Rarotonga Waste Facility Management Plan

Issue 4 – Facility Operation

Government of the Cook Islands

December 2004

Rarotonga Waste Facility Management Plan

Prepared for

Government of the Cook Islands

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December 2004

1049 643 12

Quality Information

Document	Rarotonga Waste Facility Management Plan
Ref	1049 643 12 k:\dept_49\projects\4964312 - coo waste management project\waste facility management plans\rarotonga\issue 4 final comments - issue date december 2004\rarotonga waste facility management plan - issue 4 - 2004.12.22 - final.doc
Date	December 2004
Revision	Issue 4 – Facility Operation

Issue 4 – Facility Operation

Description
Management Plan

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Copy Number	Name	Organisation
1 (Master Copy)		Ministry of Works – Landfill Manager
2		Ministry of Health
3		National Environment Service
4		Recycling Centre Operational Contractor
5		Landfill Operational Contractor
6		Waste Acceptance Controller

Update Register

Issue Number	Issue Date	Summary of Modifications
1 – Final Draft	March 2004	Final draft issued for client's comments
2 – Facility Operation	August 2004	Proof copy
3	November 2004	Minor update and replacement of some pages only following ADB comments
4	December 2004	Re-issue of Section 5 and minor updates and replacement of some pages following external review comments.

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Appendices

NOTE: Each Appendix is located after the corresponding section number

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Glossary of Terms

Word	Definition
Aftercare	Management of Landfill after refuse placement has ceased.
Aquifer	A geological formation or layer of rock or soil that is able to hold or transmit water.
Background Level	Ambient level of a contaminant in the local area of the site under consideration.
CIIC	Cook Islands Investment Corporation
CAE	Centre for Advanced Engineering
Cleanfill Material	Material that when discharged to the environment will not pose a risk to people or the environment, and includes natural materials such as clay, soil and rock and such other materials as concrete, brick or demolition products.
Compacted Clay Liner	A constructed liner consisting of clay placed and compacted in accordance with an engineering specification.
Contaminant	Any substance (including gases, liquids, solids and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar or other substances, energy or heat: (a) When discharged into water, changes or is likely to change, the physical, chemical or biological condition of water, or (b) When discharged onto or into land or into air, changes, or is likely to change, the physical chemical or biological condition of the land or air onto or into which it is discharged.
Corrosivity	The ability of a substance to corrode metals or to cause severe damage by chemical action when in contact with living tissue.
Cover Material	Material placed to cover refuse.
Discharge	Includes emit, deposit and allow to escape.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and the non-living environment, interacting as a functional unit.
Ecotoxicity	Adverse toxic effects on ecosystems or ecological communities.
Environment	Includes: (a) Ecosystems, including people and communities; and (b) All natural and physical resources; and (c) Those qualities and characteristics of an area that contribute to the community's reasonable enjoyment; and (d) The cultural, economic, aesthetic, and social conditions that affect the above.
ES	National Environment Service referred to in this document as Environment Service
Final Cover	See Landfill Cap.

Word	Definition
Flammability	The ability of a substance to be ignited and to support combustion.
Flexible Membrane Liner (FML)	Flexible liner used to contain leachate.
FML Protection Layer	Geotextile placed over FML to protect it from damage due to stones in leachate drainage blanket.
Geosynthetic Clay Liner (GCL)	Flexible liner consisting of a geotextile impregnated with clay.
Geotextile	A woven or non-woven sheet material.
Hazardous Waste	As defined in Section 4.2.6.
High Density Polyethylene (HDPE) Liner	A type of plastic used in landfill FML's.
Highwalls	Rock cliffs on the Northern and Southern boundaries of the site.
Landfill Cap	Cover placed over landfill at end of life to control water ingress and environmental emissions.
Landfill Gas	Gas generated as a result of decomposition processes of biodegradable materials deposited in a landfill. It consists principally of methane and carbon dioxide, but includes minor amounts of other components.
Leachate	The liquid effluent produced by the action of water percolating through waste, and that contains dissolved and/or suspended liquids and/or solids and/or gases.
Leachate Collection Pipeline	Pipeline installed within leachate draining blanket to collect leachate.
Leachate Drainage Blanket	Layer of porous gravel at base of landfill to collect leachate.
Leachate Gravity Main	Un-pressurised pipeline conveying leachate.
Leachate Pump Station	Pump station to move leachate.
Leachate Recirculation Header Tank	Tank which stores leachate prior to distribution back into the landfill.
Leachate Rising Main	Pressurised pipe conveying leachate.
Malodorous	Unpleasant smelling
Management Plan	Rarotonga Waste Facility Management Plan
LMP	Landfill Management Plan
Main Access Road	Access road from site entrance to quarry site.
MOH	Ministry of Health
MOW	Ministry of Works
NEC	National Environment Council
Perforated Recirculation Pipe	Pipe with holes which releases leachate into the landfill.
Primary Septage Pond	First pond which receives septage.

Word	Definition
Recycling Office	Refer Site Office.
Sacrificial Geotextile	Geotextile that remains in place after removal of temporary plastic cover (Refer Section 5.5).
Secondary Septage Pond	Receives partially treated effluent from the primary pond.
Septage	Refer Section 4.3.2.
Septage Receiving Facility	Manhole and slab beside the Primary Septage Pond.
Side Liner	Liner placed on the side of the landfill.
Site Access Road	Minor road or track for occasional access to part of the site.
Site Office	Office located near Recycling Centre.
Special Waste	Wastes that cause particular management and/or disposal problems and need special care. Examples include used oil, tyres, end-of-life vehicles, batteries and electronic goods.
TWMP	Trade Waste Management Plan (Refer Section 4.3.3).
Temporary Protection Cover	The two layers over the leachate drainage blanket – a sacrificial geotextile and a temporary cover (Refer Section 5.5).
Toxicity	The adverse effects caused by a toxin (poison) that, when introduced into or absorbed by a living organism, destroys life or injures health. Acute toxicity means the effects that occur a short time following exposure to the toxin, and chronic toxicity means the effects that occur after either prolonged exposure or an extended period after initial exposure.
Treated Effluent	Effluent that has been treated.
Treated Effluent Disposal Area	Area where treated effluent is disposed.
Treatment	In relation to wastes, any physical, chemical or biological change applied to a waste material prior to ultimate disposal, in order to reduce potential harmful impacts on the environment.
Washdown Facility	Location with equipment for washing down.
Waste	Any contaminant, whether liquid, solid, gaseous or radioactive, which is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an adverse effect on the environment and which includes all unwanted and economically unusable by-products at any given time, and any other matter which may be discharged, accidentally or otherwise, into the environment.
Vector	An agent used as a vehicle for transfer. A disease vector is an agent that transfers a pathogen from one organism to another (e.g., an insect)

Executive Summary

The purpose of this management plan is to provide a best practice manual for landfill and septage pond operation covering the following main aspects:

- Waste acceptance and handling
- Operation
- Monitoring
- Emergency Procedures and Contingency Plans
- Aftercare

Waste Acceptance

Waste acceptance procedures are critical as:

- This landfill is designed to handle certain types of waste, NOT all types of waste.
- Some types of waste have to be excluded from the landfill as their detrimental effect on the environment is too severe (even in an engineered landfill).
- Other types of waste are excluded from the landfill because they will take up too much space and there are other environmentally acceptable processes available for their disposal e.g. recycling.

Landfill Operations

The landfill facility is designed to deliver world class environmental performance. In order for the landfill to achieve these environmental performance standards, it must be operated using the recommended procedures. If a world class landfill is operated like a rubbish tip it will end up with most of the problems of a rubbish tip.

This is a form of ‘bioreactor’ landfill in which the decomposition of waste is promoted by recirculating leachate. The objective is for the waste to be thoroughly decomposed by microbial action and for the waste to decompose to a stable state as soon as possible. This will reduce the period over which the landfill has to be maintained once it closes.

Septage Pond Operational Procedures

The septage receiving and treatment facility is designed to deliver international standard environmental performance. In order for the septage facility to achieve these environmental performance standards, it must be operated using the recommended procedures.

The septage pond system is a biological treatment system and will vary with loading and seasonal factors. Therefore, appropriate monitoring management of the system is required for optimum performance.

Maintenance and Monitoring

Summaries of the maintenance and monitoring requirements for the landfill and septage ponds are included on the following pages.

Closure and Aftercare

The landfill must be closed in a manner so as to minimise its impact on future generations. The landfill will need to be looked after for some time after closure (i.e. until the waste stabilises and its ongoing environmental impact is minimal).

Planning for the Future

It has taken over 10 years to obtain funding, agree on sites, design, consent, and build the landfills. The projected landfill life is approximately 15 years at the low rate of refuse production currently observed on the Island. If refuse production increases or if the landfill is used to dispose of items for which it was not designed (i.e. car bodies, green waste) then the life will be reduced accordingly.

It is important that steps are taken to preserve future options to extend the landfill by,

- Acquiring the rights to extend the landfill into what is currently T&M Heather yard (immediately upstream of the site).
- Ensuring that future developments in the valley preserve the future opportunity to divert the stream into the neighbouring valley on the Avarua side, and to divert the road out of the valley. This would allow the whole valley to be filled which would extend the landfill life by many years.

