervious pad with containment provided and not susceptible drains nearby? (14)	No=0	Yes=1	
Method of bulk delivery:	- drums? - tote? - tanker? - none of the above.		
Bulk liquid products stored in (select):	- AST? - UST? - both? - none of the above.		
Are the tanks double walled and/or corrosion resistant?	No=0	Yes=1	
Is there secure mounting and vehicle impact protection for tank/dispensing pump?	No=0	Yes=1	
Is there storage area security to prevent tampering?	No=0	Yes=1	
Containment for liquids 110% of largest tank or 25% of total volume, if AST?	No=0	Yes=1	
Are tanks provided with overfilling protection and/or alarms?	No=0	Yes=1	
Is there containment cover or precipitation collection and treatment for tank/dispensing pump?	No=0	Yes=1	
Is there evidence of spills, overfilling or leaks in vicinity of the tanks or dispensing pumps?	No=0	Yes=1	
Is there protection from freezing if necessary?	No=0	Yes=1	
Are containments free from accumulated precipitation and liquid product?	No=0	Yes=1	
Is there proper labeling of tank or dispensing pump contents?	No=0	Yes=1	
Is there permanent aboveground piping, if AST?	No=0	Yes=1	
Is there regular inspection of storage facilities conducted, if AST?	No=0	Yes=1	
If UST, are tanks and piping leak tested annually with records kept?	No=0	Yes=1	

Section Total:

Section Maximum: 15

Part 2: FACILITY EVALUATION

Fuel Delivery & Storage:

Are there delivery procedures in place?		No=0	Yes=1	
Does the loading/unloading area have impervious pad with containment and non-susceptible yard drains nearby?		No=0	Yes=1	
Method of bulk delivery:	- drums? - tanker? - tote? - None of the above.			
Bulk liquid products stored in (select):	- both? - UST? - AST? - None of the above.			
Are there double walled and/or corrosion resistant tanks?		No=0	Yes=1	
Is there secure mounting and vehicle impact protection for tank/dispensing pump?		No=0	Yes=1	
Is there storage area security to prevent tampering?		No=0	Yes=1	
Is containment for liquids 110% of largest tank or 25% of total volume, is AST?		No=0	Yes=1	
Are tanks provide with overfilling protection and/or alarms?		No=0	Yes=1	
Is there containment cover or precipitation collection and treatment for tank/dispensing pump?		No=0	Yes=1	
Is there evidence of spills, overfilling or leaks in vicinity of the tanks or dispensing pumps?		No=0	Yes=1	
Are containments free from accumulated precipitation and liquid product?		No=0	Yes=1	
Is there protection from freezing, if necessary?		No=0	Yes=1	
Is there proper labeling of tank or dispensing pump contents?		No=0	Yes=1	
Is there permanent aboveground piping, if AST?		No=0	Yes=1	
Is regular inspection of storage facilities conducted, if AST?		No=0	Yes=1	
Are tanks and piping leak tested annually and records kept, if UST?		No=0	Yes=1	

Part 2: FACILITY EVALUATION

Fuel Delivery and Storage cont'd.

Are non-gravity feed systems used for fuel supply/dispensing?	No=0	Yes=1	
Are all dispensing systems de-generized and locked between use?	No=0	Yes=1	
Are dispensing areas provided with drip and spill containment?	No=0	Yes=1	
Have workers been trained with drip and spill containment?	No=0	Yes=1	
Are Material Safety Data Sheets current and available on-site?	No=0	Yes=1	
Are registered quantities of special waste or hazardous waste produced on-site?	No=0	Yes=1	
Are requirements of applicable hazardous waste legislation being met? (15)	No=0	Yes=1	

Site waste generator number is? _____

Section Total:

Section Maximum: 22

Part 2: FACILITY EVALUATION

Spill Contingency:

Have adequately stocked spill kits been provided at bulk chemicals storage and handling points?	No=0 Yes=2	
Is an updated spill response plan prepared and available?	No=0 Yes=2	
Does the plan identify designated staff and responsibilities, drainage locations, spill kit locations and personnel to notify in the event of a spill?	No=0 Yes=2	
Are spill response instruction posted at bulk chemical storage and handling points?	No=0 Yes=2	
Have workers been trained in spill response?	No=0 Yes=2	
Is a record of worker training available?	No=0 Yes=2	
Have emergency eye-wash and shower been provided in chemical handling areas?	No=0 Yes=2	
Have there been any spills at this site in the last 12 months?	No=0 Yes=2	
If there has been any spills at this site in the past 12 months, was the spill reported to the regulatory authorities, if required?	No=0 Yes=2	

Describe spill and clean-up response taken?

