RECOMMENDED GUIDELINE

FOR

ENVIRONMENTAL MANAGEMENT PRACTICES

FOR

CANADIAN READY MIXED CONCRETE INDUSTRY

Canadian Ready-Mixed Concrete Association
365 Brunel Road, Unit #3, Mississauga, ON, L4Z 1Z5
Tel.: (905) 507-1122, Fax: (905) 890-8122
www.crmca.ca

Disclaimer

The Canadian Ready-Mixed Concrete Association (CRMCA) has adapted this document from the *"Overview of the Ready Mix Concrete Industry in British Columbia and Waste Management Practices (1988)"*, "*Environment Canada's Regional Program Report 88-0"*, the "*Environmental Management Practices for the Ready Mixed Concrete Industry of Ontario (1994)"*, the *"National Ready Mixed Concrete Association Environmental Management Practices (1996)"*, and the "*Go Green – Environmental Management Practices for Ready Mix Concrete Operations in Alberta (2003)*" .

The CRMCA Environmental Committee was responsible for completing the adaptation process. This document is not intended to be used as an audit guide nor as a guide to product quality. Following this document does not guarantee full compliance with both provincial or federal laws and regulations. The information in this document is presented with the understanding that neither CRMCA, nor its authors, offer any portion of this document as legal advice or opinion. Consultations with competent professionals in your jurisdiction are recommended for interpretations and legal advice. This document has been prepared to provide ready mixed concrete plant managers and employees with guidance about operating in an environmentally sound manner. It is intended to assist plant managers and employees in identifying areas at their facilities that may need to be addressed so that potential discharges or emissions of pollutants can be reduced or eliminated. Additionally, this document can serve as a guideline for the construction of new facilities, or expanding existing facilities. The best management practices identified in this document have been elected to apply to most ready mixed concrete production facilities and may not address all of the needs of the respective plant and the compliance requirements provided within an approval, authorization, certification or permit issued by the respective provincial regulatory authority.

Table of Contents

CHAPTER ONE

INTRODUCTION

This document has also been prepared to support the emissions reduction recommendations provided in the August 2002, Final Report, "Multi-pollutant Emission Reduction Analysis Foundation (MERAF) for the Canadian Ready-mixed Concrete Sector" prepared by ICI Consulting for Environment Canada.

OBJECTIVE

This document outlines environmental management practices that should be practical for the ready-mixed concrete industry with the intention of minimizing or reducing the potential environmental impacts resulting from plant operations.

Ready mixed concrete producers may use this information as a guideline for constructing new plants or for the expansion and upgrade of existing plants. This document has no binding legal or regulatory status.

ENVIRONMENTAL ISSUES

In comparison with other primary manufacturing facilities or activities, ready mixed concrete plant operations do not generally pose a significant threat to the environment. This does not preclude the importance of environmental awareness by the plant manager or employees.

It is important to recognize at all times that ready mixed concrete plant activities and operations, without proper controls and mitigation measures, can result in adverse affects that may impact, either singularly or in combination, the key components of the environment:

- air, land and water
- organic and inorganic matter
- all living organisms; and
- all interacting natural systems for these components

Basic environmental management should consider the following components:

- Confirming all environmental aspects associated with plant activities and operations for ready mixed concrete production or delivery;
- Identifying the potential environmental impacts that may result during all phases of ready mixed concrete production or delivery; and
- Using mitigation measures, best management practices and available technologies, to reduce or eliminate potential environmental impacts.

Pollution Prevention (P2) principles should be considered when developing environmental management program components for the ready mixed concrete plant and the plant site. Pollution Prevention involves the use of processes, practices, materials, products or energy that avoids or minimizes the creation of pollutants and waste or environmental disturbance, and reduces risk to human health or the environment.

Some facilities, depending on location and volumes of ready mixed concretes produced, may require greater control and management of onsite environment issues. Prevailing wind conditions or different land uses adjacent to the plant site may result in more rigorous or modified dust suppression activities. The presence of open water or watercourses (natural or man-made) near the plant site, should result in more stringent controls for process water or storm water drainage from the property, especially for potable water sources or watercourses containing fish or fish habitat. High volume or specialized production may introduce specific waste management concerns for handling return concrete. These are just a few of the examples provided for demonstrating the challenges of environmental management.

COMMUNITY AFFAIRS and PUBLIC CONSULTATION

An important goal of the ready mixed concrete industry is to be a responsible corporate citizen and a good neighbour. It is essential that concrete producers make every reasonable effort to improve company relations with the surrounding community. This may include maintaining a positive image of the plant and equipment as well as participating in local community affairs.

Industry Involvement in Community Affairs

Concrete producers can significantly impact the perception of their neighbours and others in their community by participating in community affairs. This involvement can take several forms (e.g., corporate membership in civic organizations, holding open houses for neighbours and community leaders, or the contribution of goods or services for worthwhile community projects, encouraging employee involvement in local government activities as appropriate).

Visual Image
Concrete plants, related buildings and concrete truck mixers should be well maintained to present a positive industry image (i.e., mixers should be kept clean, freshly painted and well maintained; truck and equipment parts, tires, empty drums, solid waste and other debris should be in an enclosed area and out of public view; keep the main chute, fold over chutes, charge hopper, fenders and frame clean to avoid broken windshield claims and spillage; consider using chute covers or caps to contain excess concrete on the chute; drain the engine oil, hydraulic fluid and engine coolants from old, unused trucks kept in the "bone yard"). See Chapter 4 (Solid Materials Management).

Traffic and Noise Management
Good community relations require reasonable access controls and truck traffic management (e.g., post appropriate truck speed limits and always enforce them; keep trucks and front end loaders away from nearby homes whenever possible; manage the dirt tracked away from the plant by company trucks; follow the established truck routes in your community).

Uncontrolled or continuous noise and dust emissions may be the most common complaints of neighbours located near or adjacent to a ready mixed concrete plant. Plant managers and employees should take necessary and reasonable steps to minimize noise levels and dust emissions so as not to create a nuisance.

CHAPTER TWO

OVERVIEW OF READY MIXED CONCRETE OPERATIONS

CONCRETE COMPOSITION

The typical components of ready mixed concrete are coarse and fine aggregates, cement and water (Table 2-1). Frequently, fly ash, slag cement or other cementitious material is added to supplement the cement. Admixtures are added to concrete to improve the properties of the fresh and/or hardened concrete.

INGREDIENT	TYPICAL COMPOSITION
	% of volume
Coarse aggregate	31 – 51
Fine aggregate	24 – 28
Portland Cement	7 – 15
SCM	2 – 3
Water	14 – 18
Admixtures	NA
Entrained Air Content	4 – 8

Table 2-1. Composition of Typical Air-entrained Concrete

Cements, Fly Ash, Slag Cement, Silica Fume

Cementitious materials are usually stored in elevated silos 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 should be used to control dust emissions from cement, slag or fly ash, which occurs when these materials are loaded into the silos. The cementitious materials are collected for recycling.

Aggregates

Aggregates are commonly stored in stockpile areas or storage bins at the plant site. These stockpiles may have feed hoppers under the pile or at one end of the pile. Sometimes, a front-end loader is used to charge the feed hopper from stockpiles on the ground. The feed hopper usually charges a conveyor belt, which rises to the plant. The gates on the hopper and the belt are cycled on and off automatically to keep the bins above the plant filled. Aggregates may also be stored underground or above the plant in larger bins using a more elaborate network of conveyor systems for materials transfer.

Admixtures

Admixtures are usually liquid additives used to control concrete characteristics and/or to improve the performance of the concrete for a given application. Admixtures are most often supplied by a tanker truck as bulk liquids, although smaller plastic containers may be used for specialty mixes and for storage at small, remote plant sites.

Material Safety Data Sheets (MSDS)

Each raw materials supplier should be providing the plant manager with up-to-date Material Safety Data Sheet (MSDS) documentation for the raw materials that are delivered and in use at the ready mixed concrete plant. Plant managers should also have their own MSDS documentation prepared for each type of concrete mixture produced at and delivered from the ready mixed concrete plant.

MIXING CONCRETE

In the batch plant, the plant operator usually oversees the batching of the ingredients from a central control room. Quantities of dry ingredients are determined by weight and added to a central mixer inside the plant or charged directly into the truck drum from overhead silos or conveyors. Water and liquid admixtures are measured by volume or by weight. Ingredients are added to the drum through a metal chute or hopper at the upper rear of the truck. Truck mixer drum capacities vary depending on the expected use of the vehicle and the production capacity of the plant (i.e., between 6 and 12 cubic meters by volume). Concrete can be truck mixed, shrink mixed or central mixed.

Truck Mixed Concrete

In truck mixed concrete, all the ingredients are charged directly into the truck mixer. No plant mixer is involved. Some or all the mixing water is usually batched at the plant. Truck mixed concrete can be mixed in the yard and agitated in transit to the job or at the job site.

Shrink Mixed Concrete
Shrink mixed concrete is partially mixed in a plant mixer and the concrete is then charged into a truck mixer. Mixing is completed in the truck mixer.

Central Mixed Concrete
Central mixed concrete is completely mixed within the plant and then discharged from the plant mixer. It may be hauled in a truck mixer, agitator or open dump truck.

WASHING THE TRUCK EXTERIOR
In some plants after loading, the truck moves to a wash down area where an overhead spray or driver operated hose is used to wash down the truck exterior with freshwater or recycle water. The loaded truck mixer then proceeds to make its delivery at the job site.

RETURNED CONCRETE
Often, some portion of the concrete load remains in the truck following delivery. On a yearly average in North America, up to five percent of the produced ready mixed concrete volume may be returned to the plant site. During plant operating hours, returned concrete is sometimes incorporated into the next batch of concrete as required, depending on the concrete specifications in the next order. When this cannot be done, usually after the day's batching is complete at the plant, the returned concrete must be discharged from the truck mixer drum for disposal or recycling.

RINSING THE MIXER DRUM
At the end of the day, the plant central mixer and the truck mixer drum must be rinsed out to remove all remnant concrete adhering to the drum insides. Normally, this process is completed by the driver using water from overhead wash racks or hoses. Fresh or recycled water is added to the drum and the drum is rotated rapidly in both directions. The rinse water is then discharged to the water collection basin or other system for water recycling. The same process would also be carried out by designated employees for maintenance of the central mixer contained within the plant at the end of the day.

Some higher volume plants may also use a mechanical reclaimer system for separating aggregates and slurry (cementitious materials and fine aggregates) from the drum washout. In some cases, operators will use a hydration stabilization admixture to allow the rinse water to remain in the mixer drum which then becomes part of the mixing water for the first batch of concrete dispatched the next day. If a hydration stabilization admixture is being used, the recommended amount of water and admixture is sprayed into the drum of the mixer truck followed by a quick spin and then the truck is parked. In the morning, the concrete is batched with the hydration stabilized washout material (refer to Chapter Three, Water Management, Hydration Stabilization, Admixtures).

SURFACE DRAINAGE AND WATER MANAGEMENT
Practices vary from each plant with respect to process water management. Ready mixed concrete plants often have paved plant areas to collect process water and surface runoff from truck loading, truck wash off and mixer drum rinsing areas. Some plants provide for the collection of runoff or leaching from reclaimed solids storage and drying piles. Suspended solids are removed using settling basins. At most plants a primary settling basin will overflow to a secondary settling basin. Additional basins in series may be used. It is common for water to be recycled in some part of the process.

Practices to control storm water runoff vary widely and are often determined by site constraints such as drainage, slope and access to storm sewer systems. At stationary plant sites the yard is usually paved (or hard-surfaced) and sloped to direct process water and storm water from these areas into the water collection basin. In more remote locations, it is common for the entire site to be unpaved, usually a compacted sand and gravel surface. Segregating the storm water runoff between process areas and aggregate storage sites and vehicle parking lots helps to minimize the amount of storm water runoff that must be managed.

Clean storm water can be discharged directly from the plant site, but any storm water coming into contact with plant process water or cementitious materials should be analyzed before discharge and recycled where possible. Regular sampling and testing of surface runoff from any outfalls on the plant site property is a useful practice to determine if the facility is releasing any potential surface water contaminants.

CHAPTER THREE

WATER MANAGEMENT

WATER USE IN READY MIXED CONCRETE PRODUCTION AND DELIVERY

A ready mixed concrete plant site typically uses water for the following activities or operations associated with concrete production and delivery:

1. Mix water for batching concrete loads
2. Washing the truck down at the plant site after loading
3. Washing the truck down after unloading at the jobsite
4. Washing the truck drum out at the end of the day
5. Stationary Reclaimer Systems
6. Acid washing of trucks
7. Boiler feed water for steam / hot water production
8. Water for cooling aggregates
9. Filling truck-mounted water tanks; and
10. Dust suppression in the plant yard, around aggregate bins and stockpile sites, and truck load-out and high traffic areas

The water used for the described activities and operations is not limited to only fresh water sources (groundwater or surface water). In most cases, recycled water from process water treatment facilities or storm water collection at the plant site could also be used.

BATCHING CONCRETE

The amount of water used in batching concrete accounts for most of total water volume used in a ready mixed concrete operation. The following examples are provided in showing methods for reducing water usage:

- Using water-reducing chemical admixtures that reduce the amount of given water in a batch of concrete.
- Using captured wash water, washout water, storm water surface runoff, slurry or chemically stabilized returned concrete in the production of ready mixed concrete.
- Developing or enhancing site drainage plans to capture and reuse storm water and process water.
- Installing metered or spring-loaded shut-off valves on the water hoses used to fill the truck-mounted tanks.
- Using smaller diameter water hoses or low volume-high pressure water hoses

TRUCK WASH DOWN AFTER LOADING

In some plant locations, a spray bar is used as one method in helping control the amount of airborne dust created when the mixer truck is loading and also removes some of the dust as the truck pulls out from under the plant after loading. The spray bar does not eliminate the need for additional washing of the back fins of the mixer to prevent a build up of materials in this area. This wash procedure should be done on a paved or hard-surfaced area that is sloped towards the washout pit or reclaim ponds, so the water can be captured and reused for washout at the end of the day.

Most wash procedures of this type are normally done exclusively with freshwater. However, by reusing water from a reclaim pond system, fresh water volumes used for truck wash down or washout can be significantly reduced. Consideration should be giving to the reuse of water from a reclaim pond system, as the truck driver may be exposed to high pH water that may be in contradiction with current health and security measures. Additionally the presence of particles in water may damage the truck paint and cause premature corrosion.

Depending on the settlement times required for the washout pit and reclaim ponds, the collected water may have to be supplemented by freshwater to ensure adequate supply volumes. Whenever recycle water is used, regular monitoring is required to ensure that most of the coarser fines are settling out. If necessary, recycled water could be used by the drivers to bring the concrete up to the required slump. All water volumes, whether fresh or recycled, can be regulated in some capacity by using metered timers or spring-loaded valves to limit the quantity used by the truck drivers.

TRUCK WASH DOWN ON THE JOB AFTER UNLOADING

Washing down chutes and the mixer at the jobsite must be managed in an environmentally acceptable manner to avoid uncontrolled discharges from the jobsite. Some jobsites will allow the chute washout material to be discharged on the ground in a designated area of the construction site that will be rehabilitated later. The aggregate and slurry remaining after washing down, will have elevated alkaline properties even with dilution by wash down process, and are considered detrimental if released to the receiving environment directly without treatment. The plant dispatchers or truck supervisor should make every reasonable effort to ensure that truck chute washout at the jobsite is in an area that has been selected by the contractor or customer to meet regulatory considerations. If a contractor or customer is unaware of regulatory requirements, the plant dispatchers or truck supervisor may provide assistance in the choice of an appropriate site for wash down. On jobsites where space and access is limited, metal washout boxes or storage tanks can be used to collect the chute washout residue so that it can be removed from the jobsite later in the day or week, depending on the load schedules and project demand.

Mixer truck operators must never washout the chute where the water and slurry mixture can drain directly into a catch basin or onto a surface that drains into a catch basin. A form-fitting chute cover or "diaper" can be used on the folded chute end to prevent spillage when the truck is moving and to allow the mixer truck to return to the plant for washout and clean up if chute washout is not available at the jobsite. After-market portable reclaiming systems can also be installed on the mixer truck to re-direct chute wash out back into the drum or another storage tank.