Summary Maintenance Schedule

		Frequency					
Major Item	**Activity Description**	**Work Days**	**Weekly**	**Monthly**	**6-Monthly**	**12-Monthly**	**Other**
Leachate Pump Station	Visual inspection of pumps		✓				
	Check level of leachate	✓					
	Check operation of primary pump (using manual override)	✓					
	Check operation of standby pump (using manual override)	✓					
	Read and record pump hours	✓					
	Check oil level and consistency in primary and standby pumps				✓		One week after installation, one month after installation and 6-monthly thereafter. If the seals have been replaced, one week after replacement. One week after an oil change
	Visual inspection of lifting handle and chain			✓			
	Check operation of telemetry system			✓			
	Visual inspection of valve chamber			✓			
	Check bearings and seals on primary and standby pumps				✓		
	Perform drawdown test and record pump outputs				✓		
	Detailed inspection of complete primary and standby pumps, full service and oil change by a local mechanic trained by Trimate					✓	
	Major overhaul in service shop in Auckland by Trimate or Trimate approved service agent						Once per 3 years
Treated Effluent Pump Station	Visual inspection of pumps		✓				
	Check level of effluent	✓					
	Check operation of primary pump (using manual override)	✓					
	Check operation of standby pump (using manual override)	✓					
	Read and record pump hours	✓					
	Check oil level and consistency in primary and standby pumps				✓		One week after installation, one month after installation and 6-monthly thereafter. If the seals have been replaced, one week after replacement. One week after an oil change
	Visual inspection of lifting handle and chain			✓			
	Check operation of telemetry system			✓			
	Visual inspection of valve chamber			✓			
	Check bearings and seals on primary and standby pumps				✓		
	Perform drawdown test and record pump outputs				✓		
	Detailed inspection of complete primary and standby pumps, full service and oil change by a local mechanic trained by Trimate					✓	
	Major overhaul in service shop in Auckland by Trimate or Trimate approved service agent						Once per 3 years
Portable Stormwater Pump and Temporary Cover System	Visual inspection of pump	✓					
	Check operation of pump (using manual override)	✓					
	Read and record pump hours	✓					
	Check oil level and consistency in pump		✓				
	Check pump bearings and seals				✓		
	Full service of pump by Trimate or Trimate approved service agent					✓	
	Ensure appropriate weights are installed on cover system						Prior to major storm event
	Visual inspection of cover system			✓			After major storm event and after blasting
Washdown Facility Booster Pump	Visual inspection of pump	✓					
	Check operation of pump (using manual override)	✓					
	Read and record pump hours	✓					
	Check oil level and consistency in pump		✓				
	Check pump bearings and seals				✓		
	Detailed inspection of complete pump by local service agent					✓	
	Full shop service of pump by local service agent						Once per 2 years
Sandfilter Unit	Visual inspection of backwash pump	✓					
	Visual inspection of remainder of filter unit	✓					
	Check level of backwash tank	✓					
	Check operation of backwash pump (using manual override)	✓					
	Read and record pump hours	✓					
	Check pump bearings and seals on pump				✓		
	Detailed inspection of complete pump as required by Operating Manual					✓	
	Full service of sandfilter unit as required by Operating Manual						As per manufacturer instructions
Septage Ponds	Check for pipe blockage	✓					

Summary Maintenance Schedule

Major Item	Activity Description	Work Days	Weekly	Monthly	6-Monthly	12-Monthly	Other
		Frequency					
Septage Ponds	Inspect fabric of pond curtains						Once per 3 years
Septage Pond Mixing Pumps	Visual inspection of pumps	✓					
	During the pump off-duty season (when climate is consistently such that there is no risk of pond overturn, and the pond mixing system is switched off), check that the pump is correctly operating by manual on/off switching						Once per two weeks
	During the pump on-duty season (when the climate is such that there is the risk of pond overturn, and the pond mixing system is switched on), check that:1) the pump is correctly operating2)there is no blockage of flow into the suction of the pump (eg. due to blockage of the suction rose on the inlet hose)			✓			
	Read and record pump hours during the on-duty period	✓					
	Check operation of telemetry system			✓			
	Check bearings and seals on primary and standby pumps					✓	
	Thorough insitu inspection of pumps by suitably qualified mechanical/electrical specialist(s) as required by Operating Manual					✓	
	Full overhaul or (depending on respective costs) replacement of pumps, at a specialist mechanical/electrical workshop approved by the pump vendor as required by Operating Manual						Every 20,000 hours of operation or every 5 years, whichever occurs the sooner
Stream Diversion Channel	Visual inspection of cut off channel culvert				✓		After major storm events
	Visual inspection of box culvert under road				✓		After major storm events
	Visual inspection of ford to cover material stockpile				✓		After major storm events
	Visual inspection of full length of stream diversion channel				✓		After major storm events
All Other Drainage Systems	Visual inspection of stormwater drain along top of side fillet/side liner				✓		After major storm events
	Visual inspection of stormwater drain along northern edge of septage ponds				✓		After major storm events
	Visual inspection of existing channel to west of septage ponds				✓		After major storm events
	Visual inspection of recycling facility drainage				✓		After major storm events
Highwall (north and south)	Visual inspection of complete highwall area - noting areas of possible instability				✓		After major storm events and after blasting
Leachate Collection System	Jet clean leachate collection pipes						Once per 5 years or as necessary
	CCTV inspection of collection pipes						Once per 10 years or as necessary
Leachate Recirculation System	Visual inspection of above ground pipes	✓					
	Visual inspection of hose leading from rising main to recirculation field	✓					
Effluent Disposal System	Visual inspection of pipes and nozzles			✓			
Recycling Centre	Refer Section 1.5 of Management Plan						
Other Buildings, Gates and Fences	Visual inspection of all buildings					✓	After major storm events
	Check all gates are closed	✓					
	Visual inspection of all fences		✓				After animal ingress
Health and Safety Items	Review condition of all safety equipment				✓		
	Fire extinguisher testing					✓	
	Replenish first aid kit				✓		As required
	Update site hazard board		✓				
Visual Screening	Undertake general maintenance (weeding etc)			✓			
Access Roads	Visual inspection of all internal road surfaces				✓		After major storm event
	Remove debris from road surfaces		✓				After major storm event and after blasting
Septage Receiving Facility	Washdown receiving facility	✓					After each septage delivery
	Clean receiving manhole grate		✓				
	Visual inspection of receiving manhole		✓				
Cover Material Stockpile Area	Visual inspection of area noting any potential instability			✓			After major storm event and after blasting
Groundwater Monitoring Well Heads	Inspect well heads for damage				✓		
	Ensure well head is accessible			✓			One day prior to groundwater well monitoring
Mobile Plant	General maintenance						Determined by Landfill Operations Contractor
	Visual Inspection for flammable materials etc	✓					

Summary Monitoring Schedule

Major Item	Activity Description	Frequency: Work Days	Weekly	Monthly	6-Monthly	12-Monthly	Other
Leachate Pump Station	Visual inspection of leachate noting odour, clarity and colour		✓				
	Measure rate of lechate production			✓			
	Leachate sample testing					✓	Three monthly and annually
Treated Effluent Pump Station	Visual Inspection of treated effluent noting odour, clarity and colour		✓				
	Measure rate of treated effluent production			✓			
	Treated effluent sample testing					✓	Three monthly and annually
Portable Stormwater Pump and Temporary Cover System	Visual inspection of ponding volumes and levels	✓					
Washdown Facility Booster Pump	No monitoring required						
Sandfilter Unit	Check headloss across sandfilter (run backwash procedure if necessary)		✓				
Septage Ponds	Check pH of ponds and add lime as required		✓				
	Check levels of both ponds are at weir level - top up if required	✓					
	Inspect pond surface for scum and/or sludge - break up as required	✓					
	Check sludge/algal zone depth - de-sludge pond if necessary				✓		
Stream Diversion Channel	Take sample of upstream surface water			✓			As specified in Management Plan
	Take sample of downstream surface water			✓			As specified in Management Plan
All other drainage systems	No monitoring required						
Highwall (north and south)	Visual inspection of complete highwall area - noting areas of possible instability				✓		After major storm events and after blasting
Leachate Collection System	No monitoring required						
Leachate Recirculation System	No monitoring required						
Effluent Disposal System	Visual inspection of ponding and/or any overland flow		✓				
Recycling Centre	Refer Section 1.5 of Management Plan						
Other Buildings, Gates and Fences	No monitoring required						
Health and Safety Items	No monitoring required						
Visual Screening	No monitoring required						
Access Roads	No monitoring required						
Septage Receiving Facility	Take samples of raw septage						Random intervals
Cover Material Stockpile Area	Visual inspection of area noting any potential instability			✓			After major storm event and after blasting
Groundwater Monitoring Well Heads	Take sample from well B1			✓			As specified in Management Plan
	Take sample from well B2			✓			As specified in Management Plan
Mobile Plant	No monitoring required						
Atmospheric Monitoring	Read rainfall gauge	✓					
	Record wind direction and speed	✓					
	Odour monitoring				✓		
Refuse Compaction	Check refuse compaction density actually achieved				✓		
Reporting	Report refuse quantities received from Waste Acceptance Controller to Landfill Manager			✓			
	Landfill Manager Annual Report					✓	