Section Total:

Section Maximum: 18

Part 2: FACILITY EVALUATION

Air Emissions and Control:

Sources of emission of potential concern:

- cement silo and/or baghouse?
- bulk fuel handling?
- solvent use?
- fugitive dust?
- vehicle traffic?
- aggregate storage and handling?
- fly-ash silo and/or baghouse?
- gas/propane/oil-fired boiler?
- bulk transfer system?
- none of the above.

Is dust controlled at transfer points?	No=0	Yes=2	
Is maintenance schedule in place for pollution control equipment?	No=0	Yes=2	
Is maintenance record maintained on-site?	No=0	Yes=2	
Does overall dust control appear adequate at this site?	No=0	Yes=2	
Are necessary air discharge permits in place?	No=0	Yes=2	

List permits and issuing agency. _____
_____
_____
_____

Are monitoring requirements being met?	No=0	Yes=2	
Are monitoring results available?	No=0	Yes=2	

Section Total: ☐

Section Maximum: 14

Part 2: FACILITY EVALUATION

Site Housekeeping:

Is the site generally tidy and well maintained?	No=0	Yes=2	
Does the site receive a minimum weekly clean-up?	No=0	Yes=2	
Are all clean-up effluents routed through the on-site treatment system?	No=0	Yes=2	
Are there any complaints reported to regulatory authorities with respect to this operation?	No=0	Yes=2	
Does equipment appear well maintained and operation as designed?	No=0	Yes=2	
Have there been any complaints from adjacent sites regarding noise or visual impact of operations?	No=0	Yes=2	

Section Total:

Section Maximum: 12

END NOTES FOR QUESTIONNAIRE USE

1. To determine volume of process effluent produced, (1) check water metre readings over time period of audit, (2) measure discharge from point sources, or (3) measure flow of total site discharge, if there is no recycle or stormwater component.

2. To determine volume of effluent reused, (1) measure return flow rate to points of consumption, (2) check flow rating and pressure for reclaim pump, or (3) subtract site discharge volume from consumption metre reading.

3. Retention time is calculated by dividing the volume of the settling basin by the rate of flow leaving the basin. Metric units make the calculation simple: 1,000 litres per cubic metre, 4.5459 litres per Imperial Gallon.

4. Are the basin sides sloped to permit backhoe or bobcat access? An open basin will be much easier to clean than a closed tank.

5. Pumps, chemical dosing equipment and settling basins require maintenance. A written schedule will define the frequency of basin cleaning, pump lubrication and other maintenance.

6. Catchment area is the area of the lot that will drain into the site drainage system during rainfall events.

7. The design rainfall event is used to size the treatment system basins to ensure a minimum retention time is maintained during a representative rainfall event. An Intensity-Duration-Frequency rainfall diagram may be available for the site area from the local weather office. A ten year return, 30 minute storm will provide a reasonable estimate of the rainfall intensity for design purposes.

8. Multiply the catchment area by the rainfall intensity from the IDF curve to give rate of stormwater collection.

9. Only contaminated runoff is of concern to the environment. Score this section even if the same treatment system is provided for both stormwater and process water. Uncontaminated runoff need not be collected or treated.

10. Of interest is the collection and treatment of contaminated runoff. Sites may combine process water and stormwater if flow rates and basin sizing permits but separate systems are also acceptable. Stormwater may be of sufficiently high quality to permit reuse in process under appropriate weather conditions. One point is awarded if reuse of stormwater is possible.

END NOTES FOR QUESTIONNAIRE USE CONT'D.

11. A decision is necessary as to which criteria to use for settling basins that treat both stormwater and process effluent. The decision will take into account the normal operating practices of the facility, the sensitivity of the receiving environment, and the magnitude of the difference between the process and stormwater volumes. There is no right or wrong answer, but the basins should be sized to provide adequate protection of the receiving environment.

12. The inventory will highlight the various chemicals in use on-site and should assist management to review purchasing policies and the appropriate size of the chemical inventory.

13. AST is an above ground storage tank, UST is an underground storage tank. For new systems, a double walled tank system is recommended.

14. An impervious unloading pad is desirable to minimize contamination of soil and surface waters. Runoff from the pad will be sent to the treatment system and/or reused. The pad can be asphalt or concrete and should have a low rollover curb to prevent runoff from entering or leaving the pad.