END OF DAY WASHOUT AT PLANT

Washout Pits and Reclaim Ponds
If employed, washout pits and reclaim ponds should be designed and constructed so that the captured water can be recycled and reused for concrete production as well as mixer truck washout when the unit is finished for the day. (see BMPs) A multiple-cell washout pit allows water to move by gravity or pump from each cell, with a final reclaim cell for wash water use. Slurry and particles separate or settle out while the water circulates between cells. Regardless of the number of cells in washout pits and reclaiming ponds, regular maintenance is required to remove settled out solids from the pit or pond bottom, maintaining optimal cell capacity. Settled solids are removed and allowed to dry in an area with containment or drainage towards the washout pit or reclaim pond.

Depending on cell volumes and settling capacity, the amount of recycle water available for reuse will reduce or eliminate the amount of freshwater required for end of day washout. Whenever possible, recycled water, rather than freshwater, should be used for mixer truck washout and wash down. It is recognized for some areas, where operations occur in sub-zero temperatures, that the washout pit and reclaim pond system will require an indirect heat source (such as a steam line) to prevent recycled water from freezing. For larger, high volume stationary plants, a partial or complete enclosure can be constructed for the washout area and reclaim pond system.

STATIONARY RECLAIMER SYSTEMS
Stationary reclaimer systems, that mechanically separate the aggregate and slurry from mixer drum washout, are also available and can be installed as part of the washout area and reclaim pond system. The recovered slurry can be reused in daily production, the recovered aggregates at anytime.

Hydration Stabilization Admixtures
Hydration Stabilization Admixtures (HSA) can also be applied for reusing larger volumes of returned concrete in subsequent concrete batches depending on HSA suspension times. This alternative reduces the amount of water used for washout and disposing returned concrete as a waste. The HSA dosage will suspend the hydration process, allowing the concrete to be used beyond its normal set up time (between 30 and 120 minutes). By controlling the amount of HSA dosage, usually determined by a computer program, the concrete set up time can be delayed routinely from anytime, usually between 3 and 24 hours for most required concrete strengths. HSA dosage requires careful monitoring and should be determined by a computer program for achieving intended concrete strength and set up times. HSA dosages can also be used to minimize the disposal of mixer drum wash water. This process enables storing wash water in the mixer drum for up to 72 hours and reincorporating the wash water with the first batch of concrete on the following day. HSA uses for returned concrete, mixer drum washout, slurry and recycle water treatment have the potential to substantially reduce on site handling and management of wastewater and waste solids.

Dry washout procedures
Crushed aggregate may replace water in the washout process in remote areas where water sources are unavailable or where water has higher delivery and service charges. The discharged aggregate from dry washout can be crushed and screened for reuse in future batches or used as a fill material depending on local customer or contractor requirements.

WASHING OF TRUCKS AT PLANT
Any truck washing and cleaning using a diluted acid solution should be done on a paved or hard-surfaced area in front of the washout pit and reclaim pond, so that the used water and diluted acid solution is captured in the washout pit and then recycled again for truck washout. Collecting the diluted acid solution in this way will also help adjust the higher alkalinity levels for the water contained in the washout pit.

HEATING AND COOLING WITH WATER

Heating Mix Water and Slurry
Boiler feed water can be used for increasing the relative temperature of mix water and slurry for batching concrete when outside temperatures are at or below freezing. Plant operators should carefully monitor water and slurry heating

temperatures, minimizing the amount of steam required, which will reduce overall water quantities and the chemicals used for water treatment.

Heating Aggregates The amount of water used in boilers to create steam for aggregate heating is relatively minimal. However, plant operators should only heat aggregate materials and water when necessary, minimizing the amount of steam required, which will reduce overall water quantities and chemicals used for water treatment.

Cooling Aggregates
In hot weather, water may have to be sprayed on coarse aggregate stockpiles to cool the material so that specified concrete temperatures can be achieved. Overall aggregate temperature is lowered as moisture evaporates from the aggregate surfaces. Water that does not evaporate can be collected if the aggregate is stored on a paved or hard-surfaced area that is sloped toward the washout pit or reclaim pond facility. If the aggregate is stored on an unpaved area, usually a compacted sand and gravel surface, the excess water will infiltrate into the ground. In this situation, use of freshwater or treated wastewater and storm water, should be considered.

FILLING TRUCK MOUNTED WATER TANKS
The water contained in truck tanks is normally used at the jobsite for adjusting the slump of the concrete load and to washout the mixer chute after unloading. This is usually fresh water from a municipal supply or water well and should not be an environmental concern. The residue and effluent from chute wash out should be handled as outlined previously.

DUST CONTROL
Water is often used to control airborne dust at ready mixed concrete plant sites during the summer months. Paved or hard-surfaced yard areas can be sloped or graded to allow storm water runoff or process water to be collected in designated locations. Again, if possible, recycled storm water should be used when spraying for dust suppression. Do not use process water before it has completed its recycle treatment for reducing pH levels and silt load. In addition to watering for dust suppression, it is important to sweep paved yards or hard-surfaced areas on a regular basis. Wet sweeping in most instances can be more effective than dry sweeping. Accumulated dust becomes more readily airborne from paved surfaces in direct comparisons with an unpaved surface. Water used for dust suppression can be recaptured and reused depending on yard drainage patterns and collection in the washout pit or reclaim pond.
For unpaved yard areas, environmentally-friendly chemical dust suppressants (non-chlorides) could also be used if sufficient water volumes are unavailable or undesirable. Approval for using a salt-based chemical dust suppressant may be required by the local municipality or provincial department of environment.

STORM WATER
It is important to prevent or minimize storm water runoff from mixing with batch process water or wastewater sources around the plant site. This is achieved by keeping the storm water runoff from entering those plant site areas where batch process water and wastewater is generated (e.g., washouts, slump racks, batch tower load-out and cement silos, etc.).

Techniques typically used include paving, grading, curbing and generally good housekeeping practices (e.g., minimize spillage when loading and unloading mixer truck and promptly cleaning up spills of cement, fine aggregates, sand, chemicals, etc.).

If Storm Water isolation measures are not feasible or adequate
Any storm water runoff accumulating onsite should be handled with the facilities used for batch process water or wastewater. When storm water is mixed with batch process water or wastewater, the mixture may require further testing and analyses when considering using either a discharge or reuse option:

Discharge Option

- Establish the discharge criteria levels set by the local municipality and considering provincial environmental guidelines. Criteria for discharge levels may be different for sanitary sewers, storm sewers and open watercourses.
- Analyze storm water for compliance with set criteria (Collect and contain, treatment and test for **pH** and suspended solids in discharge from the plant site property via drainage ditches, infiltration gallery, swales or municipal storm sewers).
- Determine the feasibility of correcting or adjusting the water to meet the discharge criteria.
- Collect and contain, treatment (by settlement), test and reuse for batch water, wash water, mixer truck washout, etc.
- Direct discharge of storm water from the plant property into water or a watercourse is not recommended without treatment.

Reuse Option

- Analyse storm water for use as batch water by checking for any impurities that may negatively affect the quality of the concrete to be produced.
- Remove or correct any impurities in storm water as required.
- Consider storm water volumes that would be available to be reused in a given period.

- Determine procedures when storm water volumes exceed production requirements.

If not already constructed and operating at the plant, either option would require the use of an engineered water management system that is properly designed, built and operated, under the direction of a water management professional. Provincial environment and municipal representatives responsible for local waterworks should also be consulted before facility construction to determine applicable guidelines for storm water discharges in the area where the plant site is located. Larger municipalities and regional districts may have storm sewerage bylaws that regulate the volume and quality of discharge into the storm sewers. Some municipalities may also allow storm water discharge through the sanitary sewer, subject to discharge criteria.

If Storm Water isolation measures are feasible

- Determine minimum and maximum storm water runoff volumes.
- Determine locations where storm water would accumulate or drain.
- Identify potential impacts for discharging higher volumes of stored storm water runoff from the property:
  - Affecting local residents or businesses
  - Affects on adjacent land or properties
  - Affects on water or watercourses (natural or man-made)

Where the discharge of storm water in higher volumes from the property presents a potential adverse affect or impact, there are a number of Best Management Practices (BMP's) or Best Available Techniques/Technologies (BAT's) available to mitigate potential environmental impacts from the discharge or release of storm water:

- Extended Detention Ponds
- Wet Ponds
- Infiltration Trenches
- Infiltration Basins
- Porous Pavement/Yard Surface Treatment
- Sand Filters
- Grassed Swales
- Diversion Ditches

Most works or structures constructed for capturing, collecting, treating, discharging or releasing storm water from a property containing an industrial activity, such as ready mixed concrete production, will require some form of authorization from the local municipality and approval from provincial Ministry of the Environment. See Appendix D for further references.

Any discharge of untreated storm water runoff (e.g., heavy silt load or containing effluent) directly into water or a watercourse should be considered as a "spill" incident requiring a report to the Provincial Ministry of the Environment by the plant operator within 24 hours. Notification of local municipality representatives may also be required. Appropriate spill response measures must be taken immediately to halt the discharge or release of untreated storm water.

WATER CONTROL

The following suggestions are provided for effective water and wastewater management:

- Minimize the need for exterior truck washing by controlling the dust losses from the plant and batch (tower) area during loading. Use recycled water for truck washing when and where possible. Install flow control devices (metering or spring-loaded valves) on water hoses and limit allowable wash time or water volumes.
- Train employees to minimize water use, ensuring that they understand the importance of controls and the possible impact on the environment and company liability.
- Limit fresh water use to hot water production, batch water, truck-mounted tanks and, if necessary (where recycled water is not available), truck exterior washing.
- Use recycled process water and storm water from paved process areas for mixer drum washout and where possible other applications (e.g., yard dust control, truck spray bars).
- Minimize wastewater volumes by controlling storm water runoff on the plant site property from mixing with effluent and wastewater sources resulting from concrete production.
- Control potential contaminant dispersal through good housekeeping and by minimizing vehicle traffic on plant site surfaces where potential contaminants may be present. This should be considered when designing a new plant or refitting and refurbishing an existing plant.
- Use recycled water for truck wash down and drum washout. Reduce total volume by using multiple small volume rinses rather than single large volume rinse (a series of small rinses are more effective and reduce the total rinse volume).
- Use hydration stabilization admixtures (refer to p. 12).
- Dry washout procedures (refer to p. 13).

WASTEWATER SOURCES

Any water used in the concrete production process or water that comes into contact with cement, fresh concrete, sand and grit particles, as well as hydrocarbon sources can be considered as wastewater.

Wastewater normally results when fresh water, process water or storm water comes into contact with or accumulating at the following plant site locations:

- Batch load-out areas and slump racks
- Cement and fly ash silos
- Aggregate bins or stockpiles
- Truck shop and service areas
- Truck drum wash down and washout areas
- Storm water runoff mixing with process water property; and
- Sludge storage pile drainage

WASTEWATER MANAGEMENT

The primary objective of wastewater management is to minimize or eliminate the potential environmental impacts from the controlled or uncontrolled discharge of wastewater from the plant site property and mixer truck operations.

The following three-step approach is recommended for wastewater management:

- Minimizing or isolating any standing water around the plant site;
- Collect, contain and control of produced waste or wastewater; and
- Test and analyse wastewater during treatment or before discharge.

The three-step approach is recommended even if the plant operator is not reusing treated wastewater in plant operations or discharging wastewater from the plant site property.

Wastewater Collection

Collection and containment of wastewater (and wastewater in contact with storm water runoff) is the next stage for effective wastewater management.

The following suggestions are provided for effective collection procedures:

- The main areas for generating wastewater within the plant site (e.g., truck loading, wash racks, washout areas, sludge storage, etc.) should be paved or hard-surfaced where possible. Paving or hard-surfacing the entire plant site may not always be the best solution if the producer does not have sufficient capacity to divert or collect surface runoff. Plant site production volumes, location and property area should be carefully evaluated before considering this option.
- All paved or hard-surfaced areas should be curbed and graded to allow for effective capture and collection of wastewater mixed with storm water runoff. These waters can be directed to the washout pit, reclaim ponds or a designated wastewater collection basin and treatment system that use a hydrocarbon – water separator unit (filter, skimmer or trap). Any groundwater and surface water that does not come in contact with wastewater should be directed away from wastewater collection areas (see Section Four).
- Equipment and vehicle traffic should be minimized through the areas where standing water or wastewater is present. Plant operators should design traffic flow around plant site and property recognizing drainage patterns and collecting basin locations. All equipment and vehicles should be properly maintained, preventing oil leaks and grease deposits outside of shop areas.
- Sufficient capacity must be provided for wastewater holding ponds/catch basins. Holding ponds or catch basins should be designed and constructed with an impermeable base to minimize subsurface leakage, except where an exfiltration process is used.
- If the walls of any containment structure breach, causing an instantaneous release to the environment (outside the plant site property) of untreated wastewater or storm water mixed with wastewater, the plant operator is required to undertake appropriate spill response measures immediately to contain the breach and to collect, clean up and remediate the spill area. Preparation of a "Spill Response Program" for ready mixed concrete operations is strongly recommended. Refer to Chapter Ten.

Any large volume "spill" incident outside of the plant site property needs to be reported to the provincial Ministry of the Environment by the company within 24 hours. (Refer to Chapter 10, Spills and Spill Response).

Wastewater Treatment

The objective for wastewater treatment is to allow for the settling out of suspended solids and ensuring that the treated wastewater is pH neutral.

Suspended solids reduction can be achieved by using a sloped concrete settling pond overflowing through a weir into a secondary or tertiary pond. If sedimentation does not achieve the required total suspended solids limit, a mechanical filter or filter press can also be used. An example of a mechanical filter is a 100 micron size in-line cloth filter through which discharge water is pumped. Cloth filters require cleaning on regular intervals to remain effective. Coagulants and flocculants could also be used where very fine particles continue to remain in suspension. The coagulants or flocculants should be environmentally-friendly (biodegradable) or further treatment will be required to neutralize the coagulants or flocculants. The injection system for coagulants and flocculants require a mechanically engineered process and maintenance by a trained operator.

Wastewater coming into contact with cement powder, concrete slurry or fresh concrete solids will become more alkaline and, in most cases, requires treatment for an elevated pH level (greater than 9.0 Relative Units). Maximum value may vary for each province.

As part of treatment within a settling pond system, two dosage processes have been used for reducing (or neutralizing) elevated pH levels:

- Mixing with a diluted acid solution by mechanical (gravity) drip

or

- Injecting carbon dioxide gas

Both treatment processes involve measured dosages and require regular monitoring and maintenance programs to ensure proper operation. Employee training is vital to the success of using these treatment systems.

REGULATORY CONSIDERATIONS

Provincial

If surface water or groundwater is diverted for the production of ready mixed concrete or to facilitate plant site operations in any way, a separate approval may be required by provincial regulation. Use of treated or untreated municipal water sources may require authorization from the local municipality.

In some provinces no person shall release or permit the release of a substance into the environment in an amount, concentration or level, or at a rate of release that is in excess of that expressly prescribed by an approval or regulations; or causes or may cause a significant adverse effect (an adverse effect is defined as impairment of or damage to the environment, human health or safety or property). Release of a substance may have to be reported as prescribed according to provincial Release Reporting Regulations.

In many provinces there may be a provincial Code of Practice for Concrete Producing Plants. Should this exist, a person responsible (the plant manager) for a ready mixed concrete plant should be in compliance with the provincial Code, which may mandate that any industrial runoff from the concrete producing plant and washings from concrete truck operations shall be controlled and disposed of in a manner to prevent adverse effects. Industrial runoff may be defined as surface water resulting from precipitation that falls on and traverses a plant excluding any undeveloped areas.

The Provincial Ministry of the Environment and local municipality representatives responsible for local waterworks and sewerage infrastructure should be consulted concerning applicable guidelines for wastewater and effluent discharge or releases in the area where the plant site is located. Generally, discharges or releases from a property containing an industrial activity must meet minimum water quality objectives if the discharge is directed from the property towards open water or watercourse. Larger municipalities may have sewerage bylaws that regulate the volume and quality of discharge into the sanitary sewers.

