Sydney Ports Corporation

Port Botany Expansion

Terminal Stormwater Management System

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CONTENTS

1. INTRODUCTION

This report addresses the collection and disposal of stormwater runoff of the proposed new container terminal at Port Botany. Controlling and treating stormwater discharges have been found to lead to significant improvements in the environmental quality of surrounding properties and adjacent water bodies.

An integrated catchment management approach to stormwater will be used. It incorporates control measures that apply the principles of water sensitive urban design. The objective of the design will be to minimise the impacts of the proposed development on the existing environment, particularly the receiving waters, Penrhyn Estuary and Botany Bay.

This report documents a methodology for managing the quality of stormwater runoff during the operation of the proposed new terminal. It also presents options for configuring the first flush system and for containing accidental spills.

2. DESIGN GUIDELINES AND METHODOLOGY

2.1 Hydrology and Drainage Issues

Because most of the proposed facility will be paved, runoff coefficients will be close to 1.0. The total peak discharges from the entire 63ha site during high intensity short duration (5 minute) storms would be in the order of 35 m^3/s for a 20 year Average Recurrence Interval (ARI) storm to 45 m^3/s for a 50 year ARI storm. The intensities of these storms would be about 210 mm/h and 269 mm/h respectively.

Final design of the stormwater drainage system will be in accordance with Botany Bay City Council and relevant authority standards, recommendations and requirements as listed.

- Botany Bay City Council. Guidelines for the Design of Stormwater Drainage Systems within the City of Botany Bay. Adopted by Council 28th August 2002.
- EPA Environmental Protection Authority of NSW's various publications including State of The Environment 2000 (SoE2000) and recommendations.
- Sydney Water Corporation's recommendations for disposal to sewer if required.
- Sydney Port Corporation's requirements.
- Australian Standards (including AS3500).
- Australian Rainfall & Runoff. A Guide of Flood Estimation. Volume 1. The Institution of Engineers, Australia. 1997.
- Australian Rainfall & Runoff. A Guide of Flood Estimation. Volume 2. The Institution of Engineers, Australia. 1987.

Stormwater discharges that initially flow from the site can contain relatively high concentrations of pollutants, especially after long periods of dry weather. The initial runoff containing this high pollutant load is called the first flush. A first flush collection system will be integrated into the stormwater collection and disposal system. The first flush will be collected and treated before discharge into Botany Bay. The first flush collection system will also contain any accidental spills.

During most storms the initial runoff dislodges and transports deposited pollutants from pavement surfaces. The proposed site will be nearly 100 per cent impervious.

The sources of pollution to the proposed terminal include:

- Atmospheric fallout. Pollutants such as dust particles, sea salt and miscellaneous pollution carried by wind such as ash from bushfires.
- Vehicles. Pollutants such as sediments, oil and grease and heavy metals from exhausts.
- Leaks from machinery and vehicles, including fuel, lubricants, oil and grease.
- Containers. Accidental spills may include hazardous substances and chemicals, non-hazardous bulk solids and liquids.
- Fire fighting, including water and fire retardant chemicals.
- People. People are the main source of gross pollutants such as litter.

Wash down water from the storage, mechanic sheds and material handling areas will be contained within individual bunded areas and treated seperately.

The EPA[1] suggests collecting the first 10 millimetres of rainfall as a design criterion for pollutants such as soluble materials, fine dusts and silts on a catchment surface that is mostly impervious.

The main site is approximately 58.5 hectares in area, hence the total volume of the first flush will be approximately 6,000 m³. The site also has relatively long flow paths up to 500 m long. In order to reduce the effects of time lag, the site will be divided into sub catchments, each of which will incorporate surface inlet pits in a series of shallow swales.

[1] EPA Environment Protection Manual for Authorised Officers. Published by: Environment Protection Authority, NSW. 1999.

2.2 Operational Requirements

The catchment management process consists of four steps:

- collection of all first flush water and spills,
- testing and treatment of potentially contaminated water,
- reuse of clean water for irrigation/washdown purposes and
- appropriate disposal of both excess clean water and contaminants.

The first flush collection and treatment flow diagram shown as figure 1 illustrates the operation of the stormwater system.

All stormwater runoff will be directed into surface inlet pits and drain via a series of box culverts with capacity to convey the 20-year ARI storm without surcharging. The first flush will discharge from each box culvert line into a first flush retention tank or trench on the edge of the site. The first flush retention tank will be a covered version of the first flush retention trench, and will be capable of supporting either medium duty loads (T44 and A14 loading) or heavy-duty loads (forklifts, cranes etc).

Each box culvert outlet will allow the first flush water to flow into a separate tank or trench compartment until it fills to a level that contains the first 10mm of runoff from each subcatchment. This level will be equivalent to the invert level of the box culverts passing across the retention trenches or tanks. Flows subsequent to the first flush in the 20-year ARI storm which are now cleaner runoff will bypass the trenches and tanks and continue to flow to the discharge points in Penrhyn Estuary without mixing with or disturbing the first flush water.

Each first flush retention tank or trench will contain a series of baffles designed to separate the collected runoff into water containing floating pollutants such as hydrocarbons and litter and water containing suspended pollutants such as sediment. It is likely that the most cost effective material with which to construct trenches, tanks and baffles will be reinforced concrete.

The baffles will be positioned to contain up to 150mm depth of water containing floating pollutants. Floating debris can be skimmed from the surface on a periodic basis. It is not anticipated that large quantities of floating debris will be encountered due to the non-public nature of the site. This surface water collected in the retention tank or trench will be pumped to a coalescing plate separator (CPS) to separate oils, greases, other hydrocarbons and any liquid pollutant that are less dense than water to separate these pollutants from an “oily water” mix. The cleaner water will then flow into a small monitoring tank for sampling.

After rainfall has ceased and after removal of any floating pollutants from the retention tanks/trenches, first flush water can be tested and, if “clean”, can be pumped directly to Botany Bay or to a water storage tank for reuse as irrigation water or for wash down water. Should first flush water contain levels of suspended solids that exceed EPA requirements (normally 50mg/l) either flocculants can be used to settle out the solids in situ or as an alternative in a tank separate from the retention trenches/tanks. If flocculation is not applied the water can be passed through the CPS system. CPS technology enables the removal of smaller particles than cannot be removed using a gravity-settling tank. Some CPS units can remove particles as small as 20microns (compared to 100microns for a typical gravity-settling tank). Additional information on oil separation is attached in Appendix A.

Clean water from the first flush system will be emptied over a period of up to 48 hours after each storm event.

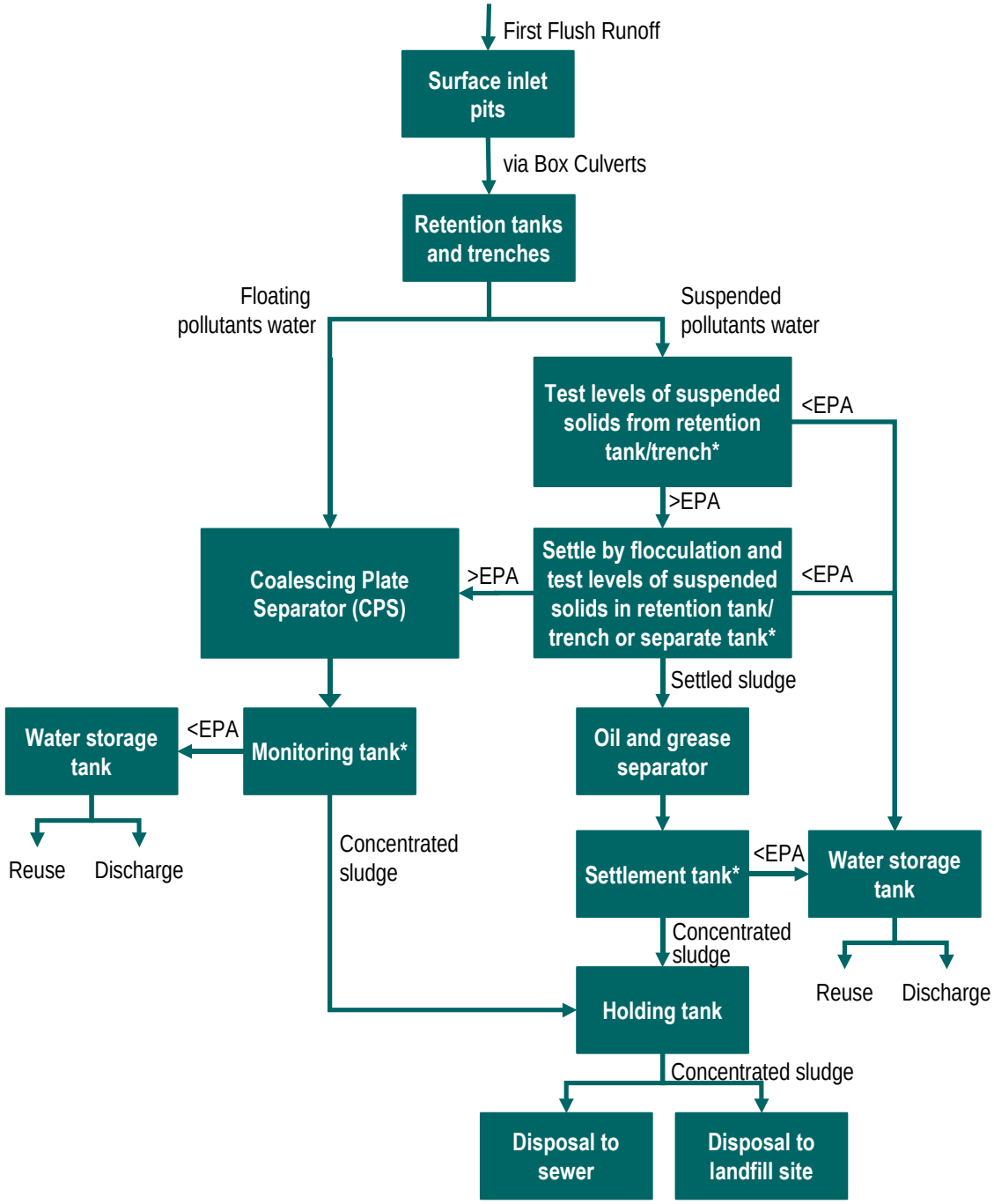
After the removal of suspended and floating matter the sludge and sediment from the bottom of the retention tanks/trenches and from the sump pits (at end of each retention trench/tank) will be either collected separately or pumped to a settlement tank via an oil/grit separator. Sump pits are described in section 2.3.