15. Each province will define hazardous waste according to some standards. In British Columbia, the Special Waste Regulation definitions are based on the Canadian Transportation of Dangerous Goods Act. Consult the local environment regulatory office for information on defining and handling hazardous waste.

APPENDIX IV

Blank Worksheets
for
Pollution Prevention Planning

Worksheet 1

Completed By: Date:

The Pollution Prevention Team

Company : _____ Facility Name: _____

Team Leader: _____ Title: _____ Phone: _____

Member Names	Responsibilities		Phone
	Corporate	Team	

Responsibility of Pollution Prevention Team:

1. Inspecting facilities to assess how materials are used and to identify evidence of waste, particularly of hazardous waste.

2. Involving co-workers in identifying problems and suggesting possible solutions.

3. Preparation of a pollution prevention plan.

Worksheet 2

Site Description

Completed By: Date:

1. **Facility Name:** _____

2. **Company Name:** _____

3. **Contact:** _____

4. **SITE ADDRESS:**

Street:

City: *Province:* *Postal Code:*

5. **LEGAL DESCRIPTION OF SITE LOCATION:**

_____

_____

6 **ESTIMATED SITE SIZE:** _____

7. **MAILING ADDRESS:**

Street:

City: *Province:* *Postal Code:*

8. **PHONE and FAX NUMBERS:**

Phone: *Fax:*

Other:

Worksheet 3

Environmental Site Specific Factors

Completed By: Date:

1. Distance to nearest water body: _____

a. Name of waterbody: _____

2. Distance to other ecologically sensitive areas:

e.g., Waterflow Breeding

Source: FREMP Habitat Inventory

Distance	*Area Description*

3. Distance to nearest populated area: _____

a. Name of Municipality: _____

4. Distance to nearest groundwater well: _____

(Source: BC Environment Water Resources Branch) _____

5. Depth to groundwater at site: _____

6. Composition of site soil: _____

_____

_____

_____

7. Average annual precipitation at site: _____

(Source: Environment Canada)

8. Is area in a 100 year flood plain? _____

(Source: BC Environment Water Resources Branch)

9. Release point for stormwater discharge: _____

10. Regulatory information

a. Liquid Waste: _____

b. Air permit: _____

c. Other (please list): _____

Worksheet 4

Completed By: Date:

Pre-Survey Information Collection

1. **Company Name:** _____ **Facility Name:** _____

2. **Operation type:** ☐ **Central Mix Process (Wet Batch)** **Cement Type:** _____

☐ **Truck Drum Mixing (Dry Batch)**

Market:

Commercial ☐

Residential ☐

3. **Availability of Essential Documentation for Site Inspection:**

DOCUMENT	AVAILABLE Y / N	DATE LATEST VERSION	LOCATION / COMMENTS
Company Literature (re: Products, Services, etc.)			
Process Description			
Diagrams, Blueprints, Drawings of Buildings, Process Areas, etc.			
Design Information including Equipment Lists, Equipment Specifications, Process Flow Diagrams			
Operating Manuals			
Water and Energy Use Record			
Inventory of Raw Materials			
Product Inventory (e.g., Loc-blocks)			
Material Balance Analysis			
Material Safety Data Sheets (MSDS)			
Pollution Monitoring Data			
Hazardous Waste Manifests			
Environmental Audit Reports			
Regulatory Permits & Correspondence			
Fire Inspection Reports			
WCB Correspondence/ Records			
Employee Training Records			
Operator Data Logs			
Site Contingency Plan			

Worksheet 5 (a)
Completed By: Date:

Process Raw Materials Input Summary

1. Facility Name: _____

2. Materials Summary

RAW MATERIAL	CEMENT	FLY ASH	AGGREGATE	WATER	AD-MIXTURES					OTHER
					1	2	3	4	5	
Trade Name										
Chemical Name										
COMPONENTS/ATTRIBUTES OF CONCERN										
Components and Concentration (Specify Units : %, PPM...)										
ANNUAL CONSUMPTION RATE										
Overall (Specify Units: Kg, Tonnes, Lbs...)										
SUPPLIERS										
Supplier #1										
Supplier #2										
COSTS										
Purchase Price (Cdn. $/_____)										
Overall Annual Cost										

Worksheet 5 (a)

RAW MATERIAL	CEMENT	FLY ASH	AGGREGATE	WATER	AD-MIXTURES					OTHER
					1	2	3	4	5	
SHIPPINGAND STORAGE DETAILS										
Delivery Mode										
Normal Order/ Delivery Size										
No. Shipments/Year										
Shipping Container (Size and Type)										
Storage Mode										
Transfer Mode										
Inventory Size (Max.)										
EMPTY CONTAINER MANAGEMENT										