Summary Monitoring Schedule

Major Item	Activity Description	Frequency: Work Days	Weekly	Monthly	6-Monthly	12-Monthly	Other
Leachate Pump Station	Visual inspection of leachate noting odour, clarity and colour		✓				
	Measure rate of lechate production			✓			
	Leachate sample testing					✓	Three monthly and annually
Treated Effluent Pump Station	Visual Inspection of treated effluent noting odour, clarity and colour		✓				
	Measure rate of treated effluent production			✓			
	Treated effluent sample testing					✓	Three monthly and annually
Portable Stormwater Pump and Temporary Cover System	Visual inspection of ponding volumes and levels	✓					
Washdown Facility Booster Pump	No monitoring required						
Sandfilter Unit	Check headloss across sandfilter (run backwash procedure if necessary)		✓				
Septage Ponds	Check pH of ponds and add lime as required		✓				
	Check levels of both ponds are at weir level - top up if required	✓					
	Inspect pond surface for scum and/or sludge - break up as required	✓					
	Check sludge/algal zone depth - de-sludge pond if necessary				✓		
Stream Diversion Channel	Take sample of upstream surface water			✓			As specified in Management Plan
	Take sample of downstream surface water			✓			As specified in Management Plan
All other drainage systems	No monitoring required						
Highwall (north and south)	Visual inspection of complete highwall area - noting areas of possible instability				✓		After major storm events and after blasting
Leachate Collection System	No monitoring required						
Leachate Recirculation System	No monitoring required						
Effluent Disposal System	Visual inspection of ponding and/or any overland flow		✓				
Recycling Centre	Refer Section 1.5 of Management Plan						
Other Buildings, Gates and Fences	No monitoring required						
Health and Safety Items	No monitoring required						
Visual Screening	No monitoring required						
Access Roads	No monitoring required						
Septage Receiving Facility	Take samples of raw septage						Random intervals
Cover Material Stockpile Area	Visual inspection of area noting any potential instability			✓			After major storm event and after blasting
Groundwater Monitoring Well Heads	Take sample from well B1			✓			As specified in Management Plan
	Take sample from well B2			✓			As specified in Management Plan
Mobile Plant	No monitoring required						
Atmospheric Monitoring	Read rainfall gauge	✓					
	Record wind direction and speed	✓					
	Odour monitoring				✓		
Refuse Compaction	Check refuse compaction density actually achieved				✓		
Reporting	Report refuse quantities received from Waste Acceptance Controller to Landfill Manager			✓			
	Landfill Manager Annual Report					✓	

1.0 Introduction

1.1 Purpose

The purpose of this management plan is to provide a best practice manual for landfill and septage pond operation covering the following main aspects:

- Waste acceptance and handling
- Operation
- Monitoring
- Emergency Procedures and Contingency Plans
- Aftercare

This management plan has been initially prepared for this landfill by Maunsell Limited as part of the Asian Development Bank (ADB) Waste Management Loan to the Government of the Cook Islands (Loan 1832-COO (SF)) and delivers the above key outputs from the Terms of Reference for the Loan Project as marked in Appendix 1.1.

This management plan also provides a number of documents required under the Project Permits granted by the National Environment Service, referred to in this document as the Environment Service (ES) (Refer Section 2.9).

For the purpose of this management plan "best practice" has been interpreted as being good international practice. The procedures outlined in this plan are the minimum required for this world-class facility to deliver the high levels of environmental performance for which it has been designed and constructed.

1.2 Who Implements the Management Plan?

The roles and responsibilities of key actors are summarised in Table 1-1 below.

Table 1-1 Responsibility for Management Plan Implementation

Actor	Responsibility
Operations Contractors	▪ Day to day compliance with operational procedures set out in management plan (Refer Section 2.6) ▪ Supply and maintain all mobile plant ▪ Regular maintenance of any fixed plant (eg pumps) and notify the MOW of any fixed plant failure
Ministry of Works	▪ Week to week oversight and management ▪ Securing funding and letting operating and maintenance contracts with conditions that require compliance with this management plan ▪ Fund the inspection and repair of fixed plant ▪ Funding and carrying out monitoring in accordance with the Monitoring Plan ▪ Secure funding and organise annual Peer Review ▪ Receive complaints ▪ Ensure that landfill capacity is used wisely by providing effective programmes to divert materials from the landfill ▪ Monitor annual capacity usage and predict life of landfill ▪ Annual reporting of results of monitoring to ES and MOH including interpretation of monitoring data and complaints records ▪ Maintaining the Waste Facility Management Plan ▪ Directing the contractors in an emergency ▪ Planning for future waste management actions
Environment Service	▪ Oversight of environmental compliance ▪ Occasional field inspections of the operation (at least once per year) ▪ Approval of any changes to this management plan ▪ Receive annual report and monitoring data ▪ Direct MOW to attend to any matters of non-compliance with management plan or the project permits ▪ Take enforcement action if required, in compliance with Environment Act.
Ministry of Health	▪ Oversight of compliance from public health perspective ▪ Occasional field inspections of the operation (at least once per year) ▪ Approval of any changes to management plan ▪ Receive annual report and monitoring data ▪ Direct MOW to attend to any matters of non-compliance with management plan or the project permits ▪ Take enforcement action if required incompliance with Public Health Act.
Community and Interested Parties	▪ Complain to MOW if operation is having off-site effects or is observed to be operating incorrectly ▪ Participate in consultation regarding any significant proposed changes to the management plan ▪ Encourage and participate in waste reduction initiatives
Cook Islands Investment Corporation	▪ Ownership of the Facility ▪ Approve management and contract structure ▪ Approve gate fees ▪ Plan for and acquire rights to land for expansion and/or replacement of facilities

1.3 Document Control and Review

This management plan is a controlled document, which means a series of “controlled copies” are updated whenever the Master Copy is updated.

Responsibility for maintaining this document lies with the Implementing Agency under the ADB Loan Agreement dated 24 September 2001, which is the Ministry of Works. The Ministry of Works holds the Master Copy and is responsible for ensuring that:

- the management plan remains relevant and up-to-date
- amendments are approved by the appropriate authorities
- controlled copies are updated
- a record is kept of changes to the management plan

The Landfill Manager shall review this FMP annually and identify if any changes to the FMP are required. These changes may be due to technical improvements in equipment, as a response to complaints or problems, response to changes in environmental regulations, due to efficiency improvements provided that environmental performance is not compromised. Any desired changes to be proposed in writing with justification by the Landfill Manager and require approval from the Ministry of Health and the Environment Service.

As well as the Master Copy held by the Ministry of Works controlled copies are held by:

- Controlled Copy 1 - Ministry of Works (Working Copy)
- Controlled Copy 2 - Ministry of Health
- Controlled Copy 3 - Environment Service
- Controlled Copy 4 - Recycling Operational Contractor (Refer Section1.5)
- Controlled Copy 5 – Landfill Operational Contractor
- Controlled Copy 6 – Waste Acceptance Controller

Controlled Copies can be distinguished from other copies as Controlled Copies have a red ink stamp on the cover with the words “Controlled Copy”. Any copy without the red ink stamp is not a Controlled Copy.

Approval of the Environment Service and Ministry of Health is required for any material changes to the management plan. The Ministry of Works will also consult with other interested parties and local communities who may be significantly affected by any proposed change to the management plan.

Operational contracts may need to be adjusted due to changes to the management plan. For these reasons it is recommended that review of this management plan should be timed to coincide with the expiry of operational contracts. Sufficient time should be allowed for the management plan review process to be completed prior to calling for tenders as the management plan will be a key component of the specifications for those contracts.

1.4 Acknowledgments

We wish to acknowledge the following groups and people for their helpful comments and assistance with preparing this management plan:

- Waste Management Project Steering Sub-Committee
- Waste Management Project Steering Committee
- Mathilda Miria-Tairea – CIWMP Project Manager
- Teresa Manarangi-Trott – Consultant to MOW
- Rene Nooapii – MOW
- David Greig – City Design Ltd

1.5 Reference to Recycling Facility

At the time of writing this first issue of the Rarotonga Waste Facility Management Plan, the construction of the entire Recycling Facility (including Hazardous Waste Storage Facility) has been deferred to a later date. Therefore, all references in this document to the Recycling Operational Contractor or any part of the Recycling Facility shall be disregarded until such a time that Recycling Operations begin at the Rarotonga Landfill site. Once Recycling Operations begin, a new revision of the management plan will be issued to include all current facets of Recycling Facility operation and interaction with other operational contractors.

All operational contractors must be aware of any temporary measures and site operational procedures instigated by the Landfill Manager until the Recycling Facility is constructed.

Some facilities will not be constructed at the time of Issue 1 of the management plan but will be required to operate the facility (e.g. toilet facilities). The Landfill Operations Contractor and Waste Acceptance Controller will supply their own temporary facilities to an equivalent standard to those outlined in this management plan (or an alternative arrangement agreed upon with the Landfill Manager).

The Landfill Operational Contractor will be responsible for maintaining the area designated to the Recycling Operational Contractor until the Recycling Facility is constructed. This maintenance will include (but is not limited to) removal of all noxious weeds and prevention of ponding.

Appendix 1.1

Terms of Reference

TERMS OF REFERENCE

1. Background

1.1 The Government of the Cook Islands has negotiated a loan from the Asian Development Bank (ADB) of about US$2.0 million for the design and construction of solid and liquid waste disposal facilities for Rarotonga and Aitutaki.

1.2 The total cost of the Project is estimated at NZ$6.0 million (US$2.8 million), including NZ$4.3 million (US$2.0 million) capital cost for Rarotonga and NZ$1.4 million (US$0.7 million) capital cost for Aitutaki. The cost also includes NZ$0.3 million (US$0.1 million) for the service charge on the ADB loan during construction. Financing will be through an ADB loan and Government counterpart funds. The ADB loan is estimated at NZ$4.2 million (US$2.2 million) and provides for 70 percent of the total Project cost. The Government will finance the balance of about NZ$1.8 million (US$0.9 million), comprising land acquisition, taxes and duties, local salaries and the cost of local office accommodation.

2. Objectives

2.1 The principal objective of the Project is to facilitate sustainable and appropriate waste management practices in Rarotonga and Aitutaki. The Project will contribute to the achievement of the longer-term goals of safeguarding public health and the environment, supporting private sector participation in waste management practices. The project combines the three principal thrusts of policy improvement, capacity building and investment in physical facilities.

2.2 Specific Project objectives are to:

- Ensure sustainability of waste management services.
- Improve the standards of waste management to protect public health and the environment.
- Increase public awareness on waste disposal practices.

3. The Project

3.1 The Project will provide appropriately designed solid waste disposal facilities and septage lagoons for Rarotonga and Aitutaki to satisfy demand for the next twenty years. The facilities will incorporate modern-day environmental control systems to protect the surrounding areas from potential environmental impacts. Both sites will have groundwater monitoring wells.