In summary, any wastewater or waterborne solid wastes resulting from ready mixed concrete production that can be discharged from the plant site or from ready mixed truck operations could be subject to the regulatory provisions of a provincial Environmental Protection Act.

Federal

Department of Fisheries and Oceans Canada (DFO) is the federal department responsible for the administration and enforcement of the Fisheries Act and its regulations.

Subsection 36(3) of the Fisheries Act prohibits the deposit of any deleterious substances that will adversely affect fish into waters frequented by fish or under conditions that will cause the deleterious substance to enter the waters frequented by fish (i.e., via storm drains or ditches). It is not necessary under Subsection 36(3) for the substance to cause actual harm, only that it has the **potential** to cause harm.

Any water, slurry or solids with an elevated pH level (greater than 9.0 Relative Units) has the potential to be considered as "deleterious substances" under Subsection 36 (3) of the Fisheries Act.

pH Level	**Comment**
pH between 6.5 and 9.0	Safe range in freshwater systems
pH between 9.0 and 9.5	Adverse effects on fish
pH between 9.5 and 10.0	Extreme stress on fish including death
pH greater than 10.0	Lethal to salmonids
pH greater than 11.0	Kills salmonids in minutes

(Reference: Fisheries and Oceans Canada)
Table 3-1: pH Levels and the Effects on Fish

Suspended solids, sediments or heavy siltation can also harm fish or fish habitat and may be considered as a "deleterious substance" for an offence within the meaning of Subsection 35 (1).

As described in the above Table 3-1, suspended solids, sediments or heavy siltation have the potential to cause harm as follows:

- Obstruct fish gills, resulting in fish kill
- Bury fish spawning grounds and fish eggs
- Create cloudy water that impedes fish and other aquatic organisms from searching and finding food
- Bury the organisms fish depend on for food
- Bury other aquatic life
- Impair overall water quality

DFO have wide-ranging investigative powers to enforce the Fisheries Act. Successful prosecutions of Fisheries Act violations may result in severe maximum penalties, up to $300,000.00 for a summary conviction or $1,000,000.00 by indictment.

In summary, any wastewater and waterborne solid wastes resulting from ready mixed concrete production that can be released or discharged from the plant site property or from ready mixed truck operations could be subject to the regulatory provisions of the federal Fisheries Act.

CHAPTER FOUR

SOLID MATERIALS MANAGEMENT

MANAGING RETURNED CONCRETE

On a daily basis, a ready mixed concrete plant should consider how returned concrete will be managed without adversely affecting the environment.

Returned concrete can result in solid wastes and waste by-products:

- Concrete in a hardened or semi-hardened state
- Reclaimed aggregate generated by a mechanical reclaimer
- Slurry generated by a mechanical reclaimer
- Slurry, process water and wastewater from settling pond systems

Providing waste solids as a fill material may not be appropriate due to regulatory limitations or required engineering specifications for fill materials.

There are a number of recommended solid materials management practices that plant managers could employ to reduce the amount of waste by-products that must be disposed.

Some methods for managing returned concrete:

- Re–using returned concrete
- Producing pre-cast products
- Discharging to a mechanical reclaimer
- Using admixtures to stabilize concrete
- Discharging at designated site
- Discharging to a wash water collection system

RE-USING RETURNED CONCRETE

Where operational and quality control restraints allow, incorporate the returned concrete into succeeding batches. This process must be closely monitored. There are many variables that can affect the success of this procedure, such as the strength, age, volume and temperature of the returned concrete and the size of the succeeding batch of concrete.

PRODUCING PRE-CAST PRODUCTS

Having pre-cast forms and moulds for interlocking blocks, highway barriers, curbs, etc. is an excellent way to dispose of returned concrete. An interlocking block form may use up to one cubic meter of concrete. Pre-cast products can then be used on site or sold to customers.

DISCHARGING TO A MECHANICAL RECLAIMER

There are several mechanical reclaiming systems available to the ready mixed concrete producer. Most systems separate the aggregates from the slurry, allowing the components to be individually recycled. Reclaimed aggregates can be reused in fresh concrete, used as clean fill material or as road base material. The slurry generated by reclaiming systems is reusable only where operational, specification and concrete quality restraints allow.

Using a mechanical reclaiming system may have the following limitations:

- Higher capital costs for acquiring system
- Operating costs for dedicated site employee and training
- Seasonal operations where temperatures are at or below freezing
- Monitoring the slurry for chemical and physical characteristics that may affect concrete qualities

USING ADMIXTURES TO STABILIZE CONCRETE

Hydration stabilization admixtures (HSA) will retard or suspend the hydration process of the cementitious portion of concrete, allowing rinse water and returned concrete to be reused. Returned concrete is frequently "stabilized" with these admixtures for re-use. The stabilization period of returned plastic concrete can be extended to 72 hours or longer, but this requires experience and familiarity with computer-assisted technology. Admixture suppliers can advise plant managers on HSA application.

HSA may have the potential limitations for concrete recycling:

- Dosage rate can be affected by several factors

- Plant manager, batcher and mixer truck drivers need training on HSA use and application
- Heavier concrete build-up can be harder to clean from mixer drums and fins
- Returned concrete treated with HSA may not always conform to new or required concrete specifications

DISCHARGING AT A DESIGNATED SITE

Returned concrete, before hardening, can be placed in a designated area at the plant site with containment and allowed to harden. This concrete can then be broken up, crushed, screened and processed as a fill material under dry ground conditions or at a construction site with self-contained drainage. There is a potential for elevated pH in surface runoff coming into contact with the concrete fill material. This type of fill material has been used as a base coarse material in road construction, or it can be blended with virgin aggregates and used as coarse aggregate for use in concrete or asphalt provided it meets the required specifications.

DISCHARGING TO A WASH WATER COLLECTION SYSTEM

Discharging smaller volumes of returned concrete into a wash water collection system is normally done as part on normal mixer drum washout after the returned concrete has been discharged using one or more of the described preceding procedures. Discharge into the wash water collection system is mainly composed of drum washout water with a small amount of rock and sand. The wash water collection system must be periodically drained and the accumulated slurry solids removed to an onsite storage and drainage facility with containment for drying. Adequate slurry containment is required and important to prevent infiltration of runoff from the drying slurry, possibly impacting site storm water runoff or local groundwater or surface water conditions. Offsite disposal of dried slurry should occur in accordance with local and provincial regulations, typically at a waste management facility approved by a provincial Ministry of the Environment.

CHAPTER FIVE

CHEMICAL AND FUEL MANAGEMENT

ADMIXTURES DELIVERY AND STORAGE

Ready mixed concrete plants use a variety of admixtures 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. Most admixtures are now composed of non-hazardous, water-based materials. Although many of these admixtures present a relatively low hazard to the environment and workers, some admixtures have high aquatic toxicity and/or require worker protection and precautions in the event of spills or direct worker contact. The most significant opportunity for leaks or spills occurs at the transfer points when deliveries are being made. Bulk admixtures are generally stored in corrosion-proof, reinforced plastic tanks, ranging in volume between 1000 and 8000 Litres. For more effective pollution prevention, plant operators should provide secondary containment for admixture storage tanks.

ACIDS AND OTHER CHEMICALS

Hydrochloric acid is diluted to prepare acid rinse solutions for periodic exterior truck washes. Typically, acids are supplied as a liquid in standard 200 Litre plastic drums and are often stored with secondary containment. Consult the supplier to see if possible freezing of the acid liquid or solution is a concern. Parts cleaning solvents may also be stored in small quantities.

Other commonly found materials: acids, calcium chloride, Portland cement, fly ash, limestone, sand and diesel fuel may be handled as required, according to provincial and/or municipal legislation or by-laws". These regulations would consider the quantities of chemicals that are used and stored at the concrete plant. Site specific best practices should be developed following regulatory requirements. Ensure acid disposal and recycling also meet with local municipal bylaws.

Design Recommendations

Table 5-1 represents recommended design features for admixture chemical storage areas at ready mixed facilities. Providing adequate containment volume for stored liquids is fundamental to a good design. All non-returnable drums and pails containing liquid admixtures are not normally recycled and must be disposed of properly. Partially used containers should be protected from further contamination or freezing which would render the chemical unusable, resulting in additional waste disposal costs.

Design Recommendations	**OBJECTIVE:** **To provide proactive spill prevention control and spill containment features for stored chemicals.**
Tanks	- Use corrosion resistant materials where recommended by manufacturers or suppliers. - Immediately reinforce or replace damaged tanks. - Mount tanks in stable position and anchor securely. - Wherever possible, locate storage tanks inside a structure and protect from potential impact and freezing. - Calibrate tanks and install accurate fluid level indicator. - Install locks and shut-off valves on all rupturable lines and tank gauges. - Identify the contents of all tanks, indicating proper WHMIS/MSDS rating (available at first aid station). - Provide good lighting in and around tank storage areas.
Drums and Pails	- If possible, store all chemically related products in the same area to avoid contamination. - Ensure all materials remain in original containers with lids intact. - Ensure all drums and pails are properly labelled and identifiable (refer to WHMIS). - Protect all liquids from freezing.
Spill Containment	- Tanks should be installed within structurally sound containment. - Containment should retain 110% of one tank 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, piping or containment.
Piping	- Design according to all applicable codes. - Select pipe in consultation with chemical suppliers. - Use above ground, visible, permanent piping throughout chemical delivery systems. - Provide impact protection for exposed pipe or pipe risers. - Clearly label piping and valves for each chemical.

	- Provide protection from freezing.

Table 5-1

Fuel and Other Hydrocarbon-based Products

Diesel fuel should be handled according to provincial and/or municipal legislation or bylaws. It can be stored on-site, both in underground and above ground storage tanks. Fuel used for vehicles consists mainly of diesel fuel. These products, if spilled or leaked into the subsurface can cause significant environmental damage particularly if they enter water wells, water courses or travel off-site onto neighbouring properties. Also of concern is if vapours from the spilled product, particularly gasoline, enter buildings and basements. This can cause a health risk exposure at relatively low levels and explosions at higher levels.

Operating Practices	**OBJECTIVE:** **Use operating practices for protecting worker health and the environment**
Personnel Training	- Provide appropriate training for supervisors and designated personnel who handle chemicals. - Provide Material Safety Data Sheets (MSDS) for all hazardous chemicals and fuels stored and used on site. - Provide explicit written safety and handling procedures for chemical and fuel storage and handling practices. - Provide yearly WHMIS training.
Security	- Provide security precautions to prevent vandalism or access by unauthorized persons. - Install locking valves on all sides 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 loading areas away from high yard vehicle traffic areas. - Restrict access to loading area during delivery. - Use dripless, cam-lock connections.
Housekeeping	- Define and practice good housekeeping practices for keeping the site clean and free of debris. - Routinely inspect the chemical and fuel storage for leaks and spills. Daily inspection is recommended. - Immediately contain leaks and repair the source.

Table 5-2

Table 5-2 presents recommended operating practices for the admixture and fuel storage areas at a ready mixed concrete plant. These recommendations are based on best management practices commonly used for chemical handling and storage areas at other industrial facilities.

CHAPTER SIX

AIR QUALITY MANAGEMENT

Ready mixed concrete plants generate and disperse varying amounts of dust during routine operations based on location and local climatic conditions.

Depending on location and potential receptors in the area, concerns may be raised about the concentration of "particulate matter" or PM (this includes all particles less than 100 microns in diameter) in dust emissions. Local air quality can also be impacted by dust emissions containing $PM_{2.5}$ (particles less than 2.5 microns in diameter) and PM_{10} (particles less than 10 microns in diameter). These much smaller particles also pose an occupational health and safety risk for workers who inhale these particles for prolonged periods of time without proper respiratory protection equipment.

Dust and particulate matter can be generated from a number of locations within the concrete plant and the plant property:

- Delivery of cement and fly ash releases during silo loading
- Delivery and stockpiling of aggregates
- Transfer points when handling raw materials
- Loading and drawing down aggregate bins
- Aggregate and cement weighing
- Truck mixer loading and charging
- Plant site equipment and vehicle traffic

Additional sources of particulate matter are the engine exhaust emissions from fixed or mobile equipment and boiler emissions.

TYPES OF DUST EMISSIONS

Point Source Dust Emissions

Dust particles dispelled or removed through a vent, flue, chimney or stack from the plant site or property, including mobile or fixed equipment, is typically defined as a "point source" dust emission. An example of a point source dust emission is the exhaust pipe for an internal combustion engine.

Fugitive Source Dust Emissions

Dust particles released from the exposed surfaces of features and structures around the plant site or property, that are not reasonably controlled using a vent, flue, chimney or stack, are typically defined as a "fugitive source" dust emissions. An example of a fugitive source dust emission would be the observed dust plume from an aggregate stockpile.

MINIMIZING SOURCES FOR DUST EMISSIONS

The plant manager's air quality management program should address the following objectives:

- Identify all sources for dust emissions that are released into the atmosphere from the plant and property by plant operations.
- Collect airborne particulates from point source dust emissions through air filtration mechanisms where practical.
- Suppress the airborne particles from fugitive source dust emissions generated from the plant and property site.

It is important for any air quality management program to also consider local climatic conditions for the plant site, with consideration for prevailing wind directions, average daily temperatures and seasonal precipitation.

Batch Plant Operations

The handling or transfer of aggregates and other raw materials into or within the batch plant can help minimize and eliminate batch plant dust emissions.

Some alternatives for minimizing dust emissions from batch plant operations:

- Fine tune the batching sequence to deliver a smooth, controlled flow of raw material into the plant mixer
- Consider covers or partial enclosures for elevated conveyors into plant
- Enclose or shield aggregate storage areas and transfer points
- For new batch plant construction, consider batch plant location in an area with minimum exposure to prevailing winds

Aggregate Storage and Handling

The storage or handling of aggregates and any other raw materials around the plant site can help minimize and eliminate plant site dust emissions.

Some alternatives for minimizing dust emissions from aggregates storage:

- Consider higher moisture content in aggregates delivered to yard
- Partial enclosures or below grade pads for aggregate stockpile areas
- Minimize exposed surface area of aggregate stockpiles
- Minimize number of transfer points for raw materials
- Minimize drop heights for conveyor or hoppers
- Consider fencing property boundaries using 2-metre high solid fence (i.e., concrete block, wood plank or chain link with PVC plastic
- For new plant site construction, consider plant site location in an area with minimum exposure to prevailing winds.

Traffic Areas

Some alternatives for minimizing dust emissions from plant site traffic:

- Consider paving or hard surfacing of high traffic areas around yard
- Keep paved or hard surfaced areas clean
- Dust suppression using water or chemical dust suppressants
- For new plant site construction, consider plant site location in an area with minimum exposure to prevailing winds.

Diesel Engine Exhaust Emissions

Diesel engine exhaust systems for all fixed and mobile equipment in use at the plant site provide multiple point source emissions. As mixer trucks wait in the yard, it is important to minimize the amount of engine idling time to reduce exhaust emissions and save fuel.

Maintaining correct engine-operating temperatures also helps in reducing exhaust emissions and prolongs equipment life. A regular preventive maintenance program will keep equipment and vehicle engines running at optimal performance. Equipment and vehicle pollution control devices should also be included as part of the regular maintenance inspection.

Boilers

Point source emissions from boiler operations must not exceed the ambient air quality guidelines established by a provincial Ministry of the Environment. For optimal point source emissions, ensure that the boiler is operated in accordance with the manufacturer's specifications. If fuel oil is used, ensure that its composition complies with applicable regulations for sulphur content. Total emissions are lower for boilers that use natural gas instead of fuel oil

DUST SUPPRESSION

Small water droplets, produced by water spray bars, are effective as a dust suppression measure. The dust particles cling to the small water droplets, preventing the dust particles from becoming airborne.

Some best management practices are provided for dust suppression:

- Using a water spray bar or spray ring to rinse down the charge hopper at the truck mixer load point.
- Using a water truck with spray bars for wetting down plant yard surfaces and roadways.
- Wetting down aggregate stockpiles using water spray bars or sprinklers.

These best management practices for dust suppression would also require coordination with water management for the plant site and property:

- Using spray bars for dust suppression at aggregate transfer points (e.g., at the end of the conveyor belt which charges the aggregate bins).
- Installing a soaker hose or spray bar at the plant yard entrance for mixer truck wheel wash.