Clean water from the CPS unit's monitoring tank and settlement tank will be discharged into the water storage tanks after sampling and analysis for reuse or directly into the bay. The removed pollutants will be transferred to a holding tank for disposal to the sewage system under licence or for transportation to an approved landfill.

Surface gradients in the majority of the site will vary from 0.3% to 1% to minimise problems with container stacking. As a consequence, nuisance surface ponding can be expected. Ponding may be aggravated by settlement of fill under the pavement and periodic asphalt resheeting may be required. All swales and other surfaces will allow overland flow to drain to the retention tanks/trenches should pits be blocked or pit inlet capacity be exceeded. Extreme storm events (i.e. >20 year ARI storms) will need to be diverted around the first flush retention tanks/trenches.

As a separate stormwater system a bioremediation swale will drain the proposed road and rail to the north of the Patrick Container Terminal, which has an area of 4.5ha. The swale will run parallel to the railway and Penrhyn Road to a number of sump pits. These sumps are not attached to a retention trench/tank but also have their base built lower than the outlet pipe in order to trap pollutants. The clean water will discharge from the sump pits to the estuary, acting as a separate collection and treatment system.

A bioremediation swale is a constructed catch drain. It is shaped or graded in earth materials and stabilized with site suitable vegetation, for the safe conveyance and water quality improvement of storm runoff.



* Sampling and analysis points for suspended solids and hydrocarbons
<EPA Pollutants less than EPA limits in treated water
>EPA Pollutants greater than EPA limits in treated water

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Figure 1 First Flush Collection and Treatment Flow Diagram

2.3 Water Quality and Treatment Requirements

It is known that "acute pollution generally arises from accidents, such as oil spills from shipping, road or industrial accidents. Chronic pollution may arise from both local and widespread sources. Catchment run-off carries nutrients, sediments and pollutants into waterways."[2]

As discussed in the previous section, these pollutants would settle on surfaces as a result of normal operations of plant and equipment as well as being carried by the wind from external sources. The site itself will be almost completely paved so that generation of dust and grit can be expected to be very low. The levels of other pollutants will depend on how well plant and equipment is maintained and on the level of operation. In addition, higher levels of pollutants can accumulate due to long periods between rain events. It is expected that concentrations of hydrocarbons to be 0.1 to 3.0 mg/l and concentrations of suspended solids to be 5 to 100 mg/l.

Sump Pits

Sump pits incorporate depressed bases that accumulate sediment and the like. The sump pits located in the retention tanks/trenches will be used as a supplement to the oil/grit separator and will need to be cleaned out periodically. The sump pits adjacent the road and rail to the north of Patrick Terminal will trap pollutants that has previously been removed through the bioremediation swale.

Table 1 lists the pollutant trapping efficiency for sumps pits as general guide.

Table 1 Pollutant Trapping Efficiency for Sump Pits[3]

Pollutant Type	Pollutant Trapping Efficiency
Litter	Low
Oxygen demanding material	Low
Sediment	Low to moderate
Oil and grease	Low
Nutrients	Negligible
Bacteria	Negligible

High efficiency notates 75 to 100% removal.
Moderate efficiency notates 50 to 75% removal.
Low efficiency notates 10 to 50% removal.
Negligible efficiency notates 0 to 10% removal.

Oil/grit Separator

The oil/grit separator would be a commercially available precast unit similar to that manufactured by Ecosol Pty Ltd. The Ecosol model RSF 5000 consists of two parallel channels and a collection/filtration silo contained within a precast unit. Through a series of apertures and baffles the unit filtrates and separates pollutants. The Ecosol model RSF 5000, or similar, will be used as an end-of-line filtration unit for collecting oil, grease, gross (including litter), coarse and fine sediments. Additional data on the Ecosol model RSF 5000 is attached in Appendix A.

Table 2 lists the pollutant trapping efficiency for oil/grit separators as a general guide.

[2] The Wetlands Policy of the Commonwealth Government of Australia. Biodiversity Group. Environment Australia. 1997.

[3] Managing Urban Stormwater. Treatment Techniques. Published by: Environment Protection Authority, NSW. 1997.

Table 2 Pollutant Trapping Efficiency for Oil/Grease Separator[4]

Pollutant Type	Pollutant Trapping Efficiency
Gross Pollutants (mostly floatable litter)	High
Attached Pollutants	Medium
Coarse Sediment	High
Oil and grease	Very High
Dissolved Pollutants	None
Fine Sediments	High

Coalescing Plate Separator (CPS)

Coalescing plate separators (CPS) or oil seperators remove oil and smaller particles from water. Units are available in a variety of capacities and are sized according to each site's requirements. The performance of a CPS unit depends on the particle size, density and distribution. CPS units will generally remove particles of hydrocarbons and solids sized 10µm to 40µm and greater.

Performance Curves comparing the "Spinifex" brand seperator (a combination unit) to a "plate"(CPS) unit and settling tanks is attached in Appendix A. The performance curves show that oil separators tend to make a notable difference.

Water Tanks

The water storage tanks have been sized to provide sufficient volume of washdown water and flushing water for the box culverts to last up to 8 weeks between rainfall events. The water may thus potentially be recycled many times before disposal. Increasing the size of the tanks will provide increasing environmental benefits as more water is stored thereby increasing its potential uses. Other potential uses would include irrigation and fire fighting.

2.4 Spill Management

A typical accidental spill could be in the order of 30,000 litres (30 m^3), in any single section of the first flush system would easily be contained in a retention tank/trench without the need for emergency response or human intervention. It is intended to isolate the containment of such a spill to as small a volume as possible by providing a series of baffles within each retention tank/trench compartment. If a spill occurs in dry weather, the first $8m^3$ will be contained in the central 5m long compartment and the remainder of a $30m^3$ spill would be contained in the adjacent two 7m long compartments. If a spill occurs in wet weather, all of the spill would be contained in the 150mm zone for floating pollutants in the central five compartments.

Following containment, the spill would be disposed of in an appropriate manner. This may be to truck the spill material to an appropriate plant for recovery, or it may simply involve disposal to EPA requirements. As spills may be volatile, all electrical equipment will require spark arrestors and suitable isolation to prevent explosions. The full implications of spill management are beyond the scope of this report.

Bulkheads or gate valves could also be installed as an added precaution on the ends of culverts and on the outlets to retention tank/trench sections. However, because these bulkheads would need to be manually operated after a spill, they should not be relied on as a primary containment system.

[4] For ECOSOL RSF 5000 In-Line Oil & Grease Arrestor. Ecosol Pty Ltd. Natural Ecological Solutions. Stormwater Filtration Systems. Technical Specifications. Website: www.ecosol.com.au

2.5 Operations Area Management

At least one area of the site will be designated to equipment maintenance and fuel storage. The area is likely to include a workshop for maintenance and cleaning of mobile plant operating on the terminal and a refuelling depot. The area will have appropriate spill containment measures to keep wash down and stormwater runoff separate from the rest of the terminal. Bunding the area is one type of containment measure.

Additional information on the use of bunding is contained in the "Managing Stormwater From Bunded Areas And Open Catchments Using Oil Seperation And First Flush Systems", attached in Appendix A.

All discharges from this area would be controlled and may be directed to the sewer through treatment consisting of, at minimum, sump pits. A Sydney Water Waste Trade Agreement will determine level of treatment required before discharge, as well as the acceptable quantity of discharge and type of contaminants able to be discharged to the sewer. An alternative to discharging to the sewer is to set up a treatment system, similar to the main system on the site but on a smaller scale. The system would include sump pits, a smaller CPS such as a "EnviroSEP" unit and water storage and sludge holding tank. The treated water would then be discharged or recycled after sampling and analysis.

Additional information on the "EnviroSEP" unit is attached in Appendix A.

2.6 Fire Water

Water used in fire fighting can be discharged in the same manner as wash down water and stormwater runoff. If fire suppressant foams or other fire fighting chemicals are used in the maintenance areas they will be contained within the bunded areas. Once contained, chemicals and contaminated water should be collected from the surface or discharged to the sewer. However, as there are various types of foams and chemicals, their handling and disposal is dependent on manufacturers' instructions and recommendations.

If these foams and chemicals are used in the other areas of the site they will be treated in the same manner as a spill after the fire. They will be contained into one section of the first flush retention tank/trench and disposed as required.

Additional steps can be taken to prevent spills and fire water from entering other areas by the installation of gate valves or sandbagging. Such a step would rely on gate valves being closed manually to contain any fire water. This will permit fire water to be stored on site in the retention tank and trenches and if their capacity is exceeded to be stored in the box culverts and lastly, if necessary, as surface water within shallow swales.

2.7 Monitoring

It is not possible to remove dissolved solids without expensive microfiltration and chemical systems. It is expected that the quality of water from the system described above will meet EPA standards. As a precaution, outflows should be monitored for the first 12 months of operations and additional treatment installed if required.

The different elements of the system would require monitoring for pollutants. The monitoring would be in accordance with the methods described in Approved Methods for the Sampling and Analysis of Water Pollutants in NSW[5]. This document in conjunction with

[5] Approved Methods for the Sampling and Analysis of Water Pollutants in NSW. Environment Protection Authority, NSW. 1998.

AS/NZS5667.1:1998[6] and AS/NZS5667.10:1998[7] provides a guide to the collection, handling, preservation and analysis of water that are acceptable to EPA.