3.2 The Rarotonga landfill disposal site and facilities will occupy approximately 1.8 hectares (4.5 acres) within a valley system on the north-western side of the island. The site is within an inland valley that has been cultivated in the past but has since reverted to secondary growth forest. Site facilities include security fencing, gate landfill compactor, material press for crushing waste, and a small amenities building. A surface water diversion drain also will be built. The landfill is designed with engineered control systems, including sub-drains, landfill liner and leachate and landfill gas collection and removal systems.

3.3 The Aitutaki landfill facility is located in the Taravao District in the south-central part of the island. The site is thickly vegetated and surrounded by agricultural land. Total land area required is about 0.9 hectares (2.25 acres). The landfill site will be fenced and access will be through a security gate leading from an access track. The landfill facility will comprise a disposal site with engineered control systems as on Rarotonga, a material processing building and a solid stockpile mound. A small landfill compactor, material press for crushing, and a refuse collection truck will be provided. Surface drainage will also be provided.

3.3 On Rarotonga, the septage lagoons will be located next to the landfill and will cover 0.4 hectares (1 acre). The facilities on Aitutaki will also be located next to the landfill and also will occupy 0.4 hectares (1 acre). Both facilities will be fenced, properly engineered and include two lined lagoons, connecting pipework, an underground drainage system, and a filtered effluent disposal system. They both make provisions for insect control.

3.4 The project will be completed over 15 months with detailed engineering design to start in October 2002. Construction will commence at the beginning of March 2003 on Rarotonga and April 2003 on Aitutaki respectively. All work will be completed and assets commissioned by the end of January 2004.

4. Project Components

4.1 Rarotonga (Vairauara Ki-Uta-Heather Quarry Arorangi) Waste Management Site The Project's physical components in Rarotonga and Aitutaki comprise the construction of a solid waste landfill facility, recycling centre and septage treatment facility at Arorangi.

4.2 The scope of work comprises:

- Civil engineering works including land clearance;
- Site excavation, stockpiling and compaction works, construction of site perimeter drains, valley diversion drainage culvert and ancillary structures;
- Construction of landfill subdrain system;
- Earthworks for septage lagoons;
- Geo-composite landfill and lagoon liner systems;
- Leachate and treated septage collection systems;
- Landfill gas system;

- Installation and development of groundwater monitoring wells;
- Provision of security gate and fencing; construction of recycling shed and office;
- Remediation of adjacent landfill "dump" facility through excavation and removal of buried waste materials and placement into the new landfill facility.
- Supply of plant and equipment, including landfill compactor, leachate collection tank, material crusher/press and recycling containers.
- Construction of septage treatment facilities to include 2 lined lagoons, connecting pipework, an underground drainage system, and a filtered effluent disposal system including provision for insect control.

4.2 Aitutaki (Taravao) Waste Management Site

The Project's physical components in Aitutaki comprise the construction of a solid waste landfill and recycling centre and septage treatment facility, and include:

- Civil engineering works including land clearance; site excavation, stockpiling and compaction works;
- Construction of site perimeter drains and access road; construction of landfill and septage lagoon liner systems, leachate and treated septage collection systems;
- Earthworks for landfill and septage lagoons;
- Landfill gas system;
- Installation and development of groundwater monitoring wells;
- Placement of foundation materials; provision of security gate and fencing;
- Construction of recycling shed and office.
- Supply of plant and equipment, including landfill compactor, refuse collection vehicle, leachate collection tank, material crusher/press and recycling containers.
- Construction of septage treatment facilities to include two lined lagoons, connecting pipework, an underground drainage system, and a filtered effluent disposal system including provision for insect control.

5. Management and Implementation

5.1 The Executing Agency will be the Ministry of Finance and Economic Management (MFEM), which will act in conjunction with the Office of the Prime Minister's Aid Management Division (AMD). Ministry of Works (MOW) will implement the Project. A Project Steering Committee (PSC), which includes the Financial Secretary and the Secretary of MOW, has been established under the chairmanship of the Chief of Staff of the Office of the Prime Minister (who is the Head of AMD) to oversee and coordinate all project activities.

5.2 The PSC will ensure appropriate liaison among agencies involved in project implementation. The private sector, traditional leaders and the Environment Service are represented on the PSC. The Mayor of Aitutaki will represent Aitutaki Island Council

(AIC). A subcommittee of PSC, comprising the Secretary of MOW, the Financial Secretary, and the Chief of Staff of OPM will oversee and coordinate all project activities, and ensure appropriate liaison amongst the agencies involved in project implementation.

5.3 A Project Management Unit (PMU) headed by the Project Manager, who is a member of the MOW's staff has been established in MOW. Two Local Project Management Consultants (Engineer and Administration respectively) and a Waste Systems Engineer from the Engineering Consulting team will assist the Project Manager. An Engineering Consulting Team will carry out design, procurement, construction, commissioning and training functions will report to the Project Manager. A small group of secretarial and support staff will be included in the PMU.

5.4 The PMU will be responsible for initiating and managing the Project according to schedules and deadlines established. Its main responsibilities will be to:

- Formulate and operate systems for Project management, including procedures for planning, monitoring, control and reporting.
- Plan, program and co-ordinate the implementation of the Project to achieve the requirements of the implementing schedules.
- Procure engineering services, civil works contracts, materials and equipment and ensure that all contracts are awarded and completed on time.
- Oversee the engineering design work and ensure that construction is adequately carried out.
- Monitor and control Project implementation, including the preparation of quarterly progress reports. These would include details of Project costs (actual against budget), progress and quality aspects, with recommendations on appropriate actions to resolve issues that may impede Project implementation.
- Ensure that all documentation for ADB loan disbursements have been provided and that local counterpart funds are available to the Project and released on time. This will be undertaken in co-ordination with the Executing Agency
- Coordinate environmental monitoring of the Project in consultation with the Environment Service.

6. Staffing and Consultants

6.1 A Project Manager will head the PMU and will be responsible to the Secretary of MOW who will be the Project Director and the Waste Management Project's Steering Committee. One international specialist and government staff will support the Project Manager. A team of international and local consultants will provide project management and engineering services. The Government through international competitive bidding will contract the consultants.

6.2 In addition, Government will provide administrative and secretarial services, assistance with the preparation of Project accounts and technical environmental inputs to the Project. The following local staff positions are proposed:

- Environment Officer (seconded from Tu'anga Taporoporo).
- Finance Assistant.
- Administrative and secretarial support staff.

7. Terms of Reference for Engineering Consultants

General

7.1 The Engineering Consultants' tasks shall include the detailed design and supervision of construction of landfills and septage lagoons in Rarotonga and Aitutaki, preparation of environmental assessments, preparation of bid documents for civil works and for the procurement of equipment, assisting in establishing standard tendering and bid evaluation procedures, assisting in evaluating bids, commissioning and training, preparation of operating manuals, as described in these terms of reference, and other tasks as designated and assigned by the Project Manager.

7.2 The Engineering Consultants shall be responsible to the Project Manager, and shall coordinate closely with other members of the Project Management Unit, including the Project Management Consultants (Administration & Engineering), and the representative of the Environment Service. The Engineering Consultants shall, however, be solely responsible for the interpretation of all data and information received, and for physical surveys, design and construction supervision services, environmental assessments, preparation of bid documents, preparation of manuals, and for all findings and recommendations in their reports. The Engineering Consultants shall also provide for the Waste Systems Engineer with the following specific tasks below.

(a) Waste Systems Engineer

7.3 The Waste Systems Engineer will assist the Project Manager and the Environment Service to build their capacities in developing and implementing landfill and septage treatment operation and monitoring programs, developing best waste management practices, and formulating franchise agreements and operating contracts to waste management services. Specific tasks include the following:

7.4 The Terms of Reference for the Waste Systems Engineer will not necessarily be limited to the specific tasks, but shall include the following:

- Assist with formulating and awarding contracts for operating waste management facilities;
- Devise and implement standard procedures for operating and monitoring landfills;
- Ensure the smooth transition to contractual management of landfills during the commissioning of Project facilities;
- Establish waste handling and emergency control procedures;
- Develop a "best practices" manual for landfill operation and monitoring;

- Identify hazardous waste and evaluate their quality, characteristics and location
- Recommend appropriate methods of hazardous waste storage, transportation and disposal.
- Research appropriate methods and strategies for the prevention of pollution from specified materials, and develop educational fact sheets on available methods of pollution prevention
- Recommend on the introduction and enforcement of appropriate hazardous waste control regulations, standards and practices.
- Assist in extending and developing the legislative and regulatory framework for waste management to support the National Waste Management Plan and identify areas where further capacity building and technical assistance may be required.
- Assist with the design and assessment of a pilot waste segregation project.
- Assist with the preparation of remediation strategies for existing dump-sites.
- Assist with the preparation of a Waste Management Policy.
- Prepare a National Waste Management Plan (Plan) to include solid and liquid waste management, the plan ought to include a definition of waste that covers sludge and septage.
- Include in the Plan the prohibition against discharge of liquid waste, sludge, or septage to both land and waters of the Cook Islands, unless treated to acceptable levels in accordance with Public Health and Environment Service's requirements.
- Include in the Plan minimum standards of treatment that are required for specific waste streams (e.g. domestic wastes, industrial waste, agricultural wastes), particularly when these discharges enter inland and coastal waters.
- Prepare amendments to the Public Health Regulations to specifically require- periodic inspections of operating septic tank systems by Public Health Department personnel and require periodic pumping of septage from all septic tanks. Include appropriate enforcement and penalty procedures be identified in the Plan.
- Develop a water quality monitoring program that may be jointly implemented by the Ministry of Works, Ministry of Health and Ministry of Marine Resources. This activity should be coordinated with the monitoring and enforcement activities of Ministry of Works and Environment Service. Provide basic training in the use of water quality monitoring program.