Worksheet 5 (b)
Completed By: Date:

Chemical Use Summary

1. Facility Name: _____

2. Materials Summary

RAW MATERIAL	FUELS		SOLVENTS	OIL/ LUBRICANTS	ANTIFREEZE	CLEANERS/ DETERGENTS	MURIATIC ACID	OTHER
	VEHICLE	BOILER						
Trade Name								
Chemical Name								
COMPONENTS/ATTRIBUTES OF CONCERN								
Components and Concentration (Specify Units : %, PPM...)								
ANNUAL CONSUMPTION RATE								
Overall (Specify Units: Kg, Tonnes, Lbs...)								
SUPPLIERS								
Supplier #1								
Supplier #2								
COSTS								
Purchase Price (Cdn. $/_____)								
Overall Annual Cost								

Worksheet 5 (b)

RAW MATERIAL	FUELS		SOLVENTS	OIL/ LUBRICANTS	ANTIFREEZE	CLEANERS/ DETERGENTS	MURIATIC ACID	OTHER
	VEHICLE	BOILER						
SHIPPING AND STORAGE DETAILS								
Delivery Mode								
Normal Order/ Delivery Size								
No. Shipments/Year								
Shipping Container (Size and Type)								
Storage Mode								
Transfer Mode								
Inventory Size (Max.)								
EMPTY CONTAINER MANAGEMENT								

Worksheet 6
Completed By: Date:

Product Summary Information

1. **Facility Name:** _____

2. **Product Summary:**

	ANNUAL PRODUCTION
PRODUCTS	
Residential Building Concrete	
Commercial Building Concrete	
Other:	
TOTAL PRODUCTION	

RETURNED CONCRETE	
• AMOUNT RECYCLED	
– Pre-Cast Products	
– Reuse (next batch)	
– Other	
• AMOUNT DISPOSED	

Worksheet 7
Completed By: Date:

Regulatory Compliance Essential Requirements

1. AIR EMISSIONS AND CONTROLS

a. Sources of controlled emissions *(circle)*

Gas/propane/oil-fired broiler	Aggregate storage and handling
Cement silo and/or baghouse	Vehicle traffic
Fly-ash silo and/or baghouse	Fugitive dust
Bulk transfer system	Bulk fuel handling
	Solvent use

b. List permits and/or relevant regulation responsible agency:

c. Is pollution control equipment operational? No Yes

d. If routine monitoring is required by regulatory agency:

- Are monitoring results available? No Yes NA
- Is monitoring frequency and analytical sensitivity in accordance to regulatory requirements? No Yes NA
- Do results indicate compliance with regulatory limits? No Yes NA
- Has the necessary reporting to regulatory agencies occurred? No Yes NA

2. LIQUID EFFLUENT RELEASES

	TYPES	**DISCHARGE LOCATION**
a. Sources of regulated effluent releases *(circle)*	Stormwater run-off	
	Treatment System Discharge	
	Other:	

b. List permits and/or relevant regulation responsible agency:

c. Is pollution control equipment operational? No Yes NA

d. If routine monitoring is required by regulatory agency:

- Are monitoring results available?	No	Yes	NA
- Is monitoring frequency and analytical sensitivity in accordance to regulatory requirements?	No	Yes	NA
- Do results indicate compliance with regulatory requirements?	No	Yes	NA
- Has the necessary reporting to regulatory agencies occurred?	No	Yes	NA

3. SOLID WASTES

a. Sources of regulated solid wastes *(circle)*

Chemical sludges	PCB equipment
Settling pond sludges	Batteries
Petroleum hydrocarbon sludges	Contaminated Soil
	Other:

b. List permits and/or relevant regulation responsible agency:

c. Have solid wastes been evaluated to determine if they are Special Wastes?	No	Yes	NA
d. If Special Wastes are present, are storage and inspection in compliance with the Special Waste Regulation?	No	Yes	NA
e. Are licensed hazardous waste contractors used for disposal?	No	Yes	NA
f. Are shipping documents complete and available for review on-site?	No	Yes	NA

Worksheet 8
Completed By: Date:

Control of Bulk Liquid and Gases

1. INVENTORY OF BULK LIQUID AND GASES

PRODUCT	STORAGE TYPE [UST or AST]* and VOLUME [Litres]	CONTAINMENT TYPE And VOLUME [Litres]	IS CONTAINMENT ADEQUATE? [See 2(c) below]
Diesel/Gasoline			
Admixtures:			
Acid/Caustic			
Solvent			
Oil/Lubricants			
Antifreeze			
Cleaners/Detergents			
Other: *Acetylene*			