The objective of the monitoring program for the terminal will be to determine whether discharge load limits to Botany Bay and Penrhyn Estuary (to be set by the EPA) are kept. A detailed program will be described in the operational Environmental Management plan for the new terminal but generally samples will be required to be taken at regular intervals during a monitoring period, including a storm event or spill.

Sampling locations are in the retention tanks and trenches, the monitoring tank attached to the CPS and the settlement tank attached to the oil/grease separator. The sampling and testing points are shown on the first flush collection and treatment flow diagram.

[6] AS/NZS5667.1:1998. Guidance On The Design Of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples. Standards Association of Australia, 1998.

[7] AS/NZS5667.10:1998. Guidance on Sampling of Waste Waters. Standards Association of Australia, 1998.

3. OPTIONS

Because the level of the terminal is fixed at approximately 4.0m LAT it would be unnecessarily expensive to fill the container handling and storage areas to levels that would enable stormwater drainage to fall towards the terminal edge. In addition, it would be extremely difficult and expensive to fit first flush retention tanks within the terminal structure. Drainage and surface grades are therefore proposed to fall away from the terminal edge.

Heavy-duty tanks can be used to contain the first flush from the southern two subcatchments as shown in Option 1. This would impose additional impacts on costs and potential disruption to normal movements during maintenance. Alternatively, tanks that would be under container handling and storage areas can be relocated as shown in Option 2, but this would require a large pump station to pump up to 3,000 l/s of stormwater with associated high running and maintenance costs.

Gridmesh covers can be installed over retention trenches as a safety measure and to prevent access by birds and other animals. As a minimum, mesh or fabric covers should be installed to discourage birds and to reduce ingress of wind blown debris.

Spill containment options should be considered within the wider context of spill management and safety. Because manual intervention is unreliable in the containment of spills, the simple failsafe method shown in the drawings is proposed. Additional steps can be taken to prevent rainwater from mixing with a spill that has already been contained such as closure of the culvert entering the containment section (eg by use of a gate valve) and diversion of surface waters around the containment section (eg by sandbagging).

4. CONCLUSIONS AND RECOMMENDATIONS

An integrated stormwater drainage management system has been proposed for the site. Sensitive environmental conditions have dictated that the drainage system must adhere to a number of ecological philosophies and objectives as well as EPA and other environmental standards. These objectives are intended to lead to significant improvements in the quality of discharge compared to uncontrolled runoff from the site.

Careful management of the water cycle during the life of the proposed development will mitigate against adverse impacts of development to a large extent. The proposed system is flexible enough to allow augmentation of the treatment process to meet relevant standards and management of accidental spills is accommodated without operational risks.

It is recommended that the first 10mm of stormwater runoff be retained in a first flush retention system and that this water be tested and treated, if required, before being released into Penrhyn Estuary or Botany Bay. The water quality standards for discharges should be those recommended by the EPA.

Appropriate spill management plans should be developed based on the use of the first flush retention system to contain spills up to $30m^3$.

The grades of culverts are almost flat, a flushing system should be used to flush sediments from culverts on a regular basis. Recycled water can be used for this purpose.

APPENDIX A

Brochures

ECOSOL RSF 5000 IN-LINE/END-OF-LINE OIL & GREASE ARRESTER

Similarly to the **RSF 4000**, the **RSF 5000** uses a unique overflow system that operates in the event of maintenance failure or severe flooding (all flows). The ***hydraulically-driven barrier*** created by the filtered water is directed at the untreated stormwater inflow, restricting any premature by-pass of pollutants until the filtration device is full. When this occurs, the intensity of the hydraulically driven barrier reduces enabling the untreated stormwater inflow to overpower the barrier and flow freely to the outlet via the overflow/by-pass channel. No water remains in the inlet pipe after the flow of water has stopped, even when the overflow has operated, virtually eliminating remobilisation of captured pollutants. This keeps the unit clean, eliminating sediment build-up, regardless of whether the overflow has operated. The system is a compact installation requiring slightly more site space than the existing/proposed stormwater pipe/culvert.

The unit collects up to 97% of free oils and grease, as well as significant quantities of fine sediments. It is designed to handle all flows within specification, called the Treatable Flow Rate (TFR), in the manner described above. Its principles have been extensively tested as part of the **RSF 4000** University of South Australia and Adelaide tests.

Specifications

Unit Code	Inlet Pipe Diameter Range (mm)	Treatable Flow Rate (TFR) (m^3/s)	Free Oil Holding Capacity (Litres) In oil spills	Water Holding Capacity (litres)	Internal Silo Depth from Invert (mm)	Surface Footprint (m^2)	External Dimensions (LxWxD from invert) (mm)
RSF 5300	150 to 600mm	0.09	405	972	600	1.6	2400 x 1200 x 750
RSF 5450	225 to 900mm	0.17	810	1,944	600	1.1	3400 x 1500 x 750
RSF 5600	300 to 1200mm	0.25	1,350	3,240	600	1.7	4400 x 1800 x 750
RSF 5750	450 to 1350mm	0.45	2,025	4,860	600	2.9	5400 x 2100 x 750
RSF 5900	600 to 1650mm	0.70	8,500	20,400	1800	3.0	6300 x 2400 x 1950
RSF 51050	750 to 1800mm	1.00	13,200	32,800	2100	3.1	7400 x 2700 x 2250
RSF 51200	900 to 1950mm	1.50	19,400	46,600	2400	3.2	8300 x 3000 x 2550
RSF 51350	1050 to 2100mm	1.70	27,400	65,600	2700	3.3	9300 x 3300 x 2900
RSF 51500	1200 to 2400mm	2.80	37,000	89,000	3000	3.4	10200 x 3700 x 3200
RSF 51800	1350 to 2400mm	4.00	63,000	151,600	3600	3.5	12200 x 4300 x 3800

Pollution Capture Performance

Gross Pollutants *	H	Coarse Sediment	H	Fine Sediments	H
Attached Pollutants	M	Dissolved Pollutants	N	Oil & Grease	VH
Head Requirements	L	Installation Costs	L	Maintenance Costs	L

VH - Very High H – High M – Medium L - Low N – None

* Consists mainly of floatable gross pollutants

ECOSOL RSF 5000 IN-LINE/END-OF-LINE OIL & GREASE ARRESTER (cont.)

Cleaning

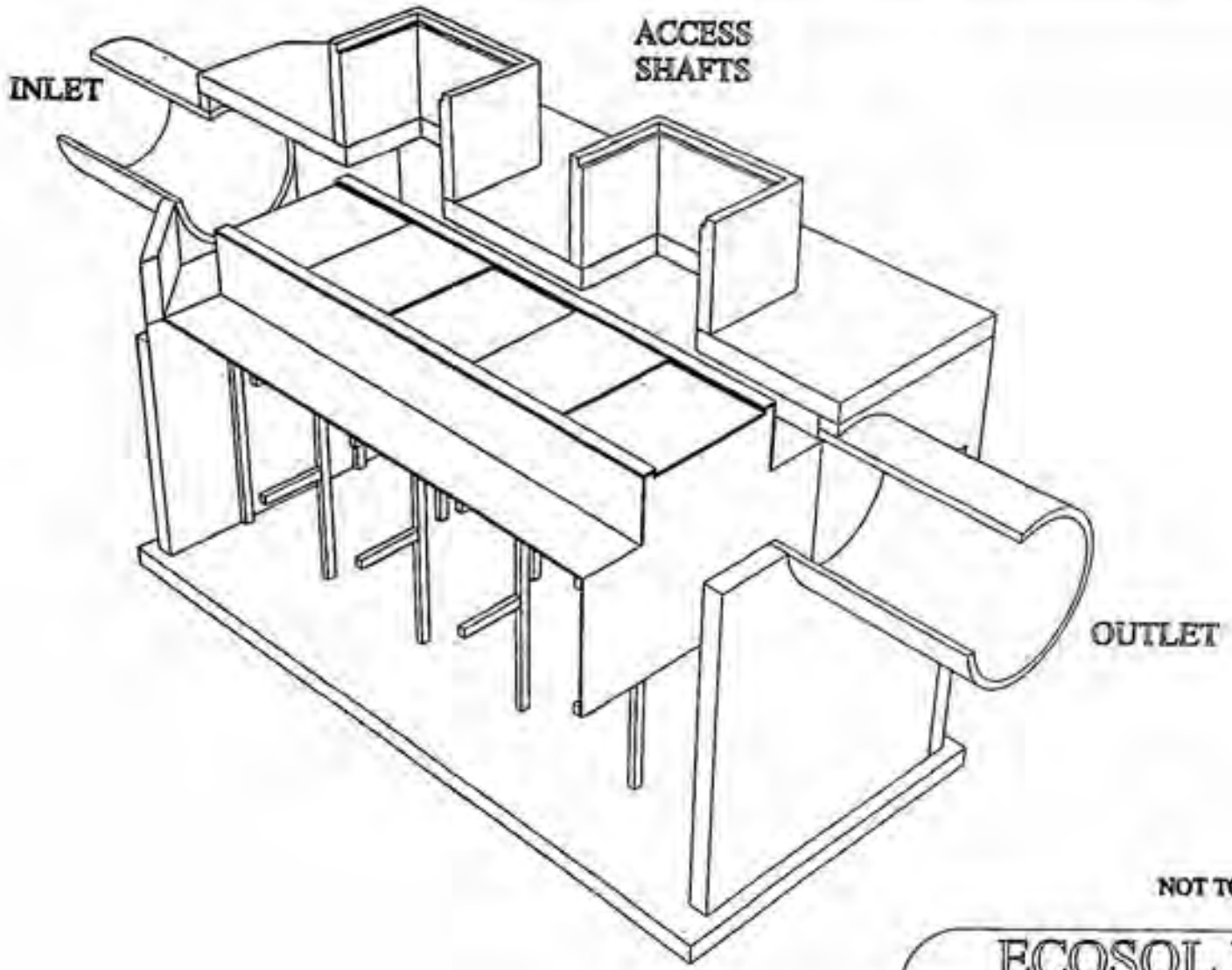
The unit is cleaned in the same way as the **RSF 4000**. As it has a significant holding capacity, and overflow channels that eliminate the risk of blockage when the collection chamber is full, a strict cleaning regime is unnecessary.