(b) Field Investigations

7.5 The Engineering Consultants shall carry out all necessary field investigations, including topographic surveys, substrata investigations, and hydrological investigations, to supplement existing information.

(c) Designs, Specifications, Pre-qualification and Tendering, and Award of Contracts

7.6 The Engineering Consultants shall prepare detailed designs, technical specifications, and cost estimates for civil works and for the supply of materials and equipment. A brief report, describing the principal features of the designs, options considered, and reasons for adopting the design approach, shall be submitted for the approval of the Project Manager prior to the issuance of tender documents. Cost estimates shall clearly indicate the local currency and foreign exchange cost components. Cost estimates shall show estimated quantities and estimated unit prices, shall make adequate provision for physical and price contingencies, and shall indicate the basis of estimates and calculations.

7.7 The Engineering Consultants shall prepare prequalification, tender, and contract documents for civil works, and for the supply of materials and equipment in accordance with the requirements of the Government and of the Asian Development Bank (ADB). In conjunction with the Project Management Consultants, the Engineering Consultants shall assist in establishing standard tendering and bid evaluation procedures, evaluating and reporting on prequalification submissions and bids received, making all necessary submissions and reports to ADB, and in awarding contracts, in accordance with procedures acceptable to the Government and ADB.

(d) Environmental Impact Assessments

7.8 During the design of the Project works the Engineering Consultants shall, in consultation with the Environment Service, prepare environmental assessments for a statutory 30-day period of public display and comment. The Engineering Consultants shall assist in assessing the comments received, and shall report on the implications of the comments received. The consultants shall make practicable and reasonable modifications to environmental assessment, and to their designs, as may be necessary in the light of comments received.

(e) Construction Supervision

7.9 In conjunction with the Project Management Consultants, the Engineering Consultants shall supervise contractors in the execution of all Project works. The Engineering Consultants shall carry out site inspections as necessary for the control of Project works, and shall assist in monitoring and recording the progress of Project works. The Engineering Consultants will monitor the environmental impacts of construction activities, and will identify appropriate remediation measures where necessary. The Engineering Consultants will be responsible for checking the accuracy of contractors' claims, before referring them to the Project Management Consultants and the Project Manager. The Engineering Consultants shall ensure that as-built drawings are prepared for all Project works.

(f) Commissioning, Evaluation of the Performance of Project Works, and Training

7.10 The Engineering Consultants shall assist in commissioning and evaluating the performance of the completed facilities, and shall provide training for landfill and septage lagoon operators, waste collection operators, and staff of MOW, AIC, and the Environment Service in effective landfill operation, equipment operation, waste handling, and dealing with hazardous and intractable wastes. The Engineering Consultants shall prepare detailed operation and maintenance programs and manuals, including initial operating budgets, for all the Project components, taking into account the recommendations and "best practice" manual prepared by the Waste Systems Engineer.

(g) Scheduling and Reporting

7.11 The Engineering Consultants shall submit brief monthly progress reports to the Project Manager, summarizing progress achieved, difficulties encountered, and issues to be resolved.

8. Data, Services, and Facilities to be provided to the Consultants

8.1.1 MOW will provide the Engineering Consultants with all available feasibility study reports, data, physical surveys, maps, and plans.

8.1.2 MOW will provide the Engineering Consultants with office space and secretarial and administrative support in the Ministry of Works headquarters building, through the Project Management Unit. A motor vehicle purchased under the Project shall also be available for day to day operations of the Project. The Engineering Consultants shall make their own arrangements for any additional office space, support services, transportation, and accommodation that may be necessary.

9. Engineering Consulting Services

The Engineering Consulting services required for the Project are listed below.

(a) Project Management

Waste Systems Engineer (International) – 4 person months

(b) Design

Civil Works Design Engineer (International) - 3.5 person months
Hydrological Specialist (International) - 1.5 person month
Design Technician (Local) - 3 person months

(c) Supervision

Civil Works Construction Manager (International) - 2 person months
Construction Supervision Technician (Local) 10 person months
Surveyors (Local) – 1 person months

2.0 Site Operation

2.1 Key Principles

The effectiveness of this facility is not only dependent on the overall design of the facility but on how it is operated. The operational contractors will observe the following general principles of operation:

- Good Housekeeping – Keep a clean, neat and orderly facility.
- Staff Training – All operations personnel will be familiar with each piece of equipment (how it works and what function it is to perform). They will then be able to spot possible failures or, if and when failures do occur, they can pinpoint the trouble and act to correct the failure in the shortest possible time.
- Routine Maintenance –Establish a routine service and maintenance schedule for each piece of equipment.
- Reference Material – Keep this management plan and all manufacturers' catalogues, manuals, blueprints etc available on site for ready reference.
- Record Keeping – Operating and maintenance records will be kept for each piece of equipment and actions, with emphasis on taking action if unusual incidents or faulty operating conditions occur.
- Spare Parts – Maintain a spare parts inventory for each piece of equipment.
- Safety – Observe good safety procedures.
- Plant and Equipment - Must be in sound condition and any oil leaks that may occur must be rectified immediately. Refuelling must be carried out with due care and every measure taken to avoid a spillage.
- Economy and Efficiency – Continually review practices and procedures to minimise costs without compromising environmental standards.

2.2 Administration

The Ministry of Works has overall responsibility for the management and operation of the facility. The actual staffing, including the possible use of external contractors, will be determined after some operational experience has been gained (Refer to Section 2.6). All staff and contractors engaged at the site shall be aware of the requirements of this management plan, with copies of this plan and the ES Permits (Refer Section 2.9) kept on site at all times for their familiarisation.

2.3 Review and Consultation

2.3.1 Peer Review

A peer reviewer who is independent of the management and operation of the site, experienced in landfill design, construction, management and monitoring, and is recognised as having such experience, knowledge and skill as necessary, and approved in writing by the ES and the MOH will be appointed to review the following 6 months after the end of the contract maintenance period and thereafter on an annual basis:

- Landfill management including leachate and nuisance control.
- Septage pond operation and management.
- Compliance with ES Permits.
- Stormwater and leachate management.
- Special waste disposal.
- Waste acceptance procedures.
- Monitoring results, records and interpretation of results.
- Construction Quality (following initial landfill construction).
- Project budget for construction in forthcoming years.
- Efficiency of void volume utilisation and estimated remaining life of the landfill.

2.3.2 Liaison Group

It is the intention of the MOW to provide information of the landfill operation and development and listen to concerns and ideas from the community. Prior to waste being deposited at the site, an invitation will be sent to local residents and other interested parties to join a liaison group. This group will be convened by the MOW and will meet at least once per year and when important issues need to be discussed.

2.4 Hours of Operation

The Landfill will accept waste from 9.00 am to 3.00 pm Monday to Friday and 9.00 am to 12.00noon Saturday. Refuse acceptance at the landfill outside of these hours shall be by special arrangement. The opening hours will be reviewed after 6 months operation and adjusted if necessary to reflect customer demand and efficient operation. This review shall thereafter be undertaken annually. In special circumstances, these hours may be extended to cater for peaks in waste production and emergency events. The landfill will be closed whenever weather or other conditions make its operation unsafe or impracticable. Such closures will be advertised on local radio stations.

Landfill operation hours (as distinct from the gate opening hours above) shall be such as to ensure the volume of refuse coming into the site is appropriately disposed of in the landfill, but will generally be between sunrise and sunset, six days a week.

2.5 Disposal Charges

A current schedule of disposal charges will be displayed at the landfill office.

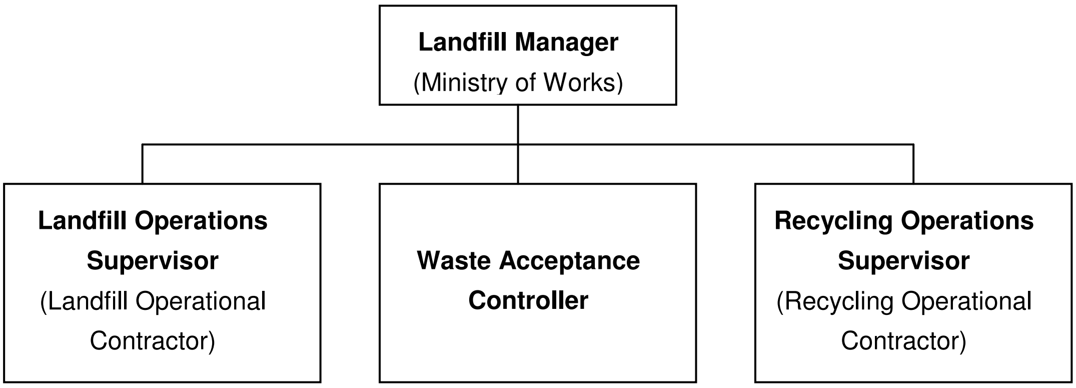
2.6 Site Staffing

All staff and contractors engaged at the site must attend the annual training session run by the Landfill Manager regarding the requirements of the management plan (Refer Section 2.6.2).

All investigations, design, supervision of construction, operation, monitoring and aftercare will be undertaken by suitably qualified personnel experienced in such works, or works of a similar nature, and to the satisfaction of the permit authority (Cook Islands Government Environment Council and Environment Service).

The management structure for the complete facility is shown in Figure 2-1. The main criterion is that there is a responsible person on site during all opening hours to collect fees, issue receipts, direct customers, check waste acceptability and observe the discharge of waste. There needs to be a pool of staff trained to undertake all of these functions to cover sickness and holidays. The staffing requirements shall be reviewed in the light of operational experience.

Figure 2-1 Rarotonga Landfill and Septage Ponds Management Structure



The physical areas of responsibility on site of the Landfill Operational Contractor and the Recycling Centre Operational Contractor (Refer Section 1.5) are identified in Figure 2-2. In these areas the nominated contractor has responsibility for:

- Health and Safety
- Ensuring compliance with the management plan, ES Permits and general good practice
- General housekeeping

A contractor may not store materials or conduct activities in another contractor's area unless this is approved in writing by the Landfill Manager.