Water used for dust suppression purposes should not be allowed to mix with surface runoff from the plant property (see Water Management, Chapter 3).

DUST COLLECTION

Dust collection systems provide one of the best available technologies to prevent the release of dust emissions from the plant (e.g., central vacuum collector system and baghouse with individual fabric bags or cartridge filters).

Central vacuum collector systems have suction shrouds for major point source emissions (i.e., at the truck mixer load point or at the cement weigh hopper) and the dust is pulled by the vacuum flow to a baghouse for collection. Individual fabric bags or cartridge filters can be installed at vents on top of cement and fly ash silos to capture dust that is generated as the silos are being filled or drawn down.

Baghouses
A baghouse contains a series of fabric bags or cartridge filters that capture the dust for disposal. In most cases, the collected dust can be recycled, eliminating the need for disposal. The Provincial Ministry of the Environment should be consulted before installing a new baghouse or modifying an existing baghouse to confirm filter specifications meet air emissions criteria. It is important that plant personnel have easy access to the baghouse for inspection and maintenance on a regularly scheduled basis.

Some best management practices for ensuring proper baghouse operations:

- Pulse air, agitation mechanisms should be checked regularly
- Fabric bags should be fitted properly and inspected regularly
- Replace any damaged or torn fabric bags observed during inspections
- The silo pop valve should be checked regularly
- Keep a written record of all inspections and maintenance

A silo pop valve "blow-over," where the cement or fly ash release that has exceeded a provincially specified reporting threshold of the effluent stream, will require reporting to the provincial Ministry of the Environment.

REGULATORY CONSIDERATIONS

Provincial
There might be variations in different provincial jurisdictions. Please consult with the respective provincial ready mix concrete association for details.

Federal (CCME and MERAF)
In June 2000, the Canadian Council of Ministers of the Environment (CCME) Ministers, with the exception of Quebec, endorsed Canada Wide Standards (CWS) for Particulate Matter (PM) and Ground-level Ozone. These standards set ambient limits for PM less than 2.5 microns in diameter ($PM_{2.5}$) and ozone levels to be obtained by the year 2010.

While endorsing the preceding CWS, the CCME also agreed to a list of Joint Initial Actions aimed at reducing pollutant emissions contributing to PM and ozone levels. The Joint Initial Actions include the development of comprehensive Multi-pollutant Emission Reduction Strategies (MERS) for key industrial sectors. The MERS approach is an effort to pursue integrated solutions to problems of smog, acid rain, toxic releases, and climate change.

MERS is considered to be a national picture of sector emission reduction plans, compiled from provincial jurisdictions for PM and ozone plans and a national multi-pollutant emissions reduction analysis. Jurisdictional implementation plans for PM and ozone, which will be prepared by each participating province, will outline specific emission reduction initiatives within the respective jurisdiction to achieve the CWS.

As part of this process, a National Multi-pollutant Emission Reduction Analysis Foundation (MERAF) report was prepared for the Ready Mixed Concrete industry with participation by industry, other stakeholders, and the government representatives. This report includes a profile of the ready mixed concrete industry in Canada, a multi-pollutant emissions inventory for the industry, an emission standards review, programs and policies in Canada and abroad, available techniques (control technologies and management practices) to reduce emissions, and an evaluation of the potential emission reductions and costs associated with the available techniques.

The MERAF report was used a reference source for the air quality management issues discussed in this document. Plant managers should consult the MERAF report further for details on recommended best management practices and best available technologies.

Federal (CEPA and NPRI)
On 28 December 2002, the Canadian Environmental Protection Act (CEPA) was amended to include the reporting of Criteria Air Contaminants (CAC) emissions to the National Pollutant Release Inventory (NPRI) administered by Environment Canada. The NPRI is central to Environment Canada efforts in tracking substances of concern under CEPA. It is the only nation-wide, publicly-accessible program, providing information on pollutant releases.

Criteria Air Contaminants (CAC) are defined as follows under CEPA:

- Oxides of Nitrogen (NO_X)
- Sulphur Dioxide (SO_2)

- Carbon Monoxide (C0)
- Volatile Organic Compounds (VOC's)
- Total Particulate Matter (PM)
- Particulate Matter less than 10 microns (PM_{10})
- Particulate Matter less than 2.5 microns ($PM_{2.5}$)

A plant manager should review the NPRI reporting criteria to determine if they are required to submit NPRI reports to Environment Canada.

NPRI reports are required for each concrete plant exceeding the following defined annual threshold releases:

- Particulate Matter (PM) 20,000 kg (20.0 tonnes)
- PM_{10} 500 kg (0.50 tonnes)
- $PM_{2.5}$ 300 kg (0.30 tonnes)

CAC emissions are broken down by point and fugitive sources, storage or handling activities, as well as any other non-point (uncontrolled) releases. CAC emissions can be determined using mathematical emissions factor modelling or by taking direct samples of plant dust emissions.

CHAPTER SEVEN

NOISE MANAGEMENT

REGULATORY CONSIDERATIONS

Noise emissions are not usually considered an environmental issue and are normally enforced under the land use bylaws of the local municipality. However, some provinces define sound under provincial regulations as well.

Compliance

Local municipal noise control bylaws or provincial guidelines will normally include these items:

- The noise level expressed in decibels that can be measured at the property line
- The days of the week that the plant is allowed to operate
- The hours of the day that the plant is allowed to operate
- Proximity to certain buildings (e.g., schools, churches, hospitals, etc.)

The standards that are normally considered in determining whether a violation of a noise bylaw exists may include, but are not limited to:

- The volume of the noise
- The intensity of the noise
- The nature of the noise
- The origin of the noise
- The volume and intensity of the background or ambient noise level
- The proximity of the noise to others (sensitivity receptors)
- The land use zoning of the area
- The population density and habitation of the area
- The time of day that the noise is generated
- The duration of the noise
- Whether the noise is recurrent, intermittent or constant
- Whether the noise is produced by a commercial or non-commercial activity
- Whether the noise is produced by a third party activity

MEASURING NOISE

Noise volume is measured by a sound level meter and gives an instantaneous reading of the sound pressure in decibels. A decibel (dB) is a measure of the intensity of sound. Sound decreases the farther away from the source it travels, which means that the location of the noise measurements is very important.

MAJOR NOISE SOURCES

It is important to evaluate how much and when noise is emitted. The major sources of noise and examples of sound levels that have been measured are provided for a typical ready mixed concrete plant:

- Aggregate Hopper Vibrators — 108 dB
- Pneumatic Chipper Hammers — 107 dB
- Cement and Fly Ash Blowers — 101 dB
- Pneumatic Impact Wrench — 90 dB
- Conveyor — 85 dB
- Aggregate transfer points — Variable
- Plant signal horns — Variable

These examples may not reflect measured noise levels of similar equipment in a concrete plant. When properly installed and isolated, similar equipment can produce lower measured levels.

REDUCING PLANT NOISE

Lower noise levels may be obtained using the following noise reduction techniques:

- Maintain equipment to ensure that there is not an increase in noise from worn parts
- Install pumps and motors on rubber mounts when possible
- Minimize the free fall height of the aggregates
- Vent air cylinder and vibrator exhausts to a common manifold or to coarse aggregate bin
- Ensure that cement and fly ash delivery trucks are equipped with intake and exhaust mufflers on bulk trailers

ISOLATING PLANT NOISE

Another strategy to combat noise complaints is to isolate the ready mixed concrete plant from its neighbours. When planning new concrete plants, or upgrading existing facilities, consider these techniques to isolate noise:

- Locate ready mixed concrete plants in compatibly zoned areas.
- Lower the overall plant site elevation relative to site elevations of neighbours' property. (This strategy can be combined with the storm water retention system to prevent storm water from running off the property).
- Use sound barriers, high walls, earthen berms capped with vegetation and tree lines to attenuate the noise at the property line.
- Install the cement delivery blower in a sound proof enclosure.
- Situate the plant as far as is practical from the property line of neighbours who might be disturbed.

REDUCING TRUCK NOISE

Ready mixed concrete truck mixer fleets can reduce truck noise significantly by following several important techniques:

- Make sure that the muffler is properly matched to the truck engine.
- Conduct regular maintenance, reducing noise from worn parts.
- Lock and secure all chutes so they do not rattle and bang.
- Control rate of depressurization of truck mounted water tanks.

CHAPTER EIGHT

PLANT CLOSURE

TYPES OF PLANT CLOSURE

Closure can include an entire facility or only one component within a facility. Closure can be temporary if the unit or facility is expected to reopen within a short time under the same or new ownership. Permanent closure means the unit or facility will not reopen in its current form. Often equipment will be dismantled and facilities demolished during permanent closure.

REGULATORY CONSIDERATIONS

Land use bylaws will vary between municipalities depending upon the unit or facility being closed and a permit ay be required to close a unit or facility. Plant managers should consult with the development officer for the local municipality that they operate in.

The Provincial Ministry of the Environment may become involved in the closing of the ready mixed concrete plant if remediation is required for identified contamination within the plant site property and to ensure that any hazardous wastes are being handled and disposed of in accordance with regulations.

CONTROL PLANS

The uncontrolled or accidental release of substance to air, water or land can pose a danger to the environment, human health and safety, or property. Closure or remedial action plans should be reviewed to determine what environmental, human health or safety risks could exist and develop appropriate mitigation measures and control tactics during site decommissioning. Environmental consultants may be required in some instances for the preparation of specific closure or remedial action plans.

The Provincial Ministry of the Environment or Environment Canada, as well as the fire and emergency response departments for the local municipality may require advance notification of the site closure intent, providing copies of written closure or remedial action plans. Some closure activities, such as asbestos abatement or UST excavation and removal, must be performed by contractors licensed or certified to perform such work.

Potential environmental, health and safety hazards can exist with any of the following closure activities:

- Underground or aboveground storage tanks (USTs or ASTs) containing fuels, solvents, waste oil or admixtures
- Facilities or structures containing asbestos, lead or polychlorinated biphenyls (PCBs)
- Concrete washout areas, wash water ponds and sumps
- Groundwater supply or monitoring wells
- Boilers or pipe, utility installations
- Any specialized insulation jackets or coverings

Disposal Plans

A comprehensive closure plan would also require that waste materials generated during the closure be properly catalogued and disposed of.

This would include waste materials:

- Reclaimed solids or scale from cleaning out storage tanks and boilers
- Building and structural debris containing asbestos or lead
- Left-over admixtures and admixture containers
- Contaminated soil or water
- Returned concrete and wash out water

INDEPENDENT AUDITS

Depending upon the scope of the planned closure, an environmental audit may be advisable before starting work. Audits are usually performed by environmental or engineering consulting firms who are experienced in this type of work. Before relying on the advice from any firm, carefully evaluate the firm's background, experience and references. The independent consultant will determine the status and possible impact of environmental conditions in the area of the unit or facility to be closed. Such an audit may be referred to as a "Phase 1 Environmental Site Assessment" or a compliance audit, as it has the capability of developing additional phases if potential problems are discovered. A thorough audit of this sort will consider operational compliance, closure compliance and risk assessment.

The audit should include these items:

- Research of historical activities at the facility and of the facility's neighbours to determine if such activities could have negatively affected the facility in the past or could negatively impact the facility in the future.

- Evaluation of current operations to determine whether possible problems or risks exist and quantify the type and severity of any concerns.
- Determine environmental compliance status and identify applicable regulatory agency notification, plan or procedural requirements.
- Classify sensitive human or environmental receptors, pathways of possible exposure and extent of potential risk.
- Identify whether there appears a need for site sampling and remediation and develop the scope and costs for any additional investigation or for remediation.

Audits help reduce a company's existing and future liabilities or exposures and aid in planning proper closure actions. Often they are required by a financial or insurance institution and are useful in establishing the value of a property. Have an audit performed when you leave a site will provide baseline information that can be used to more clearly define responsibility if future remedial action is required.

Closing Tanks Containing Hydrocarbons (New or Used) or Admixtures
If the planned closure is temporary, tanks should be emptied if possible to prevent the potential for substance release. If the tank cannot be emptied, the flow of product to and from the tank should be restricted to isolate the closed tank from any neighbouring active tanks and piping.
Routine maintenance should continue, including maintenance of any corrosion, protection system or automatic leak detection monitoring system. If a person can enter the tank, required safety procedures must be followed. Monitoring for leak detection must continue in accordance with regulatory requirements to determine whether the product is leaking from the tank or if water is intruding into the tank. Consult with the Provincial Ministry of the Environment about any additional requirements for vapour purging, labelling, resuming start-up of inactive tanks or time limits on tank inactivity.

If a tank is to be permanently closed, the Fire Department for the local municipalities will require advance notice under the provincial fire code. If there is evidence that the tank has corroded or leaking, the Provincial Ministry of the Environment, should be consulted to review tank removal, site clean up and risk management planning. The local fire departments will specify when notification must be made. Fire Department or provincial Ministry of the Environment representatives may also wish to inspect tank closure activities. If the tank contained hazardous chemicals, the local emergency response agency may also require notification.

During permanent closure actions, a determination must be made about whether site contamination has occurred. It is recommended that site soils and water sampling be performed by an experienced third-party firm. Independent evaluations help preclude future problems and uncertainties. The provincial Ministry of the Environment, as well as some local regulatory agencies, may require a report including a judgment as to whether the site closure was "clean." Often the definition of "clean" can be negotiated as part of a risk management process with the agency requesting the audit report. Care should be taken whenever moving or cutting up a tank to ensure that flammable or explosive vapours, as well as hazardous or irritating chemicals, have been thoroughly purged from the tank before disposal.

Disposal of Hydrocarbons (New or Used) or Admixture Tank Residues
Unless a tank is destined for refurbishment and reuse, the tank itself must be properly disposed of. First the tank must be thoroughly cleaned and the resulting reclaimed solids and rinse waters collected. Plastic and fibreglass tanks must be disposed of as solid wastes. Some areas allow in-place closure of underground storage tanks by filling them with concrete or sand. Selection of this closure option does not preclude adequate sampling and testing to determine if a substance release into the environment has or will occur.

Used oils and fuels may be accepted by fuel recyclers for re-blending or used to fire boilers or kilns. Prior to accepting those alternate fuels, the recycler will need to sample and test them to determine whether it is acceptable for reuse both from an environmental regulation and operational perspective. If the alternate fuel cannot be accepted for reuse, it must be transported by a licensed, permitted carrier to an approved waste management facility for disposal. If the tank owner plans to reuse this alternate fuel, a permit for special use may be required.

Cleaning agents (such as acids) and concrete admixtures are often purchased and stored in bulk at facilities. Remaining unused acids, admixtures and other bulk products may be transferred to other plant site operations, provided they are transported safely and not mixed with other products. Tank rinse waters and unusable products must be placed in drums, which are clearly labelled and disposed of as either a hazardous or non-hazardous waste. If residues are to be transported off-site for disposal and have been identified as a hazardous material, then a certified hazardous materials carrier must dispose of the hazardous waste materials as per federal Transportation of Dangerous Goods regulations.

Soils and groundwater contaminated by leaks from storage tanks must be treated on-site by experienced professionals or collected and transported off-site for disposal. When any leaks occur, all released substances should be accounted for in site clean up or disposal manifests.

Asbestos or Lead
Asbestos was once commonly used for insulation and in construction materials. It can typically be found insulating hot water pipes and boilers, and as ceiling and floor tiles, and is usually much more pervasive in older buildings. Asbestos can be allowed to remain in-place if it does not pose a hazard to human health or safety. This generally means that unless an Asbestos-Containing material (ACM) is easily crumbled (friable) or could otherwise release fibres into the air, it does not have to be removed when a unit is undergoing temporary closure. If the ACM is friable, it must be removed or repaired as if it were undergoing permanent closure.

Lead is still a common constituent in industrial paints and may also be present in water pipes or pipe segments and joints. Lead is a toxic heavy metal and unacceptable exposures could result during sanding of painted surfaces or during welding of lead-containing pipes. Lead-containing materials should be identified during closure.

Polychlorinated Biphenyls (PCB)
Polychlorinated Biphenyls (PCB) are often found in electric transformer oils, capacitors and fluorescent light fixtures. Whenever identified, the PCB-containing items should be retrofitted or replaced. An experienced electrical contractor should be retained for handling PCB and to replace PCB-containing materials. Transportation of PCB containing materials must be accompanied by a hazardous waste manifest and chain-of-custody must be documented.