Ecosol has a very competitive cleaning service, using an eductor truck to remove captured pollutants. After each clean, we provide you with a full report, detailing the volume, and type, of pollutants removed.

Specific Benefits

The key to the success of the **RSF 5000** is its simplicity. It has no moving parts and the unique hydraulically-driven barrier enhances capture performance and eliminates the risk of blockage. Other benefits include:

- the highest TFR of any comparable unit;
- effective filtration, and retention, of up to 97% of free oils and significant quantities of fine sediments;
- minimal head/hydraulic loss;
- reduced depth minimising the effect of water table problems;
- small surface footprint;
- uses existing pipe area;
- simple design;
- no requirement for drainage system invert modifications;
- site-specific engineering; and a
- large collection capacity.



NOT TO SCALE

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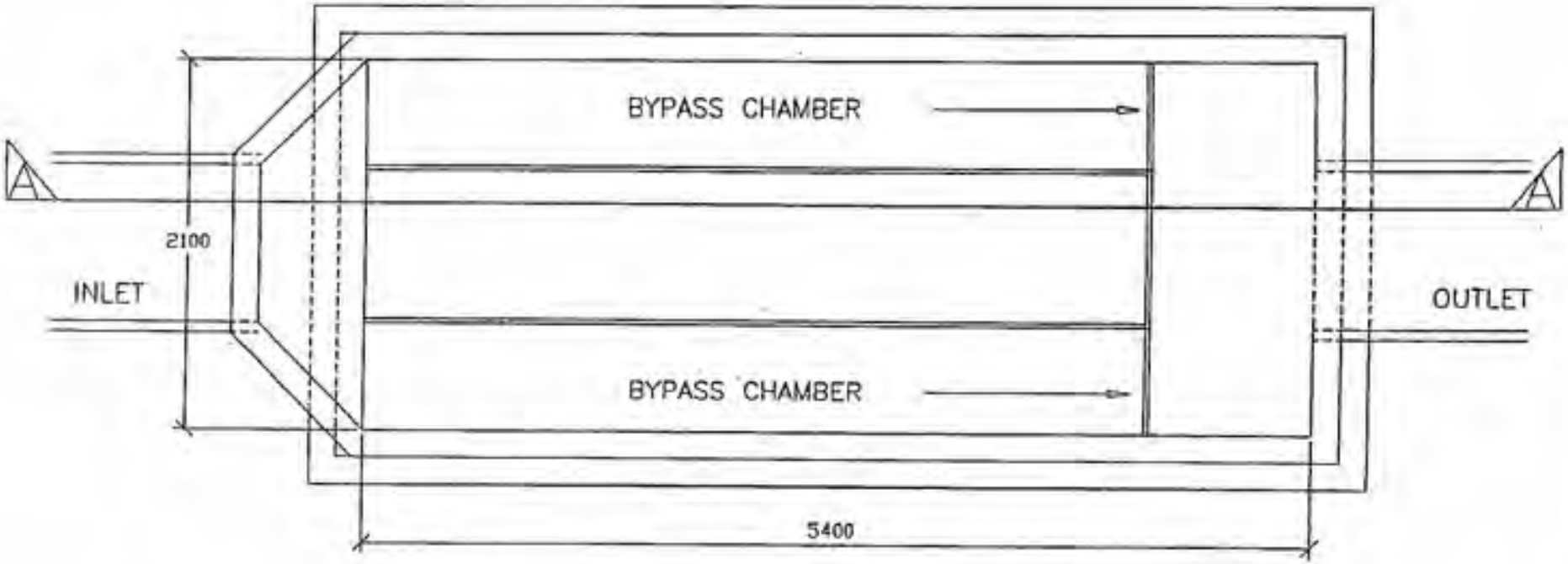
RSF 5900

DRAWING NO.	50003
DRAWN BY	Scott Ray
DATE	3/5/99



PLAN

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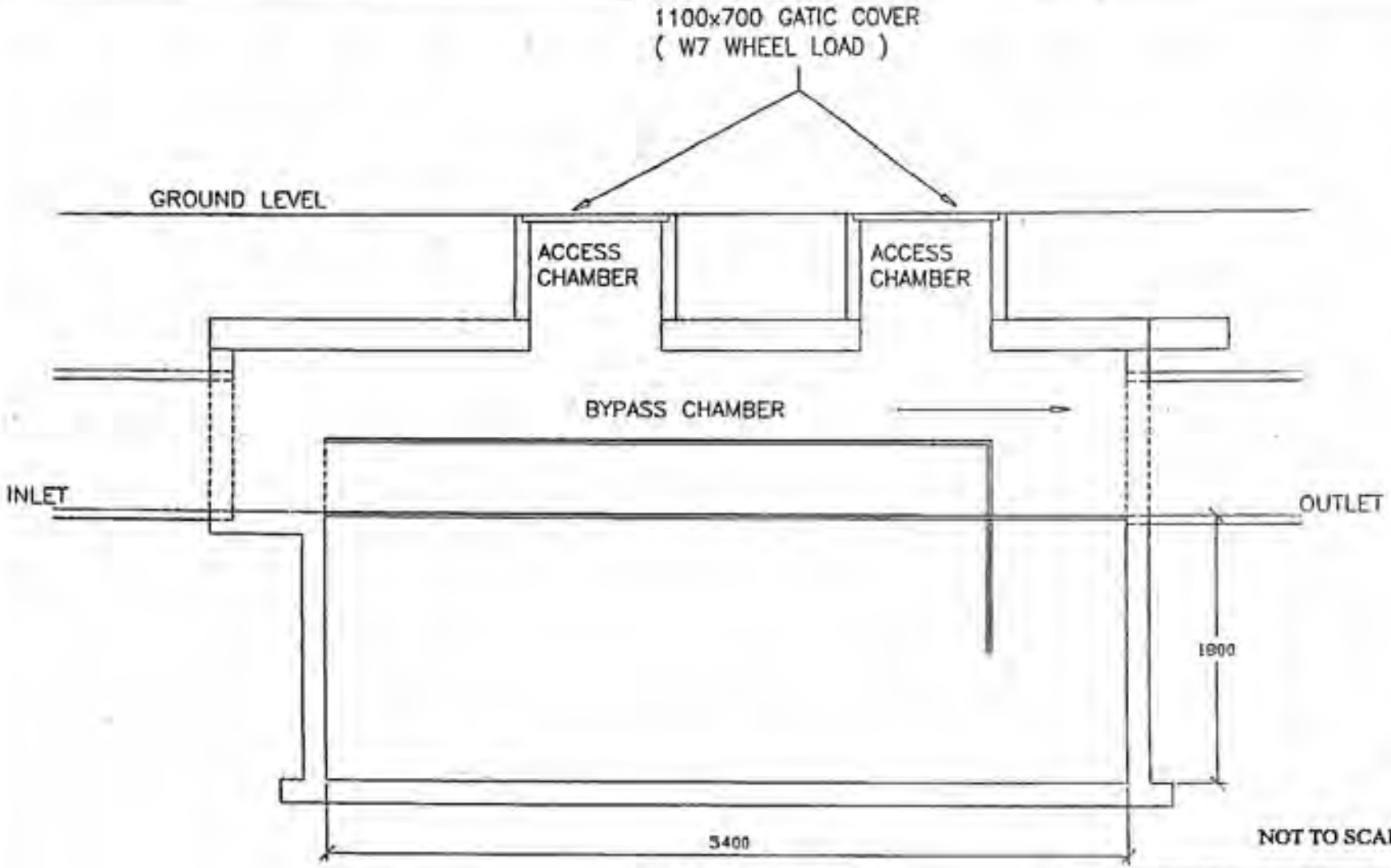

NOT TO SCALE

SECTION A–A

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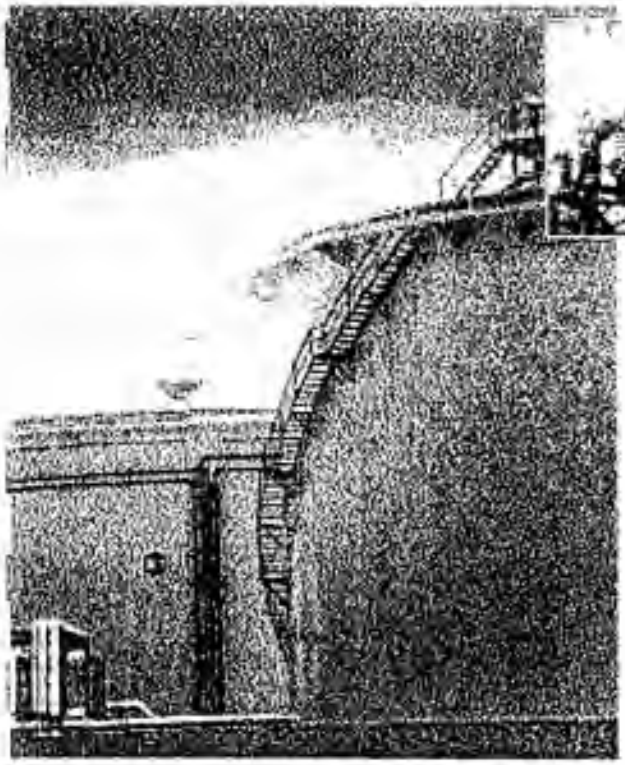
AJM EnviroSEP

The Essential Guide to.....

Managing Storm Water from bunded areas and open catchments using Oil Separation and First Flush systems

Water &
Waste Water
Treatment
Engineers

AJM Environmental Services Pty Ltd



Managing Storm Water in Bunds

If you own , operate or manage a site typical of those listed opposite, it is likely that you will be responsible for the safe containment of oil or fuel.