Construction works may be undertaken on the site from time to time by third parties engaged by the MOW. These activities must have prior approval from the Landfill Manager, who shall consult beforehand with the contractor who has responsibility for the area in question.

2.6.1 Landfill Manager

An appropriately experienced person will manage the operation of the landfill, septage ponds and recycling operation. It should be noted that this is not necessarily a full time role. Responsibilities of the Landfill Manager include:

- Ensuring that the Contractors comply with the quality standards specified in their contracts.
- Weekly inspection of the facilities to ensure that they are being operated in compliance with the management plan, permit conditions and otherwise in accordance with good practice.
- Receive weekly or monthly records from operator, update and maintain records, provide input to credit control for invoicing.
- Coordinate annual inspection of equipment by Contractor and repair where necessary. Evidence to be provided to MOW of inspection by Contractor and repair.
- Run at least one training session per year for all operational staff covering the requirements of the most recent version of this management plan.
- Receive, investigate and respond to complaints, including directing contactors to take any remedial measures that are reasonably necessary.
- Plan for, secure budget, and contract major items of construction (eg Side liner lifts, additional facilities and landfill extensions).
- Plan for and undertake required environmental monitoring.
- Convene liaison committee at least annually and ensure that minutes are taken and distributed to participants.
- Set gate fee in consultation with the CIIC
- Measure the actual refuse compacted density actually achieved on six monthly basis.
- Compilation of an annual report on the operation of the above as described in Section 7.7.5.
- Prepare monthly, half-yearly and annual reports for incorporation into the Ministry of Work's monthly, half-yearly and annual Report.

Figure 2-2 Areas of Responsibility

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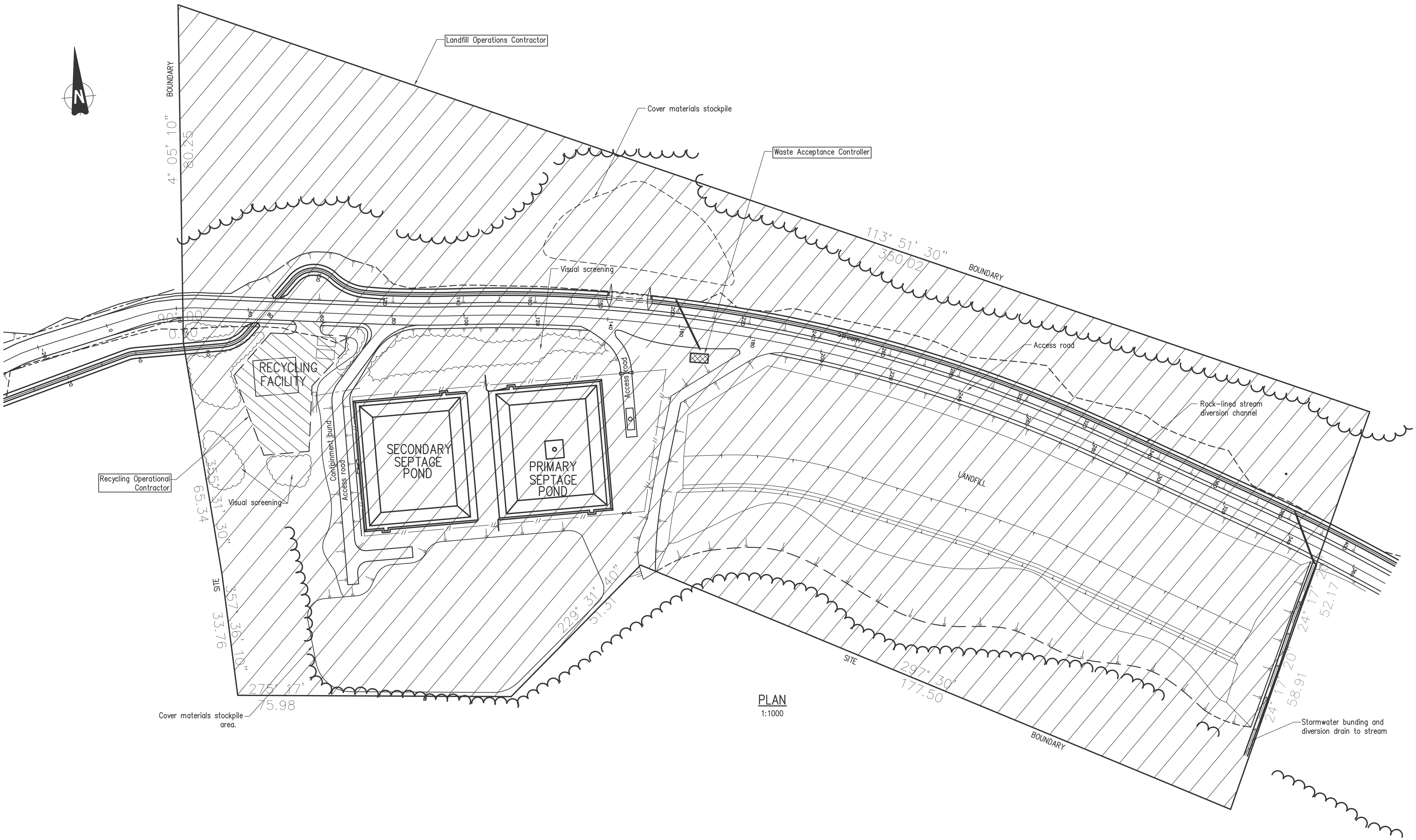

RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
ISSUE 2 – FACILITY OPERATION

Figure 2–2:
AREAS OF RESPONSIBILITY

CAD Ref: K:\Dept_49\Projects\4964312 – COO Waste Management Project\CAD\Working\Rarotonga Management Plan\Issued\04.12.22\ Figure2-2_rev2.dwg   Last saved: Wed, 22 Dec 2004 02:37 pm

2.6.2 Landfill Operational Contractor

As detailed in Figure 2-2, the Landfill Operational Contractor is responsible for the operation, management and maintenance of the majority of the site – excluding the recycling facility area. The Landfill Operational Contractor shall be responsible for all aspects of supplying, maintaining and operating the mobile plant required for the landfill.

A suitably experienced and qualified person (Refer Section 5.3 CAE Landfill Guidelines) will be appointed by the Landfill Operational Contractor as the Landfill Operations Supervisor. The appointment of the Landfill Operations Supervisor will be subject to the approval of the Landfill Manager. The Landfill Operations Supervisor will be responsible for the day-to-day management, operation and maintenance of the landfill and septage ponds, and shall ensure compliance of appropriate aspects of the management plan. The Landfill Operations Supervisor will be responsible for:

- Direction of site traffic
- Fielding general enquires relating to the Landfill and Septage Ponds
- Windblown litter collection
- Nuisance Control
- Reporting relating to the Landfill and Septage Ponds
- Inert fill separation
- Refuse spreading, compacting and covering of working face
- Proper covering of the working face at the end of the day
- Provide training for any other Landfill and Septage Pond Operational staff
- Safe interaction of the quarry and landfill operations
- Ensure safe operating practices and adhere to the site Health and Safety Plan.

2.6.3 Waste Acceptance Controller

The duties of the WAC may be assigned to other staff if a different staffing structure is adopted. For instance waste disposal fees maybe paid at the MOW offices in which case the WAC will not need to collect fees but will collect a ticket or inspect the receipt provided by the MOW. A person shall always be designated during all landfill opening hours to fulfil the WAC duties of inspecting, accepting, and rejecting loads. This role could be undertaken by landfill operational staff who have other duties provided they are always present on site in a position where they can easily see vehicles entering the site and can interview the driver. The Waste Acceptance Controller will be responsible for:

- Unlocking and locking of site gates at the beginning and end of each day

- Ensuring waste loads are roadworthy and covered
- Waste acceptance screening
- Septage acceptance screening
- Fee collection (additional charge for uncovered loads)
- Ensuring all collected fees and receipts are accounted for and are given to the Landfill Manager on a monthly basis
- Providing the Landfill Manager with a summary of the quantities of each waste type received on a monthly basis
- Collection of litter from roads entering the site.

The Waste Acceptance Controller must be present on site during all working hours.

2.6.4 Recycling Centre Operational Contractor

(REFER SECTION 1.5)

As detailed in Figure 2-2, the Recycling Centre Operational Contractor is responsible for operation, management and maintenance of the recycling facility area. However, it should be noted that the amenities (Refer Section 3.4) in this area are to be made available to ALL staff and visitors on the site.

A suitably experienced and qualified person will be appointed by the Recycling Centre Operational Contractor as the Recycling Centre Operations Supervisor for the day-to-day management and operation of the Recycling Centre, and shall ensure compliance of appropriate aspects of the management plan. The appointment shall be subject to the approval of the Landfill Manager. The Recycling Centre Operations Supervisor will be responsible for:

- Fielding general enquires relating to the Recycling Centre
- Reporting relating to the Recycling Centre
- Implementation of recycling procedures and exporting of recyclable products
- Providing training for all Recycling Centre staff
- Maintenance, cleaning and housekeeping of the Recycling Centre, site office and all related amenities
- Providing consumables (excluding food) for the site office amenities

If the Recycling Centre Operational Contractor wishes to use any part of the site outside his area of responsibility (Refer Figure 2-2), he must request permission from the Landfill Manager. The Landfill Manager will consult with the Landfill Operations Supervisor before making a decision.

2.7 Training

All landfill operations site staff will be required to have an understanding of the principles of landfill and septage pond management. All Recycling Centre operations staff will be required to have an understanding of the principles of Recycling Centre management (Refer Section 1.5).