Hazardous Materials Identification and Handing
When asbestos lead, PCB or any other hazardous materials are allowed to remain in-place during temporary closure, personnel must be informed and properly trained to avoid unnecessary and potentially dangerous contact. Only specially trained and qualified individuals should remove, replace or repair items containing a hazardous material component.

Before a unit is permanently closed, all hazardous materials must be removed from the unit by properly trained individuals. The locations and quantities of hazardous materials to be removed should be identified prior to demolition. Monitoring should continue throughout the removal operation and afterward to ensure that the unit meets regulatory cleanup specifications. Careful monitoring helps ensure remediation proceeds as planned and is inclusive, until hazardous material removal is completed. Unauthorized individuals should not be allowed in the zone designated by the remediation team as possibly contaminated.

If the sale of the property is the reason for the closure, some of these clean up requirements may or may not apply. If the purchaser is financing the property acquisition in any way, the financial institution will usually determine site clean up requirements that would be required of the seller.

Disposal of Asbestos, Lead, or PCBs
Check with your province to determine the proper procedure for asbestos, dry lead-based paints and materials which contain PCB's. Qualified personnel, certified under the Transportation of Dangerous Goods Act, should only be used for transporting and disposal of any items containing asbestos, lead, PCB's or other hazardous waste.

Closing Storm Water and Process Water Collection Basins
Ready mixed concrete plant facilities can generate large quantities of rinse water, cement-sand slurry and returned concrete. These materials are usually non-hazardous and are collected in a water collection basin or onsite sump. During on-going plant operations, a facility may need to temporarily render a basin inactive. As long as the water collection basin is not abandoned and appropriate monitoring and testing continues as required, such temporary closure would be acceptable. It is important to ensure that any contents within the onsite ponds, basins or sumps are not purged or discharged directly from the property without proper treatment.

If a water collection basin is to be permanently closed, the collected process water or storm water could be discharged if it meets Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems published by the Ministry of the Environment in your province and the sewerage discharge requirements are compatible with the local municipality. Provincial Ministry of the Environment and local municipality representatives responsible for local waterworks and sewerage infrastructure should always be consulted first concerning applicable guidelines for discharge in the area where the plant site is located. Testing may also be required to determine whether the remaining reclaimed solids are hazardous (pH greater than 12.5 Relative Units) or require special handling. In some instances, the local municipality could allow in-place closure of a water collection basins and returned concrete disposal ponds depending upon pond constituents, existing area land use designations and future site-use plans. Closure design and long-term monitoring requirements may vary, depending upon the residue composition, site history and future land uses.

Hardened cement-sand slurry and returned concrete can generally be reused as fill material in places on the concrete plant's property. Testing may be done to determine material specifications. Backfilling of cementitious materials or broken waste concrete is not recommended if the local groundwater table is near (within one metre) of the property surface. If unable to reuse or recycle the cementitious materials for property backfill and the pond cannot be closed in place, then these waste materials must be transported off-site and disposed of in an approve landfill or waste management facility. Offsite transport can be a costly process, in terms of initial cost and long-term liability, and should be carefully assessed.

Groundwater Supply and Monitoring Wells

Check your provincial requirements with regard to registration of groundwater wells, monitoring wells and well closures. Groundwater and monitoring wells may remain inactive as long as they are not abandoned without proper closure. The period over which wells may remain inactive varies by provincial regulation. Water well drillers in your province should be familiar with the closure requirements depending on well depth.

Some provinces have provided regulations for the permanent closure for groundwater and monitoring wells. Proper closure usually involves grouting the well from the bottom up using a cement and bentonite slurry mixture. The well casing may also required being cut off lightly below existing ground level. When performed properly, well closure activities should not generate appreciable amounts of waste. Excess grout, cuttings and pipe lengths should be disposed of as solid waste.

Boilers

Check with your appropriate provincial Government for permits related to boilers and other high-pressure vessels. The permitting authority varies by province and may be left inactive, provided that routine inspections and maintenance continue to be performed. In many provinces, boiler inspectors must be certified and inspection and permit renewal must occur annually regardless of the status of the boiler.

Permanent closure of boilers may require notification to the permitting authority. Transfer of a boiler from one facility or location to another must usually be accompanied by an inspection and re-certification of boiler integrity, and notification to the permitting authority.

Asbestos may be found in insulation or other materials either outside or inside the boiler. Proper handling of asbestos is imperative. (See the earlier discussion on asbestos). Unless a boiler is properly maintained for safe use, or is transferred to another owner, it must be disposed. The boiler should be thoroughly cleaned and resultant scale and rinse waters collected. If the tank is steel, it may be cut up and transported to a metal recycler. The scale from cleaning the boiler may need to be tested to determine if it must be disposed of as a hazardous waste because of the metals, which may be found in the scale (Refer to Chapter Nine, Waste Management).

CHAPTER NINE

WASTE MANAGEMENT

WASTE
Waste can be any solid, liquid or contained gaseous material that is no longer usable as part of the ready mixed concrete plant operations and is being disposed of on a routine basis or stored and contained onsite for future disposal.

Check with your provincial body for the formal definitions for "waste" and "hazardous waste" in your province. Some examples of hazardous wastes that may exist at a concrete plant are: lead acid batteries, motor oil, antifreeze, cleaners, acids, solvents, paint, fuel, pesticides, etc. These examples are not meant to be an inclusive or authoritative list of potential hazardous materials. The plant manager should be the person responsible for determining if a waste material is hazardous.

MANAGING WASTE AND HAZARDOUS WASTE
The first step in managing waste and hazardous waste is to identify all sources of waste at the plant site; this can be accomplished by developing a generalized or specific Pollution Prevention (**P2**) plan.

This document provides guidance for plant managers or employees in how they can operate in an environmentally sound manner and outlines basic information that can be incorporated into a P2 Plan.

Pollution prevention strategies to avoid or minimize the creation of waste, environmental disturbance and the use or consumption of material resources and energy include:

- Substituting less polluting or non-polluting materials in production processes to avoid creating waste e.g., substituting a non-biodegradable solvent based detergent with a biodegradable water-based detergent.
- Improving operating efficiencies and training e.g. improving maintenance schedules to eliminate leaks, achieve longer life and more efficient operation of machinery.
- Energy Efficiency Strategy e.g. Shutting down machinery when not in use, Task specific lighting, Fuel conversion to avoid emissions and Maintaining engines to achieve maximum fuel efficiency, etc.
- Recognizing the cost of waste. Most waste is purchased first as a material input to create a good or service. Waste is expensive to store, manage, transport and dispose. If the waste has hazards, special equipment, training and management techniques are required.
- Recognizing the value of waste. Many waste products, with minimal treatment, can be recycled back into the manufacturing processes e.g., water can be recycled and reused, residual or returned concrete can be incorporated into other uses, coal fly ash can be incorporated into concrete production, etc.
- Materials purchasing and management to avoid products that may contain toxic or hazardous substances that may pose a handling, storage and disposal problem. Minimizing volumes purchased to avoid surpluses that need to be disposed of and managing materials on site to minimize contamination or spoilage.

All waste and hazardous waste must be handled, stored and disposed of properly. If there is any uncertainty on how to dispose of any waste or hazardous waste, contact the manufacturer or the local waste management facility for further information.

CHAPTER 10

SPILLS AND SPILL RESPONSE

Spills and the resulting spill response are generally the type of environmental incidents that can attract the greatest scrutiny by the public, local media and regulatory authorities. Irrespective of the long-term damage or actual magnitude of environmental damage, the spill incident and resulting spill response can produce either negative or positive public perceptions of a company or the industry. Consequently, even when the actual risk and potential impact to the environment posed by a spill incident is very minimal, it is essential that the spill incident be managed appropriately.

Although the range of substances that is typically used in ready mixed concrete operations is not likely to result in significant spills of highly toxic material, the potential for spills of any substance with the potential to harm the environment always exists.

PLANT SITE CONTAINMENT
Most ready mixed concrete plant processes do not generally involve handling large volumes of chemicals in liquid form, the most likely form of spill impact is expected to result from either overfilling of fuel or glycol storage tanks, or some form of tank leakage (either long term leakage over time or sudden burst or rupture of the tank or associated piping).

To limit the potential for this type of occurrence to result in a spill impact, it is important to take measures to ensure that tank integrity is maintained, and that secondary containment surrounding tanks structures meets all regulatory requirements. Spill collection and clean up can be more easily managed on plant site properties with paved or hard-surfaced areas.

The use of spill kits (sorbent materials used in dry compounds, or prepared for use as sorbent pads and booms) in mixer trucks or other vehicles as well as at the plant site is recommended for use as a first response.

SPILL INCIDENTS
During the course of normal plant activities and operations there is the possibility of a discharge of controlled products, which could be potentially harmful to the environment. Through pre-planning, site management and preventative maintenance, the frequency and severity of a discharge can be minimized. The number and nature of controlled products in normal plant site activities and operations is usually restricted to hydrocarbons in the form of diesel fuel, lubricating oil (new and used), and hydraulic oils.

When a release occurs, the Provincial Ministry of the Environment and the federal agencies that administer safety, transportation and environmental legislation will hold the discharger responsible for the spill incident. The discharger is responsible to report the release and to contain and clean up the product, or have these actions carried out, and to restore the site to pre-release condition.

The following substances are most likely to be spilled during ready mixed concrete activities and operations:

- Diesel Fuel
- Ethylene Glycol (anti-freeze)
- Gasoline
- Grease
- Hydraulic Oil or Used Oil
- Fresh or Wet Concrete
- Slurry
- Admixtures
- Truck-washing Acid

SPILL RESPONSE
In the event that a spill does occur, the potential impact or adverse effect on the environment is often dependent on the steps taken immediately after the spill. Basic response involves contain, collect and control principles for the spill incident. It is very important for the ready mixed concrete plant to have their Spill Response and Reporting Procedures documented for employee use.

A basic spill response plan would include, but not be limited to, the following items:

- Positively identifying the released product or products.
- Check MSDS to ensure the correct personal protective equipment is available for use by employees doing the cleanup.
- Alert any other parties who may be affected by the spill incident
- Secure spill incident area and establish access control.
- Safely contain the spill. Spread absorbent materials to soak up the spill. Prevent the spill from entering any sewer system or any body of water. A dike of sand, gravel or snow may be required.

- Collect and clean up the spill. Once the spill has been absorbed, the material should be shoveled into drums or plastic garbage cans with tight fitting lids. Concrete pads should be swept to make sure that all spill residues are removed, and washed with a detergent if necessary to ensure the concrete surface is no longer slippery. If the spill occurs on bare ground, some surface soil may have to be removed. Removing larger amounts of soil should not be necessary if the spill is contained and cleaned up promptly. Most of the spill residues should remain at or near the soil surface.
- Notify plant manager, safety officer or environmental officer about the spill incident. Also, notify customer if the spill occurred on their property.
- The plant manager or designated employees should notify the proper authorities of the spill incident if required by regulation.
- Disposal of spill, collected soils and absorbent. Label the containers of material that have been cleaned up and store the containers in a location where they will not interfere with work or traffic, and confirm proper disposal methods. The method of disposal will depend on the flashpoint of the spill, the volume of spill and saturated material, and the type of absorbent material used. Hydrocarbon contaminated wastes with flashpoints greater than 61^0C generally are not classified as hazardous wastes, and may be handled in accordance with local landfill regulations. The landfill operator may require laboratory confirmation of the flashpoint of the waste.
- Clean or decontaminate reusable equipment.
- Restock spill response equipment and supplies.
- Debrief responders and discuss response.
- Prepare an incident report for review by employees.
- The objectives of spill response, in order of importance, should be to protect life, protect the environment and protect property. In some cases, the situation may be beyond the individual's ability to collect and control. It is important not to put employees and others at risk. There are spill response agencies with expert training to handle dangerous spills, especially those involving hazardous materials.

SPILL RESPONSE INVOLVING FRESH (WET) CONCRETE

In situations where wet (fresh) concrete or partially mixed cementitious materials are released from the mixer drum in an uncontrolled situation (e.g. chute or hopper failures, collision accident opening up the mixer drum or a mixer truck rollover, implement the following release response procedures.

A basic spill response plan for wet concrete would include, but not be limited to, the following items:

- Alert any other parties who may be affected by the concrete spill.
- Secure concrete spill area and establish access control.
- Safely contain the released material. Build dikes using available onsite surface materials (e.g., soil, clay, sand, gravel or snow) to contain the wet concrete or slurry. Ensure the flow of wet concrete or slurry is prevented from entering any storm sewer opening, drainage ditch or water body.
- Depending on site conditions and area activities, let the wet concrete set up, usually within 75 to 120 minutes, depending on concrete mixture strength. For slurry, collect into drums or plastic garbage cans with tight fitting lids if spill volume is less than one cubic meter. A vacuum truck is recommended for collecting any larger volumes of slurry. Once set up, spilled concrete can be broken up using available equipment (e.g., loader, dozer or backhoe), loaded and trucked away for recycling or disposal. If the release occurs on bare ground, some surface soil may have to be removed. Removal of large amounts of soil should not be necessary if the concrete is contained and cleaned up promptly. Most of the slurry should remain at or near the soil surface.
- If the concrete spill occurs into a drainage ditch, water body or watercourse, use dikes of sand and gravel or snow and ice to contain the spilled concrete, especially concrete mixtures with increased slump or more viscous, fluid properties. Building dikes in standing water, with soil or clay materials, should only be considered as a last resort. If available, use spill kits in the mixer truck or onsite spill kits with spill socks or booms, to encircle spilled concrete and stake socks or booms as required. Sand bags can also be used for encircling spill or anchoring spill socks or booms. Let the wet concrete set up if it has entered open water, usually within 90 to 120 minutes, depending on concrete mixture strength. Because of the hydration process, increased alkalinity will occur for any water coming in contact with wet concrete. To reduce alkalinity resulting from the hydration process, use a fire extinguisher charged with a carbon dioxide compound. Discharge the fire extinguisher for about 5-10 seconds, every thirty minutes, into the water surrounding the wet concrete. A mild acidic reaction will result from mixing the water with carbon dioxide dry compound. Check pH levels with litmus paper. Use further fire extinguisher discharges to reduce alkalinity to acceptable, more neutral levels as required (pH levels between 6.0 – 9.0 Relative Units). Use a vacuum truck for collecting any volumes of contained slurry from the open water. Again, use the fire extinguisher to reduce higher alkalinity as required. When set up, concrete can be recovered using available equipment (e.g., loader, dozer or backhoe), broken up and trucked away for recycling or disposal. All efforts must be made in recovery to avoid further disturbance of the bed, slopes or banks of the water body or watercourse.

- Notify plant manager, safety officer or environmental officer about the spill incident. Also, notify customer if the spill occurred on their property.
- The plant manager or designated employees should notify the proper authorities of the spill incident if required by regulation.
- Restock spill response equipment and supplies.
- Debrief responders and discuss response.
- Prepare an incident report for review by employees.

SPILL INCIDENT REPORTING

The documented reporting procedure for the plant site should outline when it is necessary to report the spill incident to the provincial Ministry of the Environment.

Responsibility for reporting the spill is with the person who permitted the spill or the person having control of the substance.

The following information must be provided in the written report:

- Date and time of the release
- Location of the point of release
- Duration of the release and the release rate
- Composition of the release showing with respect to each substance, its concentration and total weigh, quantity and amount released
- A detailed description of circumstances leading up to the release
- Steps or procedures taken to minimize, control or stop the release
- Steps or procedures taken to prevent similar releases in the future
- Any other information requested by the Director, Regional Services

The provincial Ministry of the Environment may provide a file reference number for use in all further calls and reports regarding the spill incident. Records should be maintained for all conversations or documents produced for regulatory review.