This oil or fuel maybe stored in tanks at depots or terminals or inside transformers at sub and transmission stations. In most cases however, the vessel holding the oil is contained in an unroofed bunded area.

Bunds are constructed to act as a safe guard against events such as tank ruptures or transformer failures. Without bunding, pollution or ground water contamination risks are high.

Unfortunately in most cases, bunds also collect storm water. The legislation covering discharge of water from bunded areas is, and only ever will, become more stringent. Presently in most states and countries, to prevent the possibility of accidental drainage of potentially contaminated water from bunds, it is not permissible to install drain valves

Bunds do not only guard against major catastrophes. Minor spills, leaks or drips which can occur when filling or emptying such vessels will often result in contamination of water in bunds to levels well in excess of discharge specifications.

The solution to the management of storm water collected in bunds is either evaporation, or treatment. Evaporation obviously is the low cost option. Some issues with this option are that during high periods of rainfall the effective bund capacity will be greatly reduced. Also, as occupational health and safety requirements prohibit work being conducted in wet areas, bunds containing water and or oil can delay commencement of maintenance or emergency work.

The AJM EnviroSEP is the most practical method for maintaining a dry bund whilst treating and discharging the water in compliance with legislation.

Substations

Transmission stations

Fuel storage Bunds

Tank Farms

Refuelling bays

First Flush treatment

Power stations

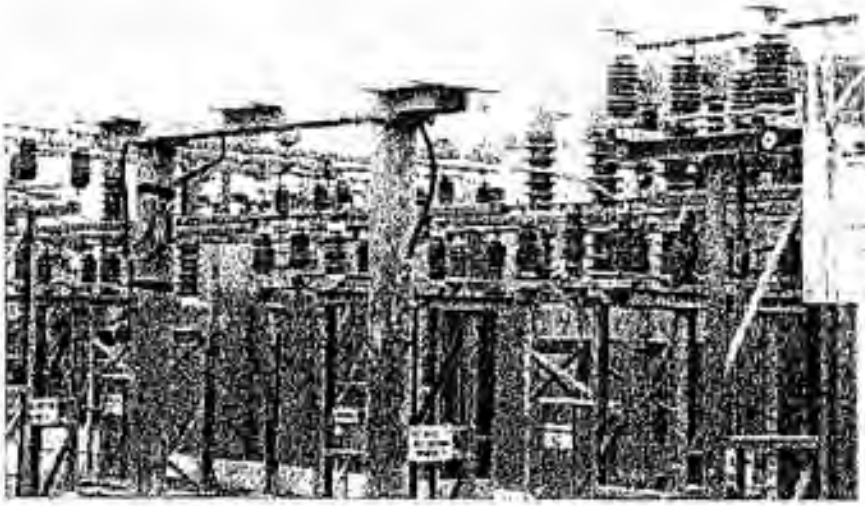
Service stations

Depots

Terminals

Refineries

AJM Environmental Systems are a privately owned Australian company. The AJM EnviroSEP is designed and manufactured in Australia.



An EnviroSEP will always..

Maintain a dry bund.

Eliminate the need for bund pump outs.

Remove traces of oil from storm water.

Provide protection from major spills.

The AJM EnviroSEP is not just another oil separator. It has been designed specifically with special features to effectively treat storm water collected in bunded areas and manage major spills.

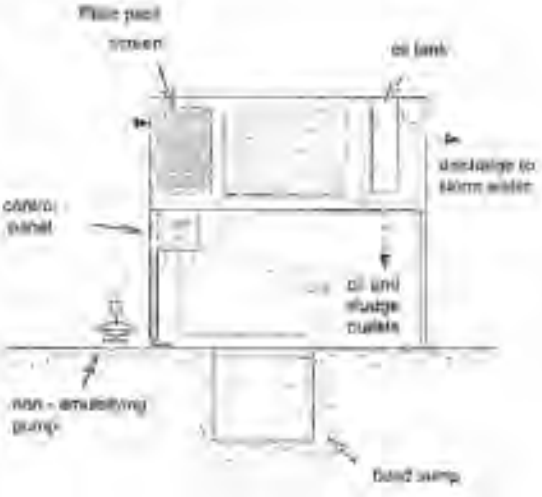
The key to the EnviroSEP design is it simplicity.

Storm water collected in bunds usually flows to a sump. This water is pumped automatically from the sump to the EnviroSEP where leaves, twigs and other foreign objects are removed from the water by a large volume removable basket strainer.

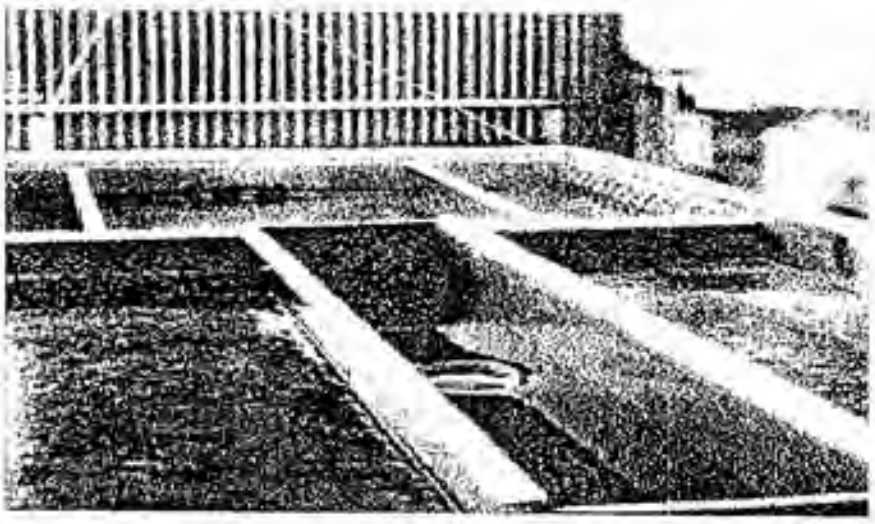
The water then flows into the coalescing plate pack where oil droplets and smaller particles are separated from the water phase. As the oil layer builds up on the surface of the unit it overflows into a built in oil tank. The treated water passes over an adjustable weir and can be discharged directly into storm water drains.

The EnviroSEP is fitted with a major spill protection cut off security system which, following a major spillage automatically stops the pump within a matter of minutes. This feature prevents the possibility of displacement of the the water in the EnviroSEP allowing oil to discharge to drain.

An additional high level sensor is installed in the bund which activates an alarm if the bund starts to fill due to pump failure.



Typical EnviroSEP installation



Principals of Oil Separation

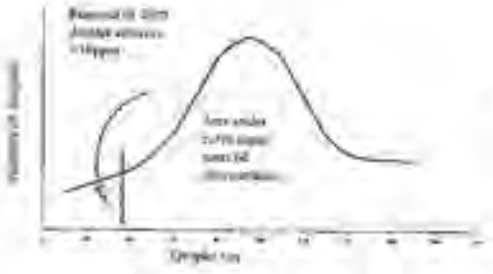
The AJM EnviroSEP is a gravity separation devise.

Gravity separation relies on there being a difference in the density of the oil and that of water.

When oil is present in water in an unemulsified or free state it exists as thousands, maybe millions of droplets ranging in size from a few microns to several centimeters which could almost be considered a 'slug'. A curve showing how these droplets are distributed can be seen on the chart below. In this example, the area underneath the curve (number of droplets x droplet size) defines the concentration of oil in the solution. It can therefore be predicted that if all droplets greater than approximately 20 microns are removed from the water phase then the concentration of oil left in the water will be of insignificant proportions.

By applying the principals of Stokes Law and

Typical Distribution of Oil Droplets in Water



calculating the rise rate of a 20 micron droplet, forms the basis of oil separator design.

Many oil separators are termed coalescing plate interceptors. Encouraging coalescence of oil droplets improves the performance as the effective droplet sizes are increased. The AJM EnviroSEP uses a pack of specially designed tubes which promote this coalescing effect whilst also providing adequate surface area and retention time for 20 micron droplets to be removed.

Other essential considerations when designing oil separators are;

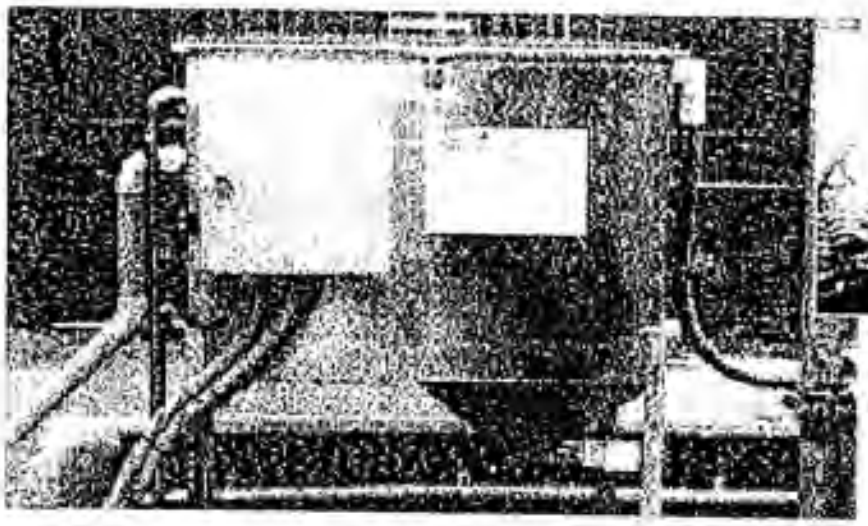
*The ensurance of near laminar flow conditions which is achieved by inlet distribution baffles.
*Equal distribution throughout the oil separator plate pack.
*Materials that attract oil and encourage coalescing.
*A plate pack angle of at least 60 degrees to maximise solids removal.
*The use of a non emulsifying pump.