**Underground Storage Tank (UST); Above Ground Storage Tank (AST)*

2. ABOVEGROUND TANKS

a. Are all tanks and drums on top of an impermeable floor? No Yes

b. Is the floor sealed (e.g., absence of cracks)? No Yes

c. Are all containment volumes in excess of 110% of the largest tank or the volume of the largest tank plus 10% of the aggregate volume of all other tanks? No Yes

d. Are all tanks free of corrosion and physical damage? No Yes

e. Are all tanks securely mounted and protected from vehicle impact? No Yes

3. UNDERGROUND STORAGE TANKS

a. Is the underground tank less than 10 years old?	No	Yes
b. Are the underground tanks and piping leak tested annually and records kept?	No	Yes

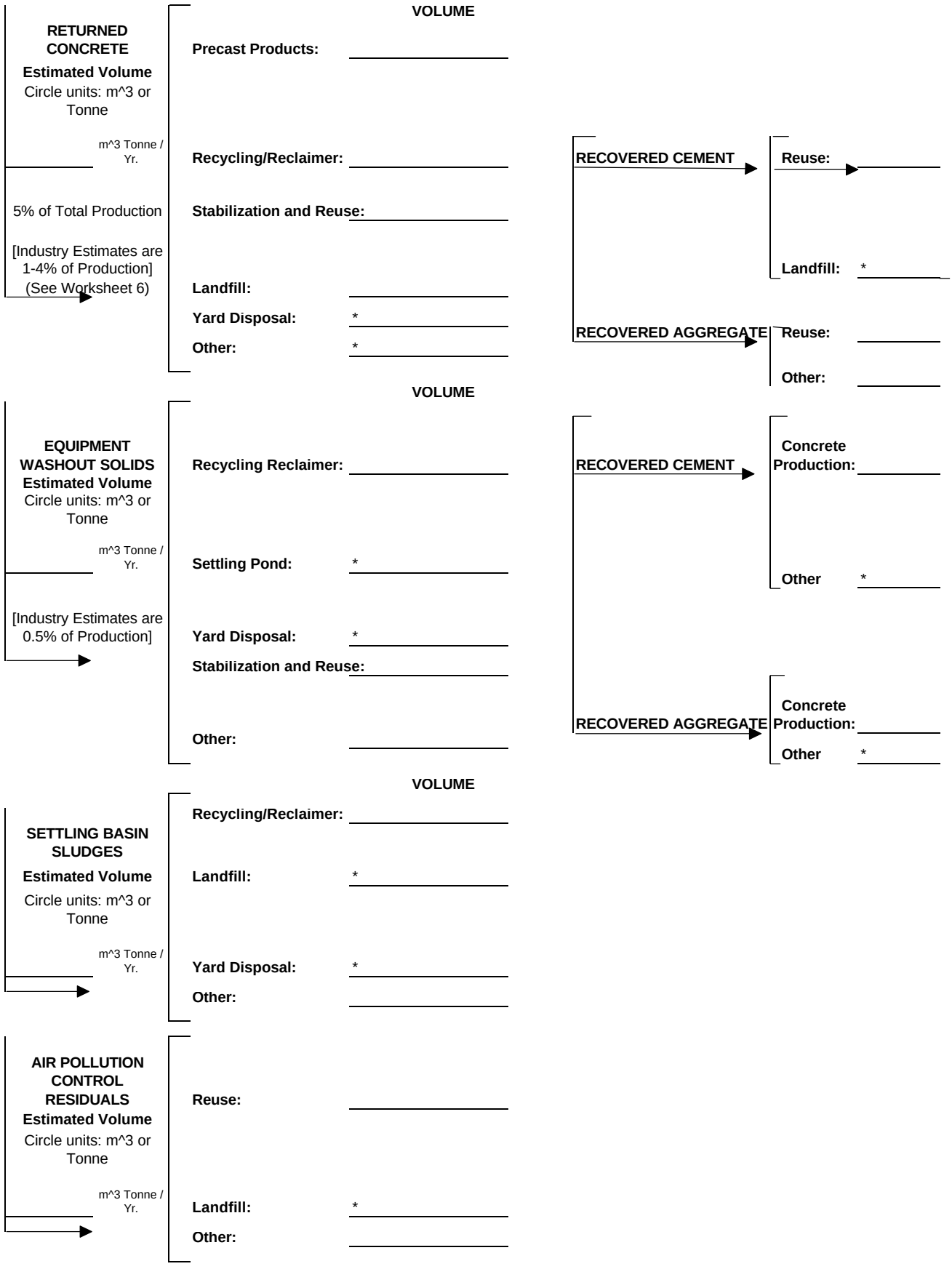
4. ALL TANKS AND DRUMS

a. Are tanks and drums secured to prevent tampering?	No	Yes
b. Are tanks provided with overfilling protection and/or alarms?	No	Yes
c. Are bulk drains (including stormdrains) located away from chemical unloading area and bulk tank storage area?	No	Yes
d. Are non-gravity feed systems used for fuel supply/dispensing?	No	Yes
e. Are dispensing systems de-energized and locked between use?	No	Yes
f. Are dispensing areas provided with drip and spill containment?	No	Yes
g. Are spill kits provided at all bulk chemical storage and handling points?	No	Yes
h. Has a spill response plan been prepared.	No	Yes
i. Is the plan readily available?	No	Yes

Worksheet 9

Completed By: Date:

Solid Waste Stream Diagram



MISCELLANEOUS SOLID WASTES

SLUDGES

Volume: _____

Disposal Method: _____

BATTERIES

Volume: _____

Disposal Method: _____

CHEMICAL CONTAINERS

Volume: _____

Disposal Method: _____

WASTES IDENTIFIED IN PLANT REVIEW (e.g., Chemical Residual)

Volume: _____

Disposal Method: _____

DISPOSAL COSTS:

(Annual)

CONCRETE SLUDGES $ _____

MISCELLANEOUS $ _____

Worksheet 10
Completed By: Date:

Assessment of Water Use and Recycling

ACTIVITY	% FRESH WATER	% RECYCLED WATER