GLOSSARY OF TERMS

ASIWPCA: Association of State and Interstate Water Pollution Control Administrators
AST: Aboveground Storage Tank
AWMA: Air and Waste Management Association
Absorption: Assimilation or incorporation of a gas, liquid or dissolved substance into another substance. See also adsorption.
Admixture, Water-Reducing: An admixture that either increases the slump of freshly mixed mortar or concrete without increasing water content, or maintains slump with a reduced amount of water, the effect being due to factors other than air entrainment.
Admixture: A material other than water, aggregates, hydraulic cement, or fibre reinforcement that is used as an ingredient of concrete or mortar and added to the batch immediately before or during its mixing.
Adsorption: Adhesion of the molecules of a gas, liquid or dissolved substance to a surface. See also absorption.
Aggregate: Granular materials, such as sand, gravel, crushed stone, crushed and broken hardened concrete, used with a hydraulic cement to produce either concrete or mortar.
Artificial Marsh Creation: Simulation of natural wetland features and functions via topographic and hydraulic modifications on non-wetland landscapes. Typical objectives for artificial marsh creation include ecosystem replacement or storm water management.
Asbestos: Insulation from mineral asbestos, which was used in ceiling insulation and in high temperature insulation.
Baghouse: An electro-mechanical device that removes particulates from air by passing the airflow through a fabric bag or paper cartridge filter.
BAT: Best Available Technology. The degree of treatment to be applied to all toxic and non-conventional pollutants based generally upon control technology which has been demonstrated as technically and economically feasible, but which may not yet have been applied in any facility.
BATEA: Best Available Technology Economically Achievable.
BMP: See Best Management Practice.
BOD: See Biological Oxygen Demand.
BTU: British Thermal Unit. The quantity of energy required to raise one pound of water through one Fahrenheit degree.
Bank Stabilization: Methods of securing the structural integrity of earthen stream channel banks with structural supports to prevent bank slumping and undercutting of riparian trees, and overall erosion prevention. To maintain the ecological integrity of the system, recommended techniques include the use of willow stakes, imbricated rip rap or brush bundles.
Baseline Condition: A known quantity or quality of a substance upon which variances can be measured.
Batch Plant: An installation for the batching and/or mixing of concrete materials.
Batch: Quantity of either concrete or mortar mixed at one time.
Best Management Practice (BMP): Structural devices that temporarily store or treat urban storm water runoff to reduce flooding, remove pollutants, and provide other amenities.
Biological Oxygen Demand: The amount of oxygen required by bacteria to destroy decomposable organic matter under aerobic conditions.
Blower: A device, using pressurized air to transport material.
CRMCA: Canadian Ready-Mixed Concrete Association
Calcium Chloride: A crystalline solid, $CaCl_2$; in various technical grades, used as a drying agent, as an accelerator of concrete, a de-icing chemical, and for other purposes (See also admixture, accelerating).
Catchment: See Contributing Watershed Area.
Cement Bulk: Cement that is transported and delivered in bulk, usually in specially constructed vehicles instead of in bags.
Cement, Hydraulic: Cement that sets and hardens by chemical interaction with water and is capable of doing so under water.
Cementitious Materials: Cements and pozzolans used in concrete and masonry construction.
Check Dam: (a) A log or gabion structure placed perpendicular to a stream to enhance aquatic habitat. (b) An earthen or log structure, used in grass swales to reduce water velocities, promoting sediment deposition, and enhance infiltration.
Chemical Oxygen Demand: The amount of oxygen required for total oxidation of organics and inorganics.
CO: Carbon Monoxide
COD: See Chemical Oxygen Demand.
CO_2: Carbon Dioxide
Compliance: Action in accordance with a request. A person or facility who is not in compliance means that they are subject to investigation or possible legal action by a government agency because of breach of a specific law, policy, regulation or guideline.
Concrete, Central Mixed: Concrete that is completely mixed in a stationary mixer before being transported to the delivery point.
Concrete, Ready Mixed: Concrete manufactured for delivery to a purchaser in a plastic and unhardened state.

Concrete: A composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate, usually a combination of fine aggregate and coarse aggregate; in Portland cement concrete, the binder is a mixture of Portland cement and water.
Contaminant: Any solid, liquid, gas, odour, heat, sound, vibration, radiation or combination thereof resulting directly or indirectly from human activities that may cause and adverse effect.
Corrosive Waste: Dissolves metals, burns skin.
DFO: Department of Fisheries and Oceans (Government of Canada), also known as, or referred to as, Fisheries and Ocean Canada, the federal government ministry responsible for administrative and regulatory functions, including compliance and enforcement provisions, of the Fisheries Act.
Decibel: A comparative unit that measures the intensity of sound.
De-Scaling Agent: Chemicals used in water to prevent scale from forming on pipes and tanks or vessels. Bromine is a common de-scaling agent.
De-Watering: Refers to a process used in detention/retention facilities, whereby water is completely discharged or drawn down to a pre-established pool elevation by way of a perforated pipe. De-watering allows the facility to recover its design storage capacity in a relatively short time after a storm event.
Dissolved Oxygen (DO): Oxygen dissolved in water, wastewater or other liquid.
Domestic Wastewater: Domestic wastewater is domestic sewage from homes and without industrial containments.
Dry Pond Conversion: A modification made to an existing dry storm water management pond to increase pollutant removal efficiencies. For example, the modification may involve a decrease in orifice size to create extended detention times, or the alteration of the riser to create a permanent pool and/or shallow marsh system.
EIA: Environmental Impact Assessment. An analysis of the effects on the environment that will or may reasonably be expected to occur as a result of a proposed action.
EOP: End-of-Pipe Treatment. Those processes that treat a combined plant waste steam for pollutant removal prior to discharge.
EP: Extraction Procedure for determining toxicity characteristics.
ETT: Effluent Toxicity Testing, a program for testing the toxic effects on aquatic life of an effluent, or any specified pollutants contained in an effluent.
Effluent: Waste materials discharged or released into the environment in a gaseous or liquid medium.
Emergency Coordinator: The company representative assigned to handle emergencies and spill responses whose name and phone number must be available to local authorities.
Engineered Fill: Fill which can be reused in engineered applications, e.g., concrete, asphalt, and sub-base material beneath buildings and roadways (such as granular base material).
Exfiltration: The downward movement of runoff through the bottom of an infiltration BMP into the subsoil.
Extended Detention: A storm water design feature that provides for the gradual release of a volume of water (0.25 – 1.0 inches per impervious acre) or (1.57 – 6.27 centimetres per impervious hector acre) 12 to 48 interval times to increase the settling of urban pollutants and protect the channel from frequent flooding.
Extended Detention (ED) Ponds: A conventional ED pond temporarily detains a portion of storm water runoff for up to twenty-four hours after a storm using a fixed orifice. Such extended detention allows urban pollutants to settle out. The ED ponds are normally "dry" between storm events and do not have any permanent standing water. An enhanced ED pond is designed to prevent clogging and re-suspension. It provides greater flexibility in achieving target detention times. It may be equipped with plunge pools near the inlet, a micro pool at the outlet, and utilize and adjustable reverse-sloped pipe at the ED control device.
Filter Fabric: Textile of relatively small mesh or pore size that is used to (a) allow water to pass through while keeping sediment out (permeable), or (b) prevent both runoff and sediment from passing through (impermeable).
Fill: Any earth, soil, rock or granular material of a similar nature that has been excavated or manufactured.
FGD: Flue Gas Desulfurization. Any pollution control process which treats stationary source combustion flue gases to remove sulphur oxides.
OG: Oils and Grease including hydrocarbons, fatty acids, soaps, fats, and waxes. The quantity is determined by Freon extraction of the sample and infrared analysis of the extract.
FOIP: Freedom of Information Act.
Fisheries Act: Federal legislation administered by Fisheries and Oceans Canada.
Friable: Easily crumbled.
Gasoline: Automotive fuel which generally contains hydrocarbons, including propane and undercane. Unleaded fuel contains large quantities of benzene, toluene and xylene.
GC/CD: Gas Chromatograph/Conventional Detector
GC/MS: Gas Chromatograph/Mass Spectrometer
Grease: Compounded solid lubricant that contains petroleum based oil, animal fats, soaps (usually sodium, calcium, lithium), or special chemicals.
Ground Water: All water under the surface of the ground whether in a liquid or solid state.

Grassed Swale: A conventional grass swale is an earthen conveyance system in which the filtering actions of grass and soil infiltration are utilized to remove pollutants from urban storm water. An enhanced grass swale, or bio-filter, utilizes check dams and wide depressions to increase runoff storage and promote greater settling of pollutants.

Hazardous Substance: A substance or mixture of substances, other than a pesticide, that exhibits characteristics of flammability, corrosivity, reactivity or toxicity, including, without limitation, any substance that is designated as a hazardous substance within the meaning of the provincial environmental regulations.

Hazardous Waste: Waste that has one or more of the properties described in provincial environmental regulations.

High Marsh: Diverse type of wetland found in areas that are infrequently inundated or have wet soils. In Pond systems, the high marsh zone extends from the permanent pool to the maximum ED water surface elevation.

Ignitable Waste: Combustible or flammable materials (e.g., paint, solvents and used oil).

Incompatible Waste: Waste that reacts with other material or water.

Industrial Runoff: Any surface runoff resulting from precipitation that falls on and traverses a concrete producing plant, excluding any undeveloped areas.

Industrial Wastewater: Any wastewater that is the composite of liquid and water-carried wastes from a concrete producing plant.

Inert Fill: Earth, rock or waste of a similar nature that contains no organic materials or soluble or decomposable chemical substances. This fill material can be used at any site.

Infiltration Basin: An impoundment where incoming storm water runoff is stored until it gradually exifiltrates through the soil of the basin floor.

Infiltration Trench: A conventional infiltration trench is a shallow, excavated trench that has been backfilled with stone to create an underground reservoir. Storm water runoff diverted into the trench gradually exifiltrates from the bottom of the trench into the subsoil and eventually into the water table. An enhanced infiltration trench has and extensive pre-treatment system to remove sediment and oil. It requires an on-site- geotechnical investigation to determine appropriate design and location.

Irrigation: Land application for disposal of effluents.

Leachate: Liquid, especially water, which has percolated through solid waste or contaminated media and dissolved soluble components so that the liquid becomes contaminated.

Level 2 Sound Meter: An electrical instrument for determining instantaneous sound pressure levels measured in decibels.

Liquid Industrial Waste: A means of waste that is both liquid waste and industrial waste.

Low Marsh: A type of wetland with emergent plant species that require some depth of standing water throughout the year. The low marsh zone in pond systems is created in areas where the permanent pool is zero to twelve inches deep.

Lube Oil: A special crude fraction blended for viscosity. May contain up to 50% chemical blending materials.

Mechanical Reclaimer: Any equipment that mechanically separates the components of plastic concrete (e.g. aggregates, water and cement) allowing the reuse of the individual components where operational and quality constraints allow.

Metals: Limitations have been placed on the quantities of metals that can be discharged from treating plants. The limits are not always consistent, nor are they the same for every operation. Some of the metals for which limits or restrictions have been established include: Aluminium, Antimony, Barium, Beryllium, Cadmium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver and Zinc.

Milligrams per Litre (mg/L): Milligrams of a substance contained or dissolved in 1 litre of solution (usually water). Numerically equal to parts per million. See ppm.

Mixed Water: Water in freshly mixed grout, mortar, or concrete, exclusive of any previously absorbed by the aggregate.

Natural Buffer: A low sloping area of maintained grassy or woody vegetation located between a pollutant source and a water body. A natural buffer is formed when a designated portion of a developed piece of land is left unaltered from its natural state during development. A natural vegetative buffer differs from a vegetated filter strip in that it is "natural" and in that they need not be used solely for water quality purposes. To be effective, such areas must be protected against concentrated flow.

Noise Dosimeter: An instrument to measure noise exposure. It is a special purpose sound level meter which measurers accumulated exposure.

Nutrients: Total nitrogen, total phosphorus, and total potassium discharges which are limited for many waste stream discharges.

Outfall: The point of discharge for a river, drain, pipe, etc.

P2: see Pollution Prevention.

PCB: Polychlorinated Biphenyls. An ingredient contained in transformer oils and some capacitors which is a known carcinogen.

pH: The measure in relative units of acidity or alkalinity. The pH is the negative logarithm of the hydrogen ion concentration and as such represents values on an exponential scale. A pH of 7 is neutral, while a pH of 1 is strongly acidic, and a pH of 14 is strongly alkaline.

PM: Particulate Matter.

$PM_{2.5}$: Particulate Matter smaller than 2.5 microns in diameter.

PM_{10}: Particulate Matter smaller than 10 microns in diameter.

POD: Point of Discharge. The point at which wastewater enters a flowing stream or other body of water.
PPB: Parts per billion on a weight basis.
PPM: Parts per million, on a weight basis.
Pesticides, also Herbicides: Chemicals used to control insects and vegetation. Limitations on pesticides and herbicides reflect the requirements for potable water as well as the carcinogenic nature of many of these materials. Some of the pesticides and herbicides that are regulated are: aldrin, chlordane, DDT, demeton, endosulfan, endrin, heptachlor, lindane, malathion, methoxyclor, mirex, parathion, polyhedron, and toxaphen.
Phase 1 Environmental Site Assessment: A non-intrusive study that evaluates the potential presence of contamination on a property. Studies would include examinations of the environmental condition of the land and buildings on a property to determine the likelihood of any contamination on the site, environmental damage, or materials on the property that could potentially contaminate or produce environmental damage.
Phase 2 Environmental Site Assessment: A more intrusive site investigation is performed to provide sufficient information on the nature and extent of contamination, if any, to make informed decisions about the property. Physical and chemical testing or samplings are conducted with air, water, soil and materials on a property in order to determine whether these substances contain chemicals or contaminants deemed to pose a potential health or environmental hazard.
Phase 3 Environmental Site Assessment: The preparation of a remedial investigation and feasibility study for acceptable regulatory closure on a property where the previous Phase 1 or Phase 2 Environmental Site Assessment has identified the presence of contamination. On site activities will fully characterize the vertical and lateral extent of soil and groundwater contamination, identify potential remedial action alternatives, evaluate feasibility of implementing various alternatives, select the preferred alternative, obtain regulatory agreement that remedial action is acceptable, successfully implement and complete remedial actions, and conduct any necessary post-closure site activities.
Plunge Pool: A small permanent pool located at either the inlet to a BMP or at the outfall from a BMP. The primary purpose of the pool is to dissipate the velocity of storm water runoff, but it also can provide some pre-treatment.
Pollution Prevention: Pollution Prevention involves the use of processes, practices, materials, products or energy that avoids or minimizes the creation of pollutants and waste or environmental disturbance, and reduces risk to human health or the environment.
Porous Pavement: An alternative to conventional pavement whereby runoff is diverted through a porous concrete layer and into an underground stone reservoir. The stored runoff then gradually infiltrates into the subsoil.
Reactive Waste: A material that undergoes violent and rapid chemical reaction.
Reclaimed Solids: Cementitious materials, fine and coarse aggregate particles from returned concrete and mixer drum rinse water.
Recycling: Physical, chemical or biological processes are used to transform a waste into the raw material needed to make a new product. To be successful, a recycling program requires an effective infrastructure for segregating, collecting, transporting and reprocessing the feedstock, as well as the maintenance of stable markets for the derived secondary materials.
Reduction: Industrial production changes or modified consumer practices can decrease the quantity of waste product.
Release: To spill, discharge, dispose of, spray, inject, inoculate, abandon, deposit, leak, seep, pour, emit, empty, throw, dump, place and exhaust (EPEA definition).
Remediation: The act or process of correcting an adverse effect or potential adverse affect resulting from the release of a substance into the environment.
Reuse: To use a product or package again, in its original form, for either the same or a different purpose. Reuse entails less intensive cleaning/reprocessing than is usually involved in recycling.
Reverse Slope Pipe: A pipe that extends downward from a riser into the permanent pool that sets the water surface elevation of pool. The lower end of the pipe is located up to 1 foot or 0.3 meters below the water surface this is a very useful technique for regulating Extended Detention times and it seldom clogs.
Riser: A vertical pipe extending from the bottom of a pond that is used to control the discharge rate from a Best Management Practice for a specified design storm.
SIC: Standard Industrial Classification. A numerical categorization used to denote segments of industry.
SO_X: Sulphur Oxides
Spill: See Release.
TSS: Total Suspended Solids, usually expressed in ppm.
Sand Filter: A technique for treating runoff, whereby the first flush is diverted into a self-contained bed of sand. The runoff is then strained through the sand, collected in underground pipes, and returned back to the stream or channel. An enhanced sand filter utilizes layers of peat, limestone, and/or topsoil, and may also have a grass cover crop. The adsorptive media of an enhanced sand filter is expected to improve removal rates.
Sanitary Sewer: A collection system for the treatment of waster water discharge which is largely domestic, but could include industrial wastewater discharge.
Secondary Containment: Double-walled tanks, or buffer zones around a fuel or chemical tank.