Stokes Law

$$V=\frac{(d_0-d_w)d^2}{18m}$$

Where:

V= the rise rate the oil droplet
d_0 = density of oil
d_w = density of water
d = droplet size
m = viscosity of water



Features of the AJM EnviroSEP

The AJM EnviroSEP is available in a range of capacities from 1000L per hour upwards. For most single bunding applications, the AJM EnviroSEP1000 is an appropriate selection. Larger systems may be required in cases where several bunds are interconnected.

The capacity of the unit only determines the time taken to empty the bund. Several hours is generally an acceptable time period.

Model #	Capacity
EnviroSEP1000	1000 L/Hr
EnviroSEP 2000	2000 L/Hr
EnviroSEP 3500	3500 L/Hr

To determine the most suitable size of an EnviroSEP unit, measure the catchment area and multiply this value by a "worst case" storm event. A 1 in 100 year storm is adequate.Then determine how long is acceptable for water to be held in the bund and select the appropriate unit..

The EnviroSEP and all of its components are designed and manufactured in Australia. All equipment and materials selected are extremely reliable and of the highest quality to withstand outdoor installation often in remote and unattended locations.

Specifically designed for bunded areas

In-built oil storage tank

Oil tank high level alarm

Integral sludge hopper

Cleaning without removing the plate pack

Fully automatic control system

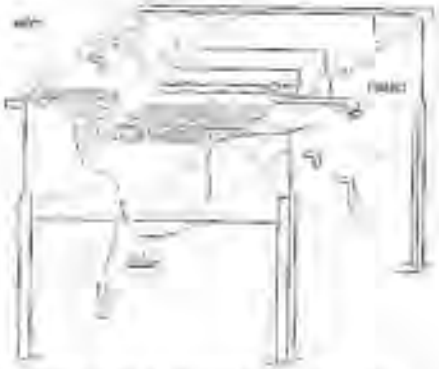
SCADA facilities

Stainless steel construction

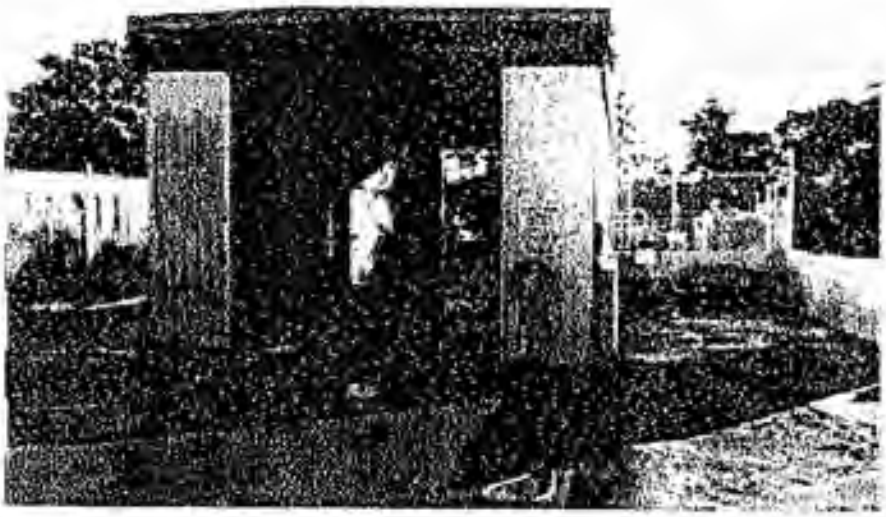
Very low maintenance

Spill protection cut off

Guaranteed free oil removal



Isometric view of an AJM EnviroSEP unit



First Flush Systems

The AJM EnviroSEP in conjunction with a first flush system is a commonly approved process for storm water management from open areas .

When pollutants deposited on exposed areas are dislodged and entrained by the rainfall run off process, the storm water that initially flows off the area will be more polluted than that which runs off later. This initial run off can be considered as a cleansing stream.

First flush systems are designed to capture, isolate and treat this cleansing stream whilst allowing subseqeent runoff to be flow direcly to storm water drains.

There are many factors that determine whether or not a first flush exists and if so, the conditions to which it applies can vary considerably. Factors such as the mobility of the pollutants, the size and drainage characteristics of the catchment area and the nature or porosity of the ground. It is essential that each case is individually assessed and designs are approved by an appropriate authority.

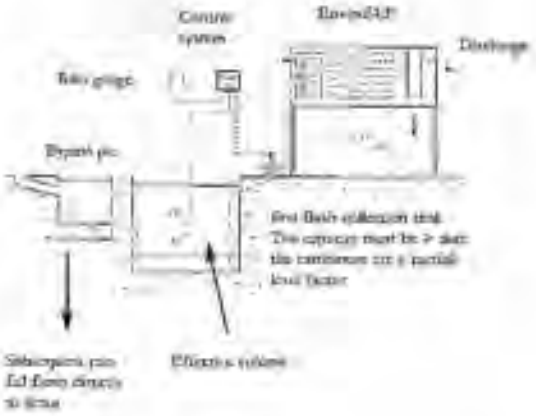
Once a first flush is accepted as a suitable storm water pollution control device, a cleansing rain fall level will be applied. this is typically between 10 and 20mm. The capacity of the first flush collection tank must be greater than this level multiplied by the area of the catchment.

How the First Flush works

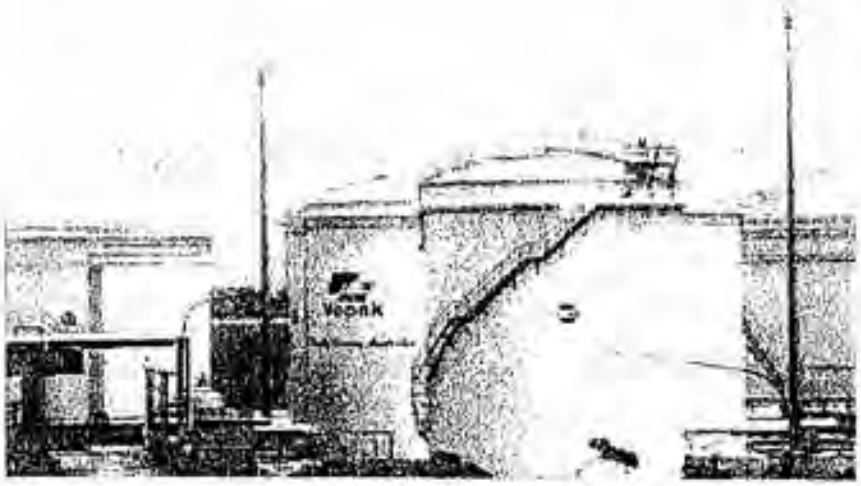
When rain starts, the storm water runs into the first flush collection pit via a storm water bypass pit. Once the first flush pit is "full" the water will backflow to the bypass pit and flow directly to storm water drains.

The rain gauge will prevent the pump from operating whist it continues to rain. After the rainfall has ceased, the water in the first flush pit is pumped to the EnviroSEP where the pollutants are removed.

The water treated by the EnviroSEP is discharged either to storm water drains or sewer



depending on local requirements and the nature of the pollutants concerned.



Design

Manufacture

Construction

Installation

Commissioning

Service

Sampling

AJM Environmental Services are an engineering company specialising in all aspects of water, waste water and storm water treatment plant design.

Our expertise spans the full range of physical, chemical and biological treatment methods

AJM maintain up to date knowledge on all environmental legislation to ensure that when we discuss pollution control methods, we have a thorough understanding of the process management, technical and legal requirements covering the treatment and discharge of water.

AJM's services include installation and management of projects from small oil separator installations, complete first flush systems to large scale water and waste water treatment plants.

All mechanical, electrical and civil designs are all conducted in house by experienced engineers and installed by our qualified trades persons, many of whom have obtained specialist qualifications such as confined space and substation entry.

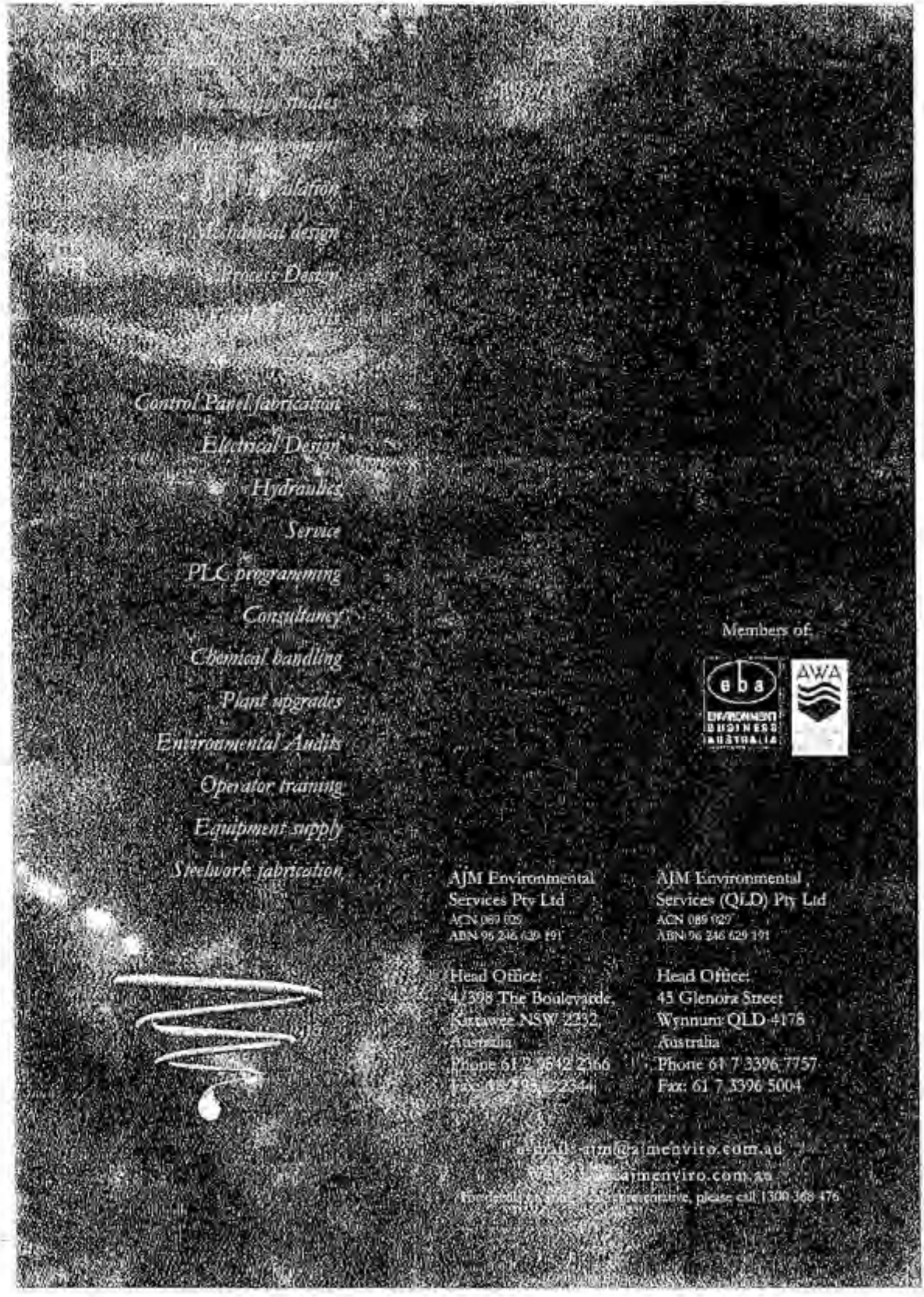
Our engineers and site personnel are experienced in design and working in hazardous or flammable areas and all work conducted complies with the appropriate standards and guidelines.