Concrete production		
Truck wash		
Drum washout		
Point source dust control		
Other uses: boiler		
hot water production		
Total freshwater use:		
Stormwater: % controlled (into treatment system)		
% uncontrolled		

Worksheet 11
Completed By: Date:

Assessment of Current Pollution Prevention Measures

Objective: To evaluate current practices *versus* pollution prevention concepts outlined in Appendix 2.

Re: Concept 1	**Reduction of use of toxic substances, raw materials and non-renewables.**			
	1.1	Are preventive measures in place to avoid "off-spec" concrete, (e.g., periodic testing of scales, batch gate operation, etc.)?	No	Yes
	1.2	Is an operator's manual available?	No	Yes
	1.3	Is regular operator training provided?	No	Yes
	1.4	Is water conservation practiced by restriction of freshwater uses to purposes such as: · truck exterior washoff? · hot water production? · batch waters for high quality concrete?	No	Yes
	1.5	Are flow controls installed on freshwater sources?	No	Yes
Re: Concept 2	**Reuse of recovered raw material, products and hazardous substances.**			
	2.1	Are volumes of returned concrete minimized (i.e., less than 2.5% of total production volume)?	No	Yes
	2.2	Is all returned concrete either: · reused (precast products, road base, etc.); or, · recycled (reclaimed)?	No	Yes
	2.3	Are all air pollution control residues reused?	No	Yes
	2.4	Are all drum washout solids reused or recycled?	No	Yes
	2.5	Are settling basin sludges reused or recycled?	No	Yes
	2.6	Is 100% of the process water (drum washout, truck wash) reused?	No	Yes
	2.7	Is collected yard stormwater used for washdown, etc.?	No	Yes
Re: Concept 3	**Elimination or minimization of environmental releases.**			
	3.1	Are spills of cement and concrete cleaned up immediately?	No	Yes
	3.2	Is the process area paved and curbed to collect processing water for treatment and/or recycling?	No	Yes
	3.3	Is the pavement and curbing in good condition (i.e., no cracks)?	No	Yes