Adequate opportunities will be identified for all site staff to upgrade their training in the following areas:

- Emergency Response Procedures.
- Waste acceptance procedures.
- Hazardous waste identification.
- Accidental hazardous waste acceptance.
- Effective use of personal protection equipment.
- Plant and equipment maintenance and operation.
- Hazard identification and reporting procedures.
- Health and safety for customers, contractors and visitors.
- The effective use of litter screens.
- Rodent and bird control.
- Refuelling procedures.
- Leachate management.
- Septage Pond management
- Landfill gas risks and operational procedures.
- Dust control and suppression.
- Septage receiving facility and septage truck washing.
- First Aid

2.8 Health and Safety

2.8.1 General

A site health and safety plan (HSP) will be prepared by the Landfill Operational Contractor for the landfill and septage pond activities and will adhered to by the Landfill Operational Contractor, the Recycling Centre Contractor (Refer Section 1.5) and Waste Acceptance Controller. This Plan will also be adhered to by other contractors and any other persons entering the site.

The management, workforce, contractors and visitors are to be made fully aware of the existence of the site safety regulations and the need to observe them at all times.

These regulations include instructions on:

- Speed limits – The speed limit on site will be 10km/h, including on the private road through the site to the quarry.
- Personal protective clothing
  - (a) Landfill Operations Staff – All staff will wear enclosed steel capped shoes and high visibility vests when outside the landfill office.
  - (b) Recycling Centre Operations Staff – All staff will wear enclosed steel capped shoes and high visibility vests at all times (Refer Section 1.5)
  - (c) Waste Acceptance Controller – Will wear enclosed steel capped shoes and a high visibility vest at all times.
  - (d) Site Visitors – All visitors will be recommended to wear enclosed shoes and required to stay within 3m of their vehicles.
- Uneven landfill surface – There is a significant risk of vehicles overturning on the landfill surface if the landfill operator does not adequately maintain the surface. Therefore, the following measures will be undertaken by the landfill operator:
  - (a) Maintain a well compacted and level landfill surface in the area used for dumping by waste collection contractors and private waste dumping.
  - (b) Advise all truck drivers using the landfill that to ensure their personal safety they should not move their vehicles until their load has been substantially discharged and that they should not attempt to discharge waste with their vehicles on an uneven surface.
- Fire hazards – The Landfill Operations Contractor will ensure that no smoking occurs and no open flames are used within the landfill or septage ponds area (Refer Section 9.9).
- Health Risks of Septage – All staff (Landfill Operations, Recycling Operations and Waste Acceptance Controller) will be aware of the health risks related to working with septage (Refer Section 6.2).
- Personal Hygiene – All staff (Landfill Operations, Recycling Operations and Waste Acceptance Controller) will maintain a high level of personal hygiene.
- Inoculation – All staff (Landfill Operations, Recycling Operations and Waste Acceptance Controller) will be inoculated against Tetanus and Hepatitis by their respective employers.
- Mobile Plant – All mobile plant will be maintained to a standard appropriate for general road use of the plant and will have reversing ‘beepers’ installed.

- Accidents and Incidents – All accidents and incidents will be reported to the Landfill Manager as soon as possible. An accident is defined as an event that has caused injury to a person, damage or an adverse environmental outcome. An incident is defined as a 'near miss' event that could have caused a person injury, damage or an adverse environmental outcome. Incidents must be reported to the Landfill Manager so the event can be analysed and appropriate procedures adopted so as to avoid the incident re-occurring in the future.
- Personal noise exposure – All Landfill Operations staff using mobile plant and all Recycling Centre staff will use hearing protection as appropriate.
- Substances hazardous to health – All staff (Landfill Operations, Recycling Operations and Waste Acceptance Controller) will be made aware of the hazardous nature of some forms of waste (Refer Section 4.2.6).
- Emergency Response Procedures – The appropriate emergency service (fire or ambulance) will be contacted in the first instance of any emergency (Refer Section 9.2).
- Rockfall – Although the risk of rockfall is low due to highwall stabilisation during construction, a risk still exists. All staff and any visitors to the site will be made aware of the following:

  (a) No loitering within 6m of the highwall
  (b) No persons will be near the highwalls during quarry blasting (Refer Section 5.14)
  (c) Any person engaged in construction or operational activities with 10m of a highwall is to wear a hardhat whenever they are outside of a vehicle.

- Landfill Cell Construction – Refuse cells will be constructed according to Section 5.4 so as to minimise instability risks.
- Septage Ponds – All gates to the septage ponds will be locked when the area is unsupervised by Landfill Operations staff.

These regulations will be regularly updated.

Access to pump stations or any other underground chamber or trench is restricted to members of staff and contractors who are fully trained with health and safety procedures for confined space entry. There is a high risk of asphyxiation and explosion, therefore staff and contractor must have appropriate health and safety equipment. A Permit to Work (Refer Section 2.8.2) must be obtained before any confined space entry. Guidelines for working in confined spaces are included in Appendix 2.2 and an example of a confined space Health and Safety Plan is included in Appendix 2.3.

The following site staff will have undergone training and hold a current first aid certificate:

- At least one member of staff in the Recycling Centre
- The landfill compactor operator
- The Waste Acceptance Controller

Adequate measures will be adopted to ensure that a minimum of one member of staff holding a first aid certificate will be on the site at any one time during landfill and recycling centre operation.

2.8.2 Permit to Work System

A 'Permit to Work' system will be designed by the Landfill Manager and utilised by the Landfill Operations Contractor. Activities requiring a Permit to Work include, but are not limited to, the following:

- Hot work and electric work
- Confined space entry
- Work on the Highwalls (this activity also requires a Health and Safety Plan to be prepared)

2.8.3 Site Safety Board

A whiteboard in the Waste Acceptance Controller office will be permanently marked up as shown in Table 2-1.

Table 2-1 Site Safety Board Mark Up

Date	Hazard Location	Hazard Description

The Landfill Operations Contractor shall update this board weekly with a list of hazards that are currently encountered on site. Hazards listed on this board could include, but are not limited to, the following:

- Quarry blast notification
- Hazardous maintenance works
- Areas of active earthworks
- Unstable sections of Highwall

All visitors and other contractors entering the site will be made aware of this board and all the relevant hazards listed upon it.

2.9 Environment Service Permits

The landfill and septage ponds must be operated in accordance with the Project Permits issued by the NEC and any amendments to these permits. The Rarotonga Landfill and Septage Ponds Project Permit and ES Approval of Design Changes are included in Appendix 2.1.

2.10 Site Security

The Landfill Operational Contractor will be responsible for the security of the landfill area and the septage pond area (including the disposal area). The Recycling Centre Operational Contractor and Waste Acceptance Controller will be responsible for the security of Recycling Centre and the Recycling Centre Office (including any outdoor plant related to the recycling operations). All structures that require locking are shown in Figure 2-3.

The following structures will only be unlocked for maintenance, operation and/or monitoring purposes and will remain locked at ALL other times:

- All groundwater monitoring well heads
- Leachate Pump Station
- Leachate Pump Station Control Panel
- Leachate Pump Station Valve Chamber
- Rodding Chamber
- Treated Effluent Pump Station
- Treated Effluent Pump Station Control Panel
- Treated Effluent Pump Station Valve Chamber
- Sand Filter Kiosk
- Gate G2 (Personnel Gate on West side of Septage Ponds)
- Gate G3 (Personnel Gate on South-East corner of Septage Ponds)

The following structures (Refer Section 1.5) shall remain unlocked during the gate opening hours defined in Section 2.4:

- Recycling Centre (All external doors)
- Recycling Centre Office

Gate G1 (Vehicle access gate to the Septage Receiving Facility) will be unlocked during operational hours but is to be closed at all times except when a septage tanker is discharging its load.

The main entrance gate will be operated by both Operational Contractors and a key will be supplied to the Quarry Operator(s). The main entrance gate will be unlocked as required for landfill and quarry operations.

All locks, fences and gates will be maintained by the Landfill Operational Contractor for the duration of landfill and septage pond operation. Any vandalism discovered by the landfill or recycling centre staff will be reported to the appropriate authorities immediately and remedied as soon as practical.