Secondary Treatment: This type of treatment refers to waste water treatment for control of BOD, COD, Suspended Solids, Turbidity, Bacteria and Viruses.

Sediment Forebay: A storm water design feature that employs the use of a small settling basin to settle out incoming sediments before they are delivered to a storm water BMP. This feature is particularly useful in tandem with infiltration devices, wet ponds or marshes.

Sludge: Any thick, semi-fluid mass. Usually a muddy or slushy sediment or a filtered waste product.

Slurry: Thin mixture of water combined with any of several fine, insoluble materials.

Solid Waste Management: The entire process of collecting, sorting, processing, recycling, reclaiming and disposing of waste. The recommended waste management hierarchy begins with consideration for practicable waste reduction and reuse measures, followed by recycling and resource recovery, and finally disposal.

Storm Sewer: Collection system for surface water runoff.

Storm Water Treatment: The detention, retention, filtering or infiltration of a given volume of storm water to remove urban pollutants and reduce frequent flooding.

Storm Water Wetland: A conventional storm water wetland is a shallow pool that creates growing conditions suitable for the growth of marsh plants. A storm water wetland is designed to maximize pollutant removal through wetland uptake, retention and settling. A storm water wetland is a constructed system and typically is not located within delineated a natural wetland. A storm water wetland differs from an artificial wetland created to comply with mitigation requirements in that the storm water wetland does not replicate all the ecological functions of natural wetlands. An enhanced storm water wetland is designed for more effective pollutant removal and species diversity. It also includes design elements such as a Forebay, complex micro topography, and pond-scaping with multiple species of wetland trees, shrubs and plants.

Substance: Any matter that is capable of being dispersed or transformed and dispersed in the environment. Also any sound, vibration heat, radiation or other form of energy and any combinations thereof.

Swale: A natural depression or wide, shallow ditch used to temporarily store, route, or filter runoff.

TDS: Totally Dissolved Solids. The total material actually dissolved in the stream. It is the same as salt dissolved in water and should not be confused with suspended solids for turbidity. Total Dissolved Solids can include both organic and inorganic materials.

TSP: Total Suspended Particulate.

TSS: Total Suspended Solids. The material held in suspension in the stream and subject to removal by settling or flotation. TSS generally consists of insoluble organic material as well as sand and grit.

TWA: Time Weight Average.

Toxic Substances: Chemicals and materials that pose an unreasonable risk to human health, e.g., pesticides, herbicides, heavy metals, etc.

Truck Mixer: A drum suitable for mounting on a truck chassis and capable of mixing dry aggregate, cement and water into concrete.

Turbidity: Turbidity develops from very fine solids held in suspension and not readily separated by gravity of flotation.

UST: Underground Storage Tank

Uniform Hazardous Waste Manifest: The form for the manifest as set out under federal regulations for the Transportation of Dangerous Goods Act.

VOC: Volatile Organic Compounds. Organic compounds that participate in photochemical reactions.

Vegetated Filter Strip: A vegetated section of land designed to accept runoff as overland sheet flow from upstream development. It may adopt any natural vegetated from, from grassy meadow to small forest. The dense vegetative cover facilitates pollutant removal. A filter strip cannot treat high velocity flows; therefore, they have generally been recommended for use in agriculture and low-density development. A vegetated filter strip differs from a natural buffer in that the strip in not "natural"; rather, it is designed and constructed specifically for the purpose of pollutant removal. A filter strip can also be an enhanced natural buffer whereby the removal capability of the natural buffer is improved through engineering and maintenance activities such as land grading or the installation of a level spreader. A filter strip differs from a grassed swale in that a swale is a concave vegetated conveyance system and a filter strip has a fairly level surface.

Waste: Any solid or liquid material or product or combination of them that is intended to be treated or disposed of, or that is intended to be stored and then treated or disposed of, but does not include oilfield waste or recyclables.

Wastewater Settling System: Any area that accumulates and contains wastewater and allows for the deposition of fine insoluble particles. The water, less the deposited particles, may be reused where operational and quality constraints allow.

Water: All water on or under the surface of the ground, whether in liquid or solid state.

Water Act: Water Act, varies by province. Usually the purpose of this Act is to support and promote the conservation and management of water, including the wise allocation and use of water

APPENDIX A

REFERENCES

Code of Practice for Concrete Producing Plants, Department of Environment, Government of Provincial, Queen's Printer for Provincial, Edmonton, AB, September 1996

Richard D. Gaynor, *ASTM STP 169c*, *Ready Mixed Concrete*, American Society for Testing and Materials, Philadelphia, PA, NRMCA Publication #186, August 1994.

Richard D. Gaynor, Jon I. Mullarky, *Mixing Concrete In A Truck Mixer*, National Ready Mixed Concrete Association, Silver Spring, MD, 1975

Multi-pollutant Emission Reduction Analysis Foundation (MERAF) for the Canadian Ready-mixed Concrete Sector, Final Report, prepared for Environment Canada (Government of Canada) and the Canadian Council of Ministers of Environment (CCME), ICF Consulting Canada, Inc., Toronto, ON, August 2002

Ready Mix Concrete Industry Environmental Code of Practice, March 1993, Environment Canada (Government of Canada), 1993

Technical Pollution Prevention Guide for Ready-mixed Concrete Operations in the Lower Fraser Basin, DOE FRAP 1997-13 prepared for Environment Canada (Government of Canada), Envirochem Special Projects Inc., North Vancouver, BC, February 1997

Effluent Limitations and New Source Performance Standards for the Concrete Products Source Category, Environmental Protection Agency, Government Printing Office Washington, D.C., 1978

Keeping It Clean: Making Safe and Spill-Free Motor Fuel Deliveries, Environmental Protection Agency, Government Printing Office, Washington, D.C., December 1992.

Musts for UST's: A Summary of the Regulations for Underground Storage Tank Systems, Environmental Protection Agency, Government Printing Office, Washington, D.C., September 1988.

Oh No! Petroleum Leaks and Spills: What Do You Do?, Environmental Protection Agency, Government Printing Office, Washington, D.C., December 1989.

Profile of the Stone, Clay, Glass and Concrete Industry, Environmental Protection Agency, Government Printing Office, Washington, D.C., September 1995.

SPCC Plans, Environmental Protection Agency, Government Printing Office, Washington, D.C.

Straight Talk On Tanks: A Summary of Leak Detection Methods for Petroleum Underground Storage Tanks, Environmental Protection Agency, Government Printing Office, Washington, D.C., November 1989.

Steven H. Kosmatka, William C. Panarese, *Design and Control of Concrete Mixtures*, Portland Cement Association, Skokie, IL, 1994

Conversations with Graham Bryant, P.Eng., Marshall Macklin Monaghan, December 1993.

A Current Assessment of Urban Best Management Practices, March 1992, Metropolitan Washington Council of Governments.

Storm Water Quality Best Management Practices, June 1991, MOEE.

Understanding the Small Quantity Generator Hazardous Waste Rules. A Handbook for Small Businesses, Office of Solid Waste and Emergency Response, Washington, D.C., September 1986

Tank Closure Without Tears and What Do We Have Here?, New England Interstate Water Pollution Control Commission, Boston, MA.

® NQ 2621-900. *"Bétons de masse volumique normale et constituants".*
Bureau de normalisation du Québec, November 2002.

® NQ 2621-905. *"Bétons de masse volumique normale et constituents – Protocole de certification".* Bureau de normalisation du Québec. Décembre 2002.

APPENDIX B

MERAF REPORT (FINAL) FOR THE CANADIAN READY-MIXED CONCRETE SECTOR

EXCERPTS FROM MERAF REPORT SUMMARY (pp. i-ii)

Environment Canada and the Canadian Council of Ministers of the Environment (CCME) are committed to addressing particulate matter and ground level ozone. In June 2000, CCME Ministers, with the exception of Quebec, endorsed Canada Wide Standards (CWS) for Particulate Matter (PM) and Ground-level Ozone. These standards set ambient limits for PM less than 2.5 microns ($PM_{2.5}$) and ozone to be obtained by the year 2010. The standards are as follows:

- $PM_{2.5}$: 30 micrograms/m^3, 24 hour averaging time, by year 2010
  (Achievement to be based on the 98^{th} percentile ambient measurement annually, averaged over 3 consecutive years.)
- Ozone: 65 parts per billion, 8 hour averaging time, by year 2010
  (Achievement to be based on the 4^{th} highest measurement annually, averaged over 3 consecutive years.)

When these CWS were endorsed, CCME Ministers also agreed to a list of Joint Initial Actions aimed at reducing pollutant emissions contributing to PM and ozone. The Joint Initial Actions include the development of comprehensive Multi-pollutant Emission Reduction Strategies (MERS) for key industrial sectors. The MERS approach is an effort to pursue integrated solutions to problems of smog, acid rain, toxic releases, and climate change.

A MERS is considered to be a national picture of sector emission reduction plans, to be built from jurisdictional PM and ozone plans and national multi-pollutant emissions reduction analysis. Jurisdictional implementation plans on PM and ozone, which will be prepared by individual jurisdictions, will outline emission reduction initiatives to achieve these CWS.

The MERS are developed in partnership with provinces, territories and stakeholders and will focus on three general activities:

- *National Multi-pollutant Emission Reduction Analysis Foundation (MERAF):* Technical feasibility studies of emission reduction options and costs, and economic profiles, as input into development of sector actions in jurisdictional plans. Work contributing to the MERAF may be conducted by industry, other stakeholders, and the federal government.

- *Forum for Information Sharing & Coordination:* Jurisdictions and stakeholders to share information on how a particular sector is being dealt with in different parts of the country.

- *National Sector Roll-up:* The national picture of the sector is to be assembled by 2003 based on actions in jurisdictional plans and national multi-pollutant analysis.

This MERAF report for the Canadian Ready-Mixed Concrete Sector represents the first phase in the MERS process. It is intended as a source of information on technically feasible emission reduction options for consideration in the development of jurisdictional implementation plans under the CWS. The report draws upon readily available information. It is not intended as a policy document. More specifically, the report provides:

- A profile of the ready-mixed concrete industry in Canada;
- A multi-pollutant inventory of emissions from the industry;
- A review of emission standards, programs and policies in Canada and abroad;
- A set of available techniques (control technologies and management practices) to reduce emissions from industry;
- An evaluation of the potential emission reductions and costs associated with the available techniques;
- An analysis of data constraints; and
- An assessment of areas for possible further analysis

APPENDIX C

AVAILABLE TECHNIQUES

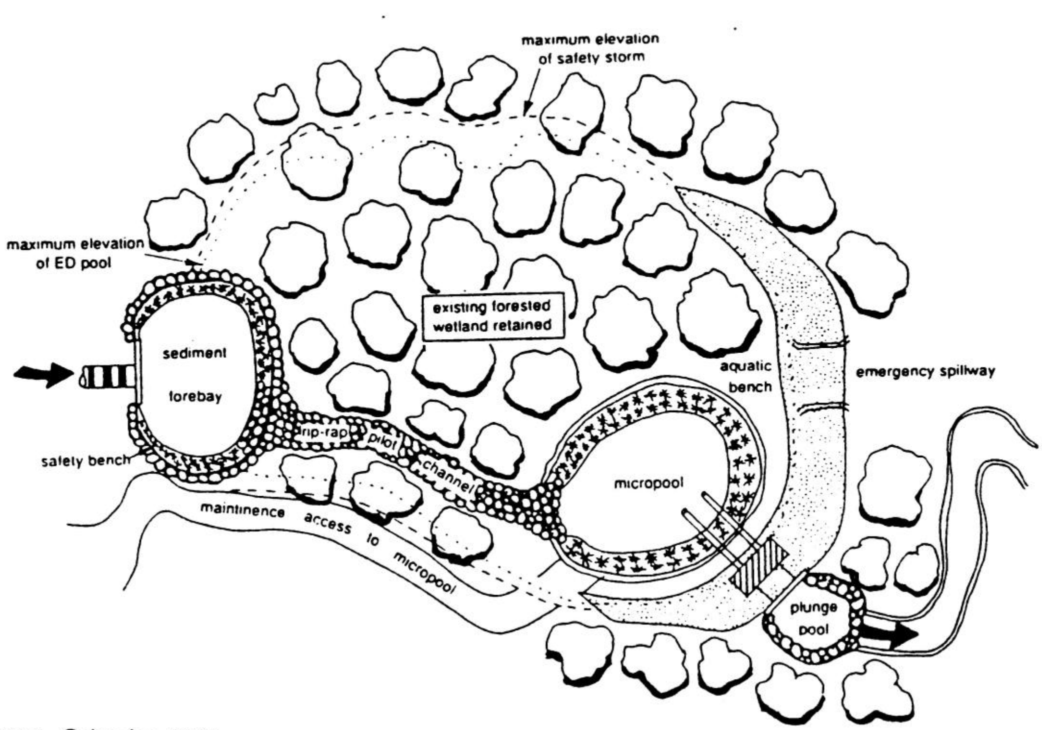
EXTENDED DETENTION PONDS

Definition

Conventional Extended Detention (ED) ponds temporarily detain a portion of storm water runoff for up to twenty-four hours after a storm using a fixed orifice. Such extended detention allows pollutants to settle out. The ED ponds are normally "dry" between storm events and do not have any permanent standing water.

Enhanced ED ponds are designed to prevent clogging and re-suspension. They provide greater flexibility in achieving target detention times. They are equipped with plunge pools near the inlet, a micropool at the outlet, and utilize an adjustable reverse-sloped pipe as the ED control device.

Schematic Design of an Enhanced Dry ED Pond System



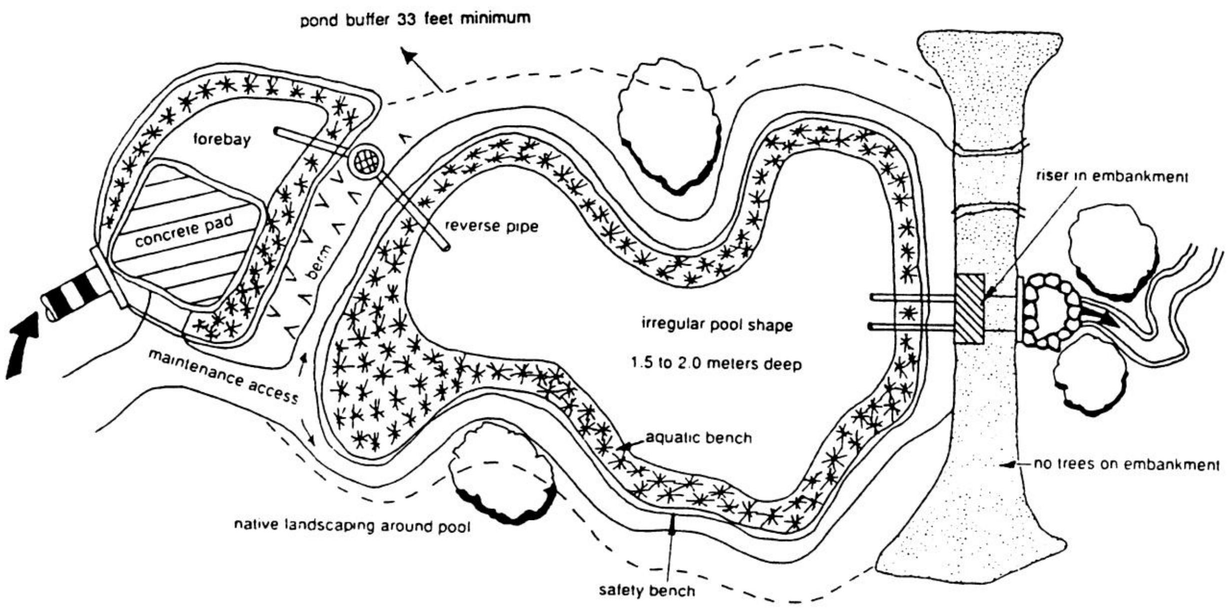
Source: Schueler, 1991.