ZERO Discharge Solutions

In some environmentally sensitive areas zero discharge of oil is enforced. The AJM oil separator as an individual piece of process equipment is designed and guaranteed to discharge less than 10ppm of oil.

Although the system will normally achieve close to undetectable concentrations of oil, depending on the nature of the application and factors such as oil solubility, low concentrations may still be detected in the discharge.

The AJM polishing filter is a low cost, low maintenance solution to zero discharge. This unit is installed on the discharge of the EnviroSEP and contains an absorbent filter cloth which will ensure virtually all traces of oil are removed.


Feasibility studies
Risk management
Simulation
Mechanical design
Process Design
Control Panel fabrication
Electrical Design
Hydraulics
Service
PLC programming
Consultancy
Chemical handling
Plant upgrades
Environmental Audits
Operator training
Equipment supply
Steelwork fabrication
Members of:
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AWA
AJM Environmental Services Pty Ltd
ACN 089 029
ABN 96 246 629 191
Head Office:
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Kirrawee NSW 2232,
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ABN 96 246 629 191
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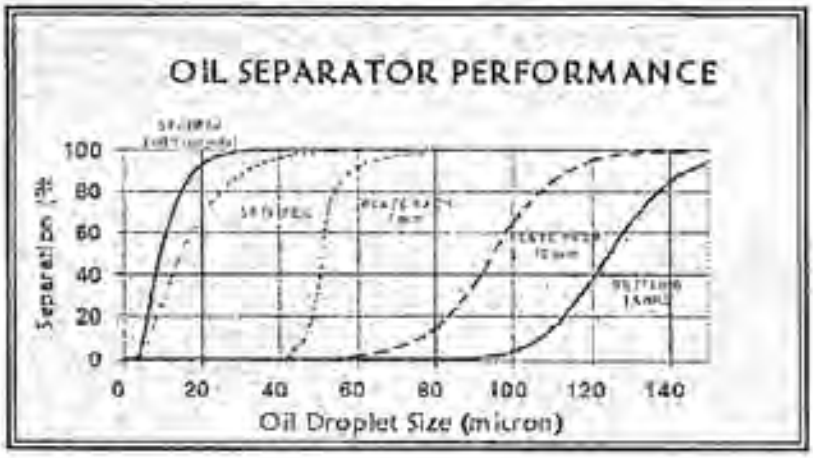
45 Glenora Street
Wynnum QLD 4178
Australia
Phone 61 7 3396 7757
Fax: 61 7 3396 5004
e-mail: ajm@ajmenviro.com.au
www.ajmenviro.com.au
For details of your nearest representative, please call 1300 368 476

formance Curves

What is a Performance Curve?

A performance curve is one effective way to measure the 'power' of an oil separator. Thi performance curve plots oil droplet size on the horizontal axis and percentage removal c The curve plots the actual percentage of oil of a certain size removed. A more powerful able to remove a higher percentage of smaller oil droplets. The most accurate curves ar the actual oily water feed conditions. See also FAQ for more information.

Why are Performance Curves important?



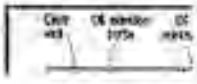
The Spinifex Separator is extremely efficient. The performance curves show that it has the capability to efficiently remove oil droplets from 10 µm and greater.

- More po separator higher per smaller oil will result water.
- Performa enable co purchase separator performan objectivel
- Many oil equipmen claim to b achieve, s and greas treated wa specifying and perfo such clain credibility.

Types of Separator

Plate Pack also known as:

- Coalescing plate separator (CPS)
- Coalescing plate interceptor (CPI)
- Tilted plate separator
- Vertical gravity separator (VGS)



Settling Tanks also known as:

- API separators
- Triple Interceptors
- Above ground tanks
- Collection pits

Bell and rope skimmers are often used as part of an oily water treatment system however they are not included as they are not water treatment devices. These devices typically remove only some of the oil that may already be separated at the surface of water via some other means such as from a gravity vessel.

What data is needed for a Performance Curve?

To ensure that the curves can be compared and are meaningful the minimum set of dat specified and produced with performance curves includes:

1. Fluid Properties:
- Water density
- Water viscosity
- Oil density
- Oil viscosity

2. Method of Operation:
- Feed water flow rate
- Inlet oil concentration
- Data depends on type of separator

3. Separator Design Factors:
- Nominal plate spacing
- Total horizontal projected wetted plate area
- Operating oil depth
- Design retention time
- Depends on type of separator, data shown for pl

Certain factors are well known to affect the ease of oil droplet separation, so generally u under actual clients conditions or a typical set of conditions.

In the absence of client specific data the following data and conditions are typically usec separators.

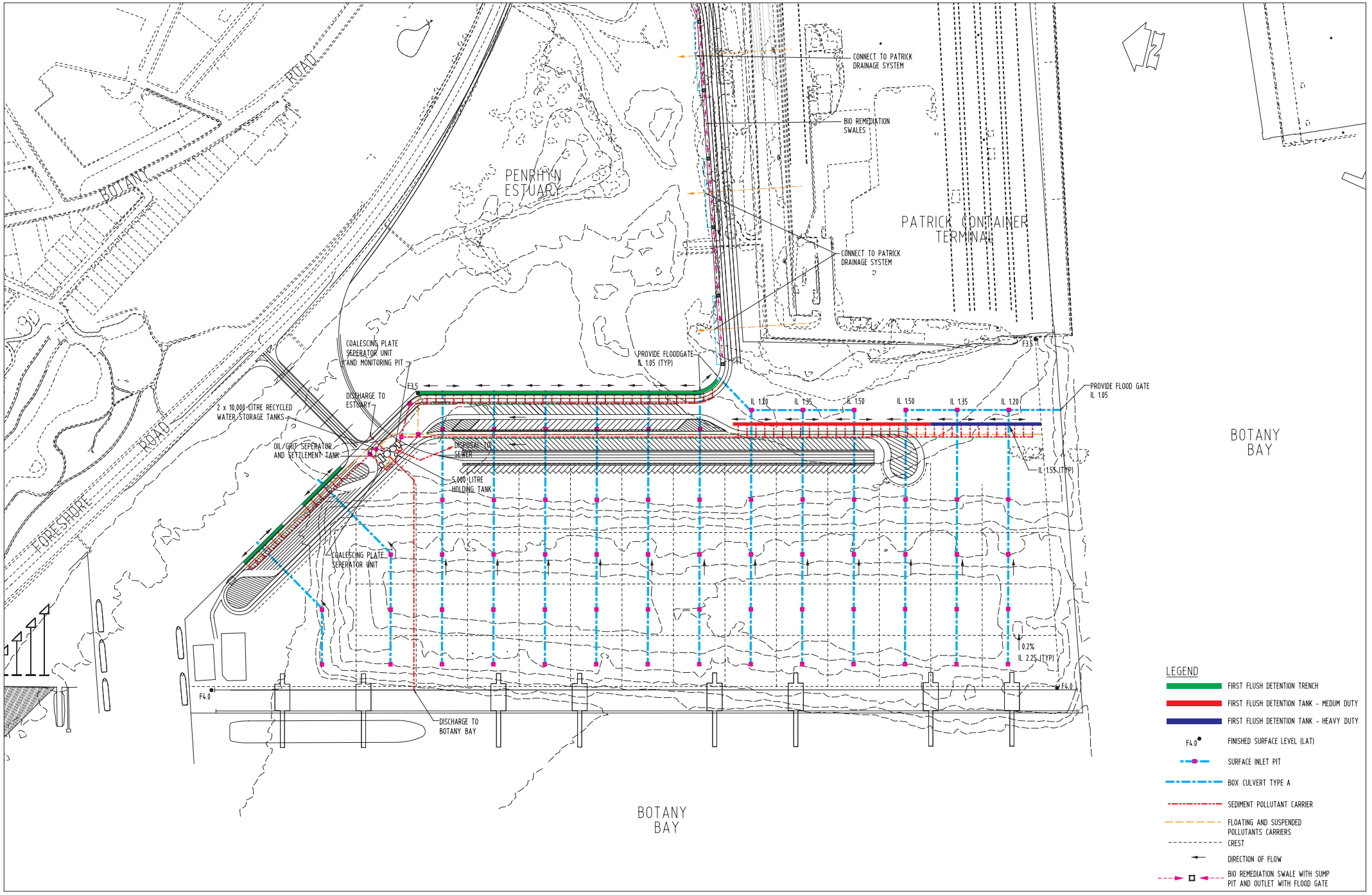
Water Temperature	25°C
Oil density	850 kg/m^3
Water density	1000 kg/m^3
Oil/Water interfacial tension	< 30 dyne/cm^2
Water Viscosity	1 cP