	3.4	Is the size of the processing area minimized and/or roofed to reduce exposure to rainfall?	No	Yes	
	3.5	Is yard stormwater diverted from the process area?	No	Yes	
	3.6	Are oil separators installed in truck wash areas and other areas where oil releases may occur?	No	Yes	
	3.7	Are measures taken to ensure proper dust control during transfer of cement and fly ash?	No	Yes	
	3.8	Are aggregate piles designed to minimize fugitive dust control (e.g., minimal surface area, storage bins, covers)?	No	Yes	
	3.9	Are high vehicle traffic areas paved?	No	Yes	
	3.10	Is the traffic system controlled (e.g., low speed limits, one-way traffic to separate dirty from clean vehicles)?	No	Yes	
	3.11	Are paved portions swept to remove accumulated dust?	No	Yes	
Re: Concept 4	**Recycling of recovered materials off-site.**				
	4.1	If all concrete and sludges are not recovered on-site, are the materials used off-site (e.g., road base)?	No	Yes	NA
Re: Concept 5	**Treatment of non-recoverable waste with a focus on recovery and minimization of residues.**				
	5.1	Is there a system (e.g., settling basin) for treatment of excess water?	No	Yes	
	5.2	Does the treatment system enable pH control?	No	Yes	
	5.3	Is the process area minimized (i.e., <10% of total yard area)?	No	Yes	
	5.4	Does routine monitoring of effluent quality occur?	No	Yes	
	5.5	Is the wastewater holding basin of sufficient volume to manage all effluent in high precipitation events?	No	Yes	
	5.6	Can concrete fines and aggregates be removed from the basins?	No	Yes	
	5.7	Is unusable sludge disposed of in approved facilities?	No	Yes	
	5.8	Are admixture and other chemical containers returnable to the supplier?	No	Yes	
	5.9	Are all chemicals no longer in use removed from the site?	No	Yes	

Re: Concept 6	**Safe disposal of wastes.**			
	6.1	Are lead batteries, solvents, waste oils, etc., stored in secure locations?	No	Yes
	6.2	Are lead batteries, solvents, waste oils, etc., recycled?	No	Yes
	6.3	Are operating procedures for waste disposal adequately defined?	No	Yes
	6.4	Has management confirmed that approved facilities are used for waste disposal?	No	Yes
	6.5	Is all documentation at hand for transport manifests, certification of destruction, etc.?	No	Yes
Re: Concept 7	**Safe handling of chemicals and products to ascertain that no site contamination or sudden releases occur.**			
	7.1	In addition to points in worksheet 8, are aboveground piping and valves visible and labelled?	No	Yes
	7.2	Are tank materials and designs as per all applicable codes and manufacturers' recommendations?	No	Yes
	7.3	Are spill response equipment, absorbents and personnel protection equipment provided?	No	Yes
	7.4	Is worker training for spill response provided?	No	Yes
	7.5	Are signs in place to identify contents of bulk tanks and drums?	No	Yes

Worksheet 12
Completed By: Date:

Facility Status and Identification of Priorities

1. Facility Name: _____

2. Summary of Compliance with Regulatory Requirements (from Worksheet 7):		
Regulatory Permit	**Permit No.**	**Compliance Status**
Liquid (Effluent Waste Permit)		
Air Permit		
Solid Waste Permit		
Special Waste Permit		
Other (please list)		
Listing of "no" responses in Worksheet 7 [Any "no" will be a priority item and must be addressed immediately.]		

3. Summary of Potential Concerns C Catastrophic Releases and Site Contamination (from Worksheet 8):	
Listing of "no" responses in Worksheet 8	Pollution Prevention Team Priority and Basis of Decision[1]

[1] Priorities may be based on aspects such as relative volumes of stored liquids, proximity to water bodies and storm drains, use of alternative control measures, etc.

4. Summary of Current Pollution Prevention Concerns (from Worksheet 11):	
Listing of "no@ responses in Worksheet 11	Pollution Prevention Team Priority and Basis of Decision[2]

[2] Priorities may be based on aspects such as: potential for high cost/benefits; relative volumes of wastes; local conditions such as proximity to water bodies; low rainfall conditions, etc.

Worksheet 13
Completed By: Date:

Identification of Easily Implemented Pollution Prevention Measures[1]

1. Facility Name:		
2. Recommended measures for immediate implementation:		
Measure	**Priority**	**Type of Pollution Prevention Measure[2]**

1 No technical/economic analysis required
2 Operating practice, maintenance, minor equipment change, minor process change, etc.

Worksheet 14
Completed By: Date:

Identification of Pollution Prevention Concerns which Require Detailed Assessment

1. **Facility Name:** _____

2. **Identification of Pollution Prevention Concerns and Possible Response Options.**

Pollution Prevention Concern (From Worksheet 12)	Possible Options (From Appendix 2)

Worksheet 15
Completed By: Date:

Technical Feasibility

Instructions: Copy this form and use one form for each Reduction Option.