WET PONDS

Definition

Conventional wet ponds have a permanent pool of water for treating incoming storm water runoff. In **enhanced wet pond** designs, a forebay is installed to trap incoming sediments where they can be easily removed; a fringe wetland is also established around the perimeter of the pond.

Schematic Design of an Enhanced Wet Pond System



Source: Schueler, 1991.

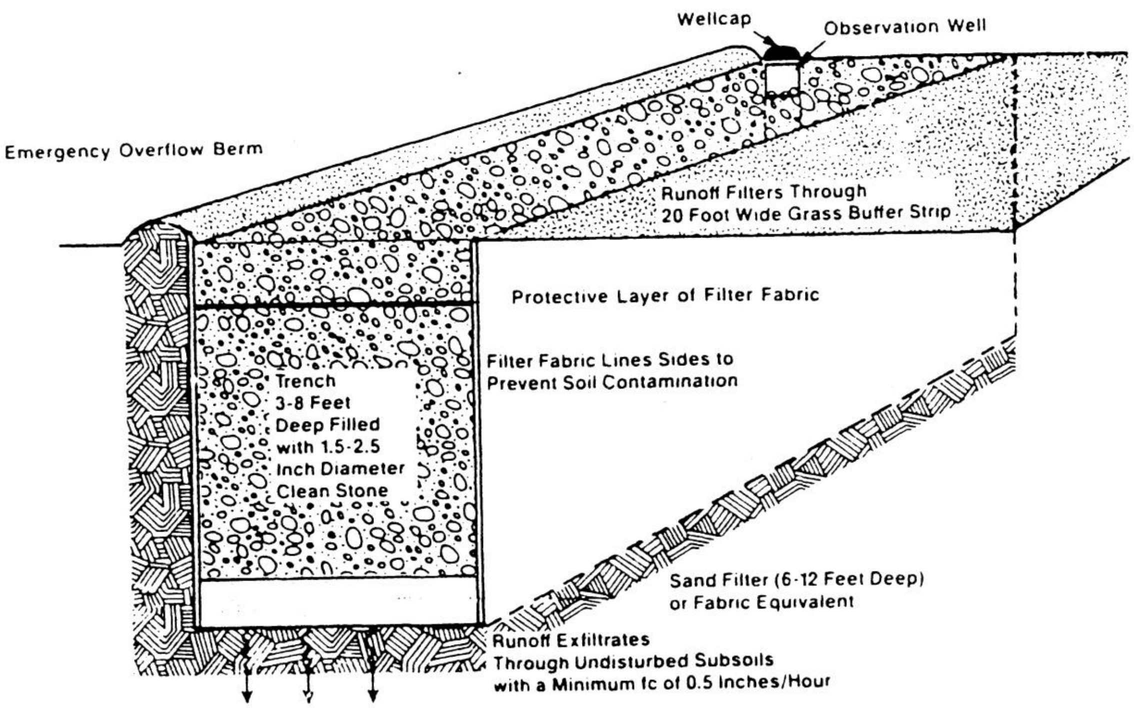
INFILTRATION TRENCHES

Definition

A **conventional infiltration trench** is a shallow, excavated trench that has been backfilled with stone to create an underground reservoir. Storm water runoff diverted into the trench gradually exfiltrates from the bottom of the trench into the subsoil and eventually into the water table.

Enhanced infiltration trenches have extensive pre-treatment systems to remove sediment and oil. They require on-site geotechnical investigations to determine appropriate design and location.

Schematic Design of a Conventional Infiltration Trench



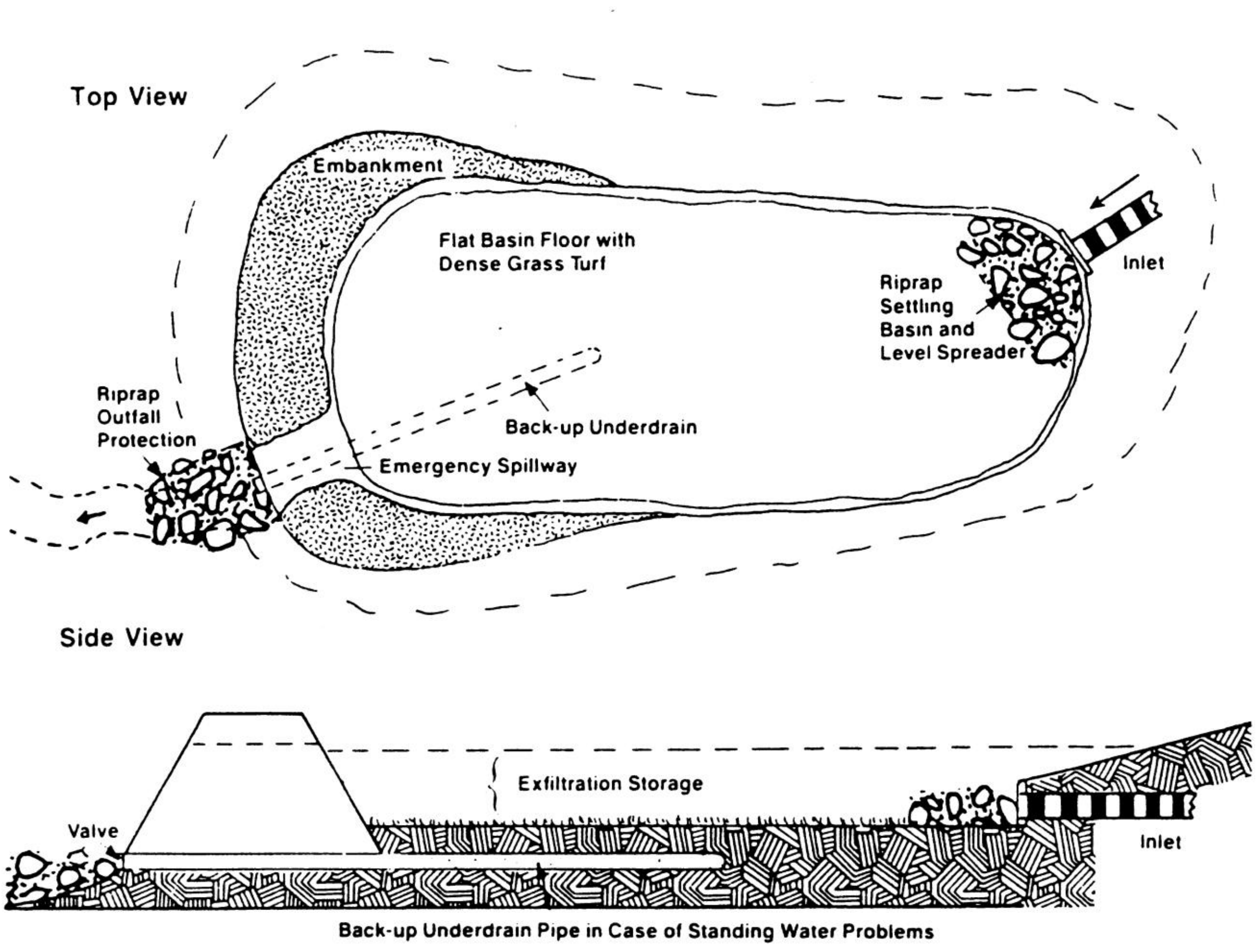
Source: Schueler, 1987.

INFILTRATION BASINS

Definition

Infiltration basins are impoundments where incoming storm water runoff is stored until it gradually exfiltrates through the soil of the basin floor.

Schematic Design of an Infiltration Basin



Source: Schueler, 1987.

PERVIOUS or POROUS PAVEMENT

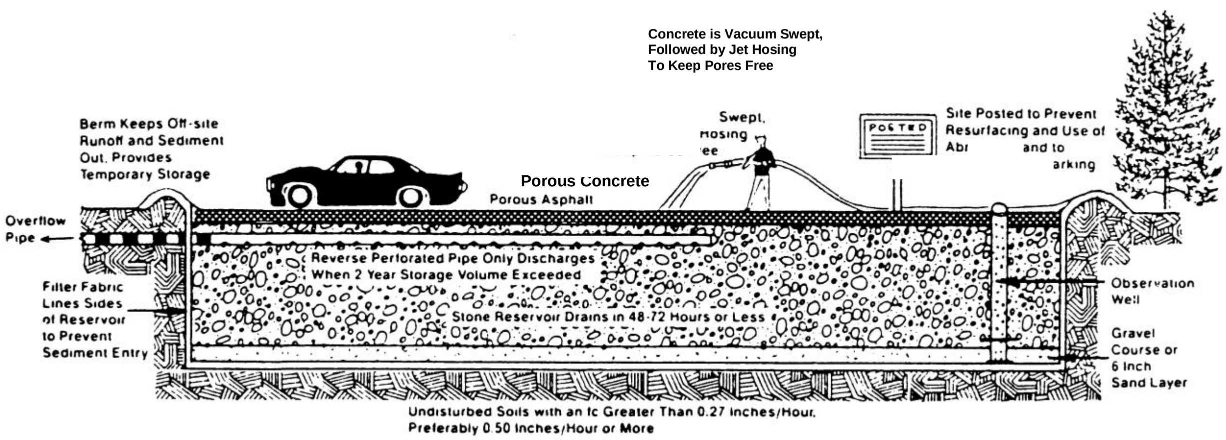
Definition

Pervious or porous pavement is becoming a popular alternative to conventional pavement whereby runoff is diverted through a porous concrete layer and into an underground stone reservoir. The stored runoff then gradually infiltrates into the subsoil.

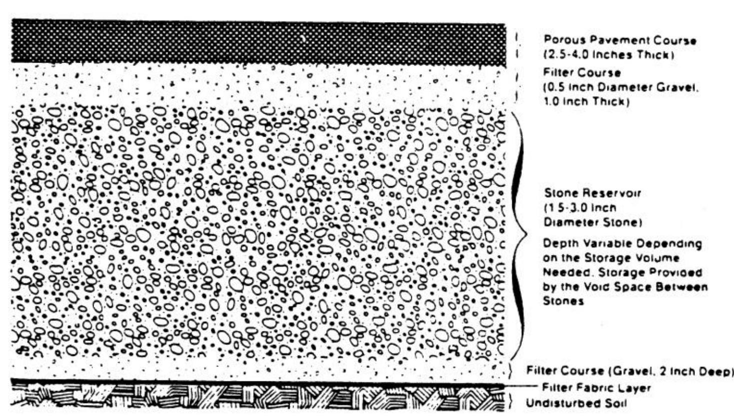
Cement, coarse aggregates and water are used to provide sufficient paste and bonding ability to glue the coarse aggregates together in a structural pavement that essentially "drinks" liquid. Water filters through the pavement to a secondary drainage/filter layer in the ground. This allows for natural recharge of groundwater much like the natural filtering effects desired in bioswales. The pavement also eliminates untreated stormwater from leaving the site. An improved and more successful stormwater management strategy is not to collect and then dispose of runoff, but to address stormwater much earlier in the development process and not generate any runoff.

The immediate benefits of using "no fines" concrete result in no water leaving the site, eliminates the need for stormwater collection and detention systems, and increases the pervious to impervious ration ratio of a property. The multiple layer pavement and drainage system will naturally provide water retention and will essentially mimic the drainage and filtration action of naturally unpaved surfaces.

Schematic Design of a Porous Pavement System



Side View



SAND FILTERS

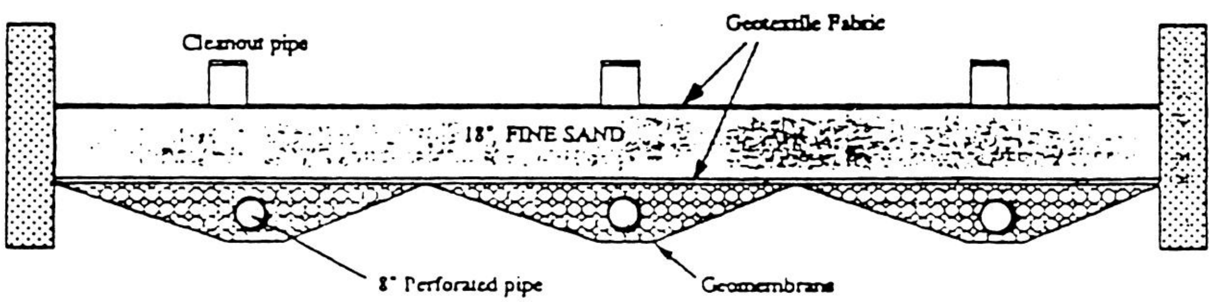
Definition

Sand filters are a relatively new technique for treating storm water, whereby the first flush of runoff is diverted into a self-contained bed of sand. The runoff is then strained through the sand, collected in underground pipes and returned to the stream or channel.

Enhanced sand filters utilize layers of peat, limestone, and/or topsoil, and may also have a grass cover crop. The adsorptive media of **enhanced sand filters** is expected to improve removal rates.

In addition, **sand-trench** systems have been developed to treat parking lot runoff.

Conceptual Design of a Sand Filter System



Source: Austin, Texas. 1991.

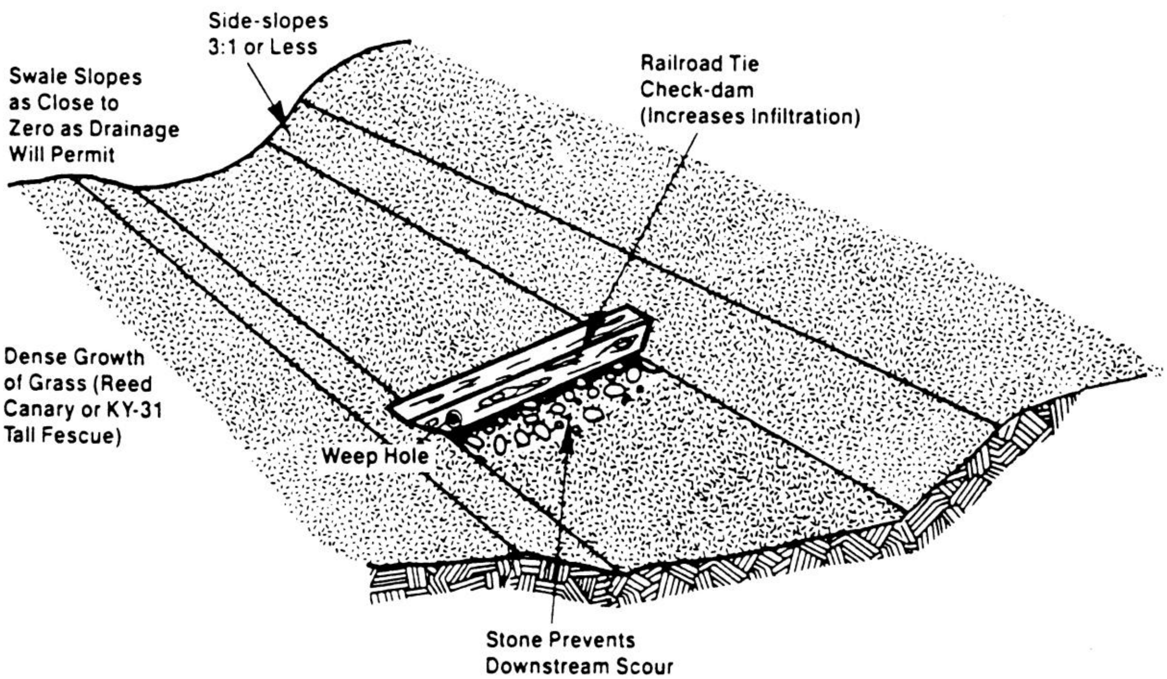
GRASSED SWALES

Definition

Conventional grassed swales are earthen conveyance systems in which pollutants are removed from storm water by filtration through grass and infiltration through soil.

Enhanced grassed swales, or **biofilters** utilize check dams and wide depressions to increase runoff storage and promote greater settling of pollutants.

Schematic Design of an Enhanced Grassed Swale



Source: Schueler, 1987.