Rated Flow	1500 l/hr
Separator Condition	Just prior to routine service (ie used condition)

APPENDIX B

Drawings

FOR CONTINUATION REFER DRAWING 81808/702/C02



Issue	Description	By	Date	Issue	Description	By	Date
2	ISSUE FOR INFORMATION ONLY	PCB	30.01.03				
1	ISSUE FOR REVIEW	CPL	06.12.02				

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CANBERRA CAIRNS PORT MORESBY AUCKLAND

CLIENT
SYDNEY PORTS

PROJECT
PORT BOTANY EXPANSION
E.I.S. ADVICE

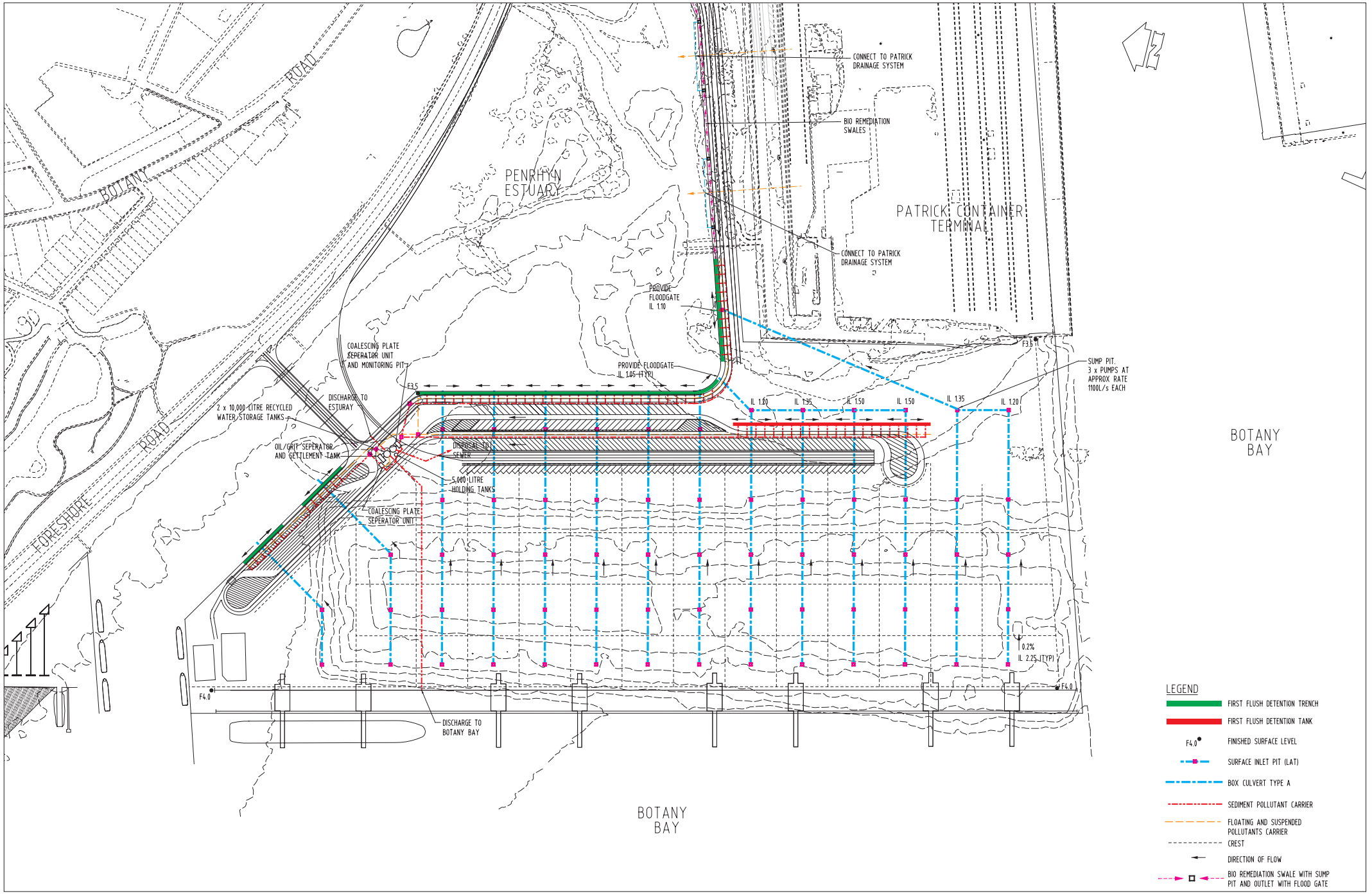
DRAWING TITLE
STORMWATER MANAGEMENT
SHEET 1 OF 3
OPTION A

Designed	LB	Authorised for Issue	
Drawn	BB	Scale	1:5000 AT A3
Checked	GH		
Job No	81808/072	Drawing No	C01
		Issue	2

A1

0 100 200mm on original

FOR CONTINUATION REFER DRAWING 81808/702/C02



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PROJECT: PORT BOTANY EXPANSION E.I.S. ADVICE

DRAWING TITLE: STORMWATER MANAGEMENT SHEET 2 OF 3 OPTION B

Designed	LB	Authorised for Issue	
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Checked	GH		
Job No	81808/072	Drawing No	C02
		Issue	2

A1

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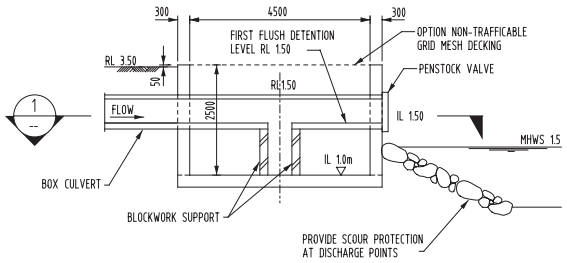
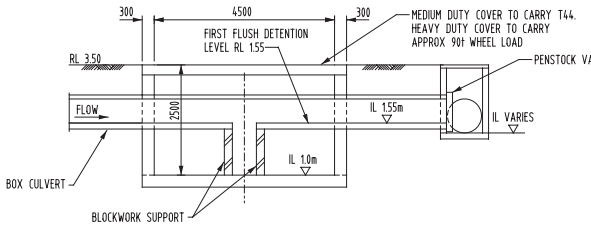
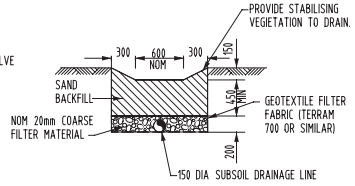


TYPICAL SECTION - BOX CULVERT OUTLET
FIRST FLUSH DETENTION TRENCH
NTS

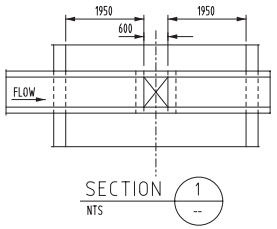


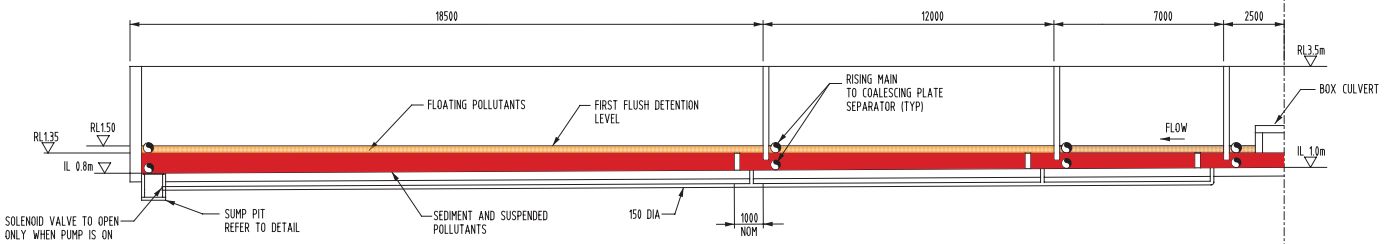
TYPICAL SECTION - BOX CULVERT OUTLET
FIRST FLUSH MEDIUM DUTY AND HEAVY DUTY DETENTION TANK
NTS



BIO REMEDIATION SWALE
NTS

NOTE:
ALL DIMENSIONS ARE INDICATIVE ONLY
ALL LEVELS TO LAT DATUM





TYPICAL SECTION - FIRST FLUSH DETENTION TRENCH
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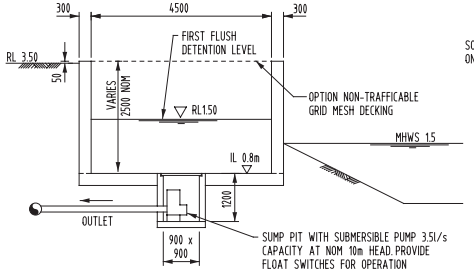
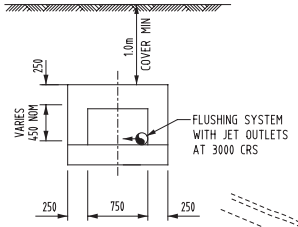


TYPICAL SECTION - SUMP PIT
NTS



BOX CULVERT TYPE A
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PROJECT
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E.I.S. ADVICE

DRAWING TITLE
STORMWATER MANAGEMENT
AND MISCELLANEOUS DETAILS
SHEET3 OF 3

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Job No	81808/072
Drawing No	C03
Issue	2

A1
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