1. **Facility Name:** _____
2. **Pollution Prevention Concern:** _____
3. **Description of option:**

_____

_____

4. **Kind of option:**
   - **F** Equipment-Related
   - **F** Process-Related
   - **F** Raw Material-Related
   - **F** Personnel-Related

5. **Describe potential personnel requirements (training, safety, etc.):**

_____

_____

6. **Are required space and utilities available? Explain:**

_____

_____

7. **Will production quality or services be affected? Does the system create other environmental or health and safety problems? If yes, explain:**

_____

_____

_____

8. Technical Feasibility Scale:

Scale for technical feasibility

1) Easily Achievable**C**Regular Maintenance
2) Minor Equipment Piping Changes
3) Minor Process
4) Major Process Change
5) Require Process Development/ New Tech.
6) Currently Unfeasible. Requires Replacement of Process

9. Does the technical feasibility of the option warrant subsequent economic analysis? Explain:

Worksheet 16 — **Financial Analyses**

Completed By: Date:

1. **Facility Name:** _____

2. **Description of Option: Installation of recycling reclaimer system for returned concrete.**

3. **CAPITAL COSTS**

Procurement Expenses:	Costs (A*)	Total
a. Recycle Equipment		
b. Materials (Piping, Pumps etc.)		
c. Installation		
d. Engineering		
e. Permitting		
f. Utility Connection		
Total Capital Costs:		

4. **ANNUAL COSTS FOR RECYCLE OPTION**

Year	Item	w/ Recycle	Total
1	a. Interest Expense (Capital Cost x Interest) ($102,000.00 x 12% =) (B*)		
	b. Depreciation Expense (C*)		
	c. Initial Training		
	d. Operating Expenses (Labour, Utilities, Maintenance)		
	e. Waste Disposal		
	Total - Year 1		
2	f. Interest Expense ($68,000.00 x 12% =)		
	g. Depreciation Expense		
	h. Operating Expenses (Assume 5% per year increase)		
	i. Waste Disposal (Assume 5% per year increase)		
	Total - Year 2		

Notation:

A* - For example only - Actual costs vary.

B* - As per U.S. EPA (1992). Assume money is borrowed for 3 years at 12% interest annually. Actual monies borrowed or repaid are neither revenues nor expenses and do not appear in financial analyses.

C* - Straight line depreciation is used at 10% each year (U.S. EPA, 1992).

5. ASSESSMENT OF APPARENT COST SAVINGS

Raw Material	Quantity	Cost	Total
j. Amount of recovered product			
k. Costs of recovered product			
l. Total value of recovered product			

Raw Material	Quantity	Cost	Total
m. Amount of recovered product			
n. Costs of recovered product			
o. Total value of recovered product			

Water/ Solvent Reduction	Quantity	Cost	Total
p. Amount of recovered water/ solvent			
q. Cost per volume			
r. Total value of water			

Labour Reduction	Quantity	Cost	Total
s. Amount of reduced labour			
t. Cost Labour per Unit			
u. Total Labour Savings			

(Other Costs)	Quantity	Cost	Total
Waste Disposal Costs:			
Other Costs: Mileage			
Change in Utilities Costs:			
Change in Insurance Costs:			
Subtotal - Other			
Total Apparent Cost Savings:			

6. REAL COST SAVINGS = (Total Annual Costs - Total Apparent Cost)

The estimated cost savings in the first year would be:

Worksheet 17
Completed By: Date:

Summary of Analysis of Pollution Prevention Option

1. **Facility Name:** _____
2. **Option Name:** _____
3. **Briefly describe the option:**

4. **Waste Stream(s) affected:**

5. **Input Material(s) affected:**

6. **Product(s) affected:**

7. **Indicate Type:**

- F **Source Reduction**
  - F Equipment-Related Change
  - F Personnel/Procedure-Related Change
  - F Materials-Related Change
- F **Recycling/Reuse**
  - F On-site
    - F Material reused for original purpose
  - F Off-site
    - F Material used for lower quality purpose
    - F Material sold

8. **Financial analysis attached:**

9. **Originally proposed by:** **Date:**
10. **Reviewed by:** **Date:**
11. **Approved by:** **Date:**
12. **Reason for acceptance/rejection:**

Worksheet 18
Completed By: Date:

Summary of Approved Pollution Prevention Actions

Approved Easily Implemented Pollution Prevention Measures (From Worksheet 13)	Responsibility	Anticipated Completion Date

Approved Pollution Prevention Measures Following Detailed Analysis (From Worksheets 14 B 17)	**Responsibility**	**Anticipated Completion Date**
Re: Recommendation:		
Re: Recommendation:		
Re: Recommendation:		
Re: Recommendation:		
Re: Recommendation:		