Figure 2-3 Site Security

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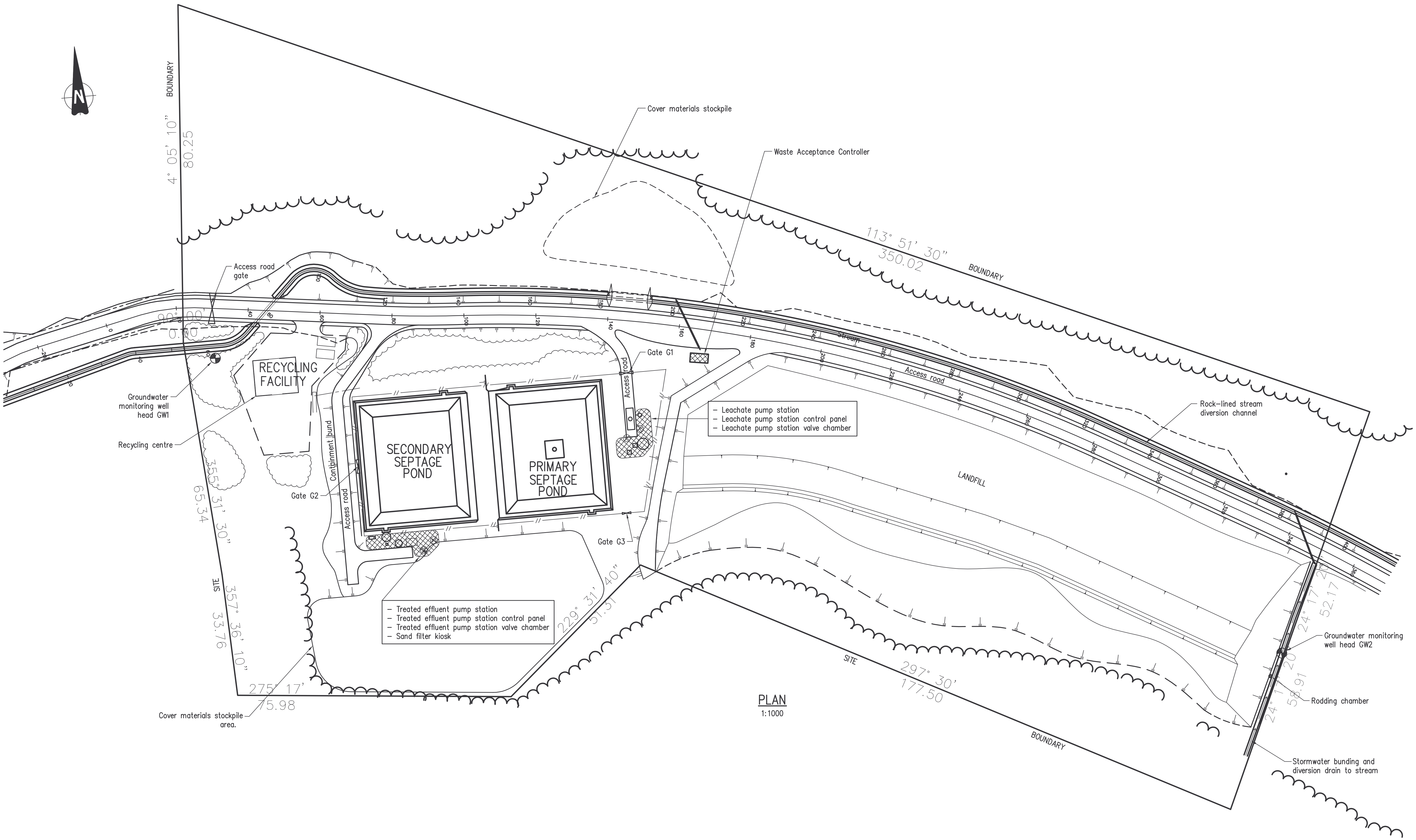


CAD Ref: K:\Dept_49\Projects\4964312 - COO Waste Management Project\CAD\Working\Rarotonga Management Plan\Issued\04.12.22\ Figure2-3_rev2.dwg Last saved: Wed, 22 Dec 2004 02:38 pm

RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
ISSUE 2 – FACILITY OPERATION

Figure 2–3:
SITE SECURITY

Appendix 2.1

Environment Service Permits

ENVIRONMENT SERVICE
TU'ANGA TAPOROPORO

19th September 2003

Project Management Unit – Waste Management Project
Ministry of Works
RAROTONGA

Kia Orana

RE: PROJECT MANAGEMENT UNIT – WASTE MANAGEMENT PROJECT (MINISTRY OF WORKS): RAROTONGA AND AITUTAKI LANDFILL PROJECT COST SAVINGS

Please be advised that your application for changes to the Rarotonga and Aitutaki Landfill Project was considered and approved by the Environment Council on the 18th September 2003.

We acknowledge receipt of your letter dated 28th August 2003, regarding some changes to the EIA Reports for the Rarotonga and Aitutaki Landfill Project.

The Tu'anga Taporoporo has reviewed your letter as well as the spreadsheet indicating the changes made either by reducing the scope or level of service or deferring that activity till the following year, when funding is available.

Please be advised that the Environment Council has approved only the item numbers in the spreadsheet, identified below:

P3 *Defer construction of whole Rarotonga Recycling Facility (including earthworks)*

P7 *Aerators Design (both Rarotonga and Aitutaki)*

N21 *All Aitutaki Roads in coral sand – ie exclude AP20 surfacing*

P6 *Complete road at Rarotonga site to design elevations in general fill material. (Assuming N22 is also incorporated)*

N22 *All roads narrower (Rarotonga savings incorporated with item P6)*

P3 *Defer construction of whole Aitutaki Recycling Facility (including earthworks)*

P13 *Aitutaki Landfill Shorter and wider and optimise excavation depth*

PO Box 371, Rarotonga, Cook Islands.
Phone: (682) 21256 / 24256 Fax: (682) 22256 Email: resources@environment.org.ck / ipukarea@environment.org.ck

N13	*Rarotonga – Lower first pond so that leachate pumps not necessary and provide more simple leachate recirculation system*

R9	*Raise Rarotonga Landfill Base to reduce rock excavation*

Should you require further clarification regarding the above please feel free to contact Mr Antoine Nia (Environment Officer - Projects).

Yours sincerely

Mr Ian Karika-Wilmott
CHAIRMAN
ENVIRONMENT COUNCIL

Mr Vaitoti Tupa
DIRECTOR
ENVIRONMENT SERVICE

ENVIRONMENT SERVICE
TU'ANGA TAPOROPORO

17th June 2003

Project Management Unit – Waste Management Project
Ministry of Works
RAROTONGA

Kia Orana

RE: PROJECT PERMIT: RAROTONGA LANDFILL AND SEPTAGE PONDS PROJECT, LAND VAIRAUARA-KI-UTA, PART SECTION 106, TOKERAU TAPERE, ARORANGI DISTRICT – RAROTONGA

We acknowledge receipt of your letter dated 29th May 2003, regarding the Environment Council's Consents dated 23rd May 2003, for the Waste Management Project for Rarotonga and Aitutaki.

The Tu'anga Taporoporo has reviewed your letter as well as the Consent conditions.

Please find attached the revised conditions outlined in the Project Permit, which will be monitored by the Environment Service.

Please be advised that the Environment Service will await the completion of the Landfill Facility Management Plan, which will be submitted to the Environment Council for further approval.

Should you require further clarification regarding your Project Permit please feel free to contact Mr Antoine Nia (Environment Officer - Projects).

Yours sincerely

Mr Vaitoti Tupa
DIRECTOR
ENVIRONMENT SERVICE

PROJECT PERMIT

Project Owner: Project Management Unit – Waste Management Project (Ministry of Works)

Issue Date: 17th June 2003

Project Title: Rarotonga Landfill and Septage Ponds Project

Project Address: Vairauara-Ki-Uta Part Section 106, Tokerau Tapere, Arorangi District - Rarotonga

Project Description: The design and construction of:
(a) An Engineered Landfill;
(b) Two Septage Ponds with aeration in primary and secondary pond;
(c) Recycling Center.

CONSENT: Pursuant to Section 31 of the Rarotonga Environment Act 1994-95, the Environment Council has approved the Project subject to the following conditions:

- **Definitions**

For the purposes of these conditions, the following definitions apply:

"Engineer" means Meritec Limited;

"Landfill Facility" means the Engineered Landfill, Septage Ponds and Recycling Center;

"Landfill Facility Management Plan" means a plan for the Landfill Facility that covers, describes or outlines all engineering design, operation management, monitoring and contingency plans, post closure care provisions and waste management;

"PMU" means the Project Management Unit of the Waste Management Project under the Ministry of Works;

"proposed work" means the work referred to in the **Project Description** above;

"site" means the site where the Landfill Facility is to be located, namely Vairauara-Ki Uta Part Section 106, Tokerau Tapere, Arorangi District, Rarotonga.

- **Further information and design confirmation**

1. That flow calculations for the Landfill Facility catchment based on predicted rainfall intensities using a rational formulae method (or similar) to allow assessment of stream channel capacity, surface flooding depth and inundation potential be included in the final Design Report prior to Landfill Facility operation.

2. That a Groundwater Model and Monitoring Plan be developed prior to Landfill Facility operation, to indicate potential contaminant flow direction, concentration and discharge areas from the landfill, septage ponds and leachate/septage irrigation field disposal.

3. That details of the treated leachate septage irrigation field disposal capacity be included in the final Design Report prior to Landfill Facility operation.

4. That the assessment of seismic risk to landfill and septage pond structure be included in the final Design Report prior to Landfill Facility operation.

5. That an assessment of planting/vegetation potential to stabilize or reduce large scale soil/debris movement in the upper parts of the valley walls surrounding the Landfill Facility be included in the final Design Report prior to Landfill Facility operation.

6. That changes to the designs as a result of Environmental Impact Assessment (EIA) consultations and public comments/meetings are taken into consideration and incorporated into the final Design Report and Landfill Facility Management Plan.

- **Plans required prior to operation**

7. Prior to the operation of the Landfill Facility, the following plans for the Landfill Facility shall be submitted by the PMU to the Tu'anga Taporoporo for approval:

   (a) a detailed Environmental Monitoring Plan prepared by the Engineer that ensures all sources of contamination of the natural environment is monitored appropriately. It is expected that this plan be developed in line with conceptual models of stormwater and groundwater flow.

   (b) a detailed Operations Monitoring Plan prepared by the Engineer that ensures all environmental management controls are monitored appropriately. This plan should also include provisions for:-

      i) A screening process of incoming septage to ensure it is of the correct quality.

      ii) Appropriate detention time of septage within the pond systems to ensure treatment is maximized.

iii) Aftercare management of the Landfill Facility in future, for example, vegetation needs for the proposed landfill capping.

(c) a Contingency Plan prepared by the Engineer, in the event of the failure of systems or structures, with such provisions to be included in the operations and maintenance plans. The Contingency Plan should include provisions to deal with breaches of the landfill and septage pond liner.

- **Construction and management**

8. That the PMU notifies the Environment Service at least 24 hours before the proposed work is to commence on the site.

9. That the Engineer together with the PMU supervises the proposed work and submits to the Environment Service within 10 days after the date the proposed work is completed, a report verifying the completion of the proposed work and verifying that all activities have been correctly complied with.

10. That the Engineer and the PMU notifies and advises the public, nearby residents and businesses prior to and during the construction phase of the project.

11. That the PMU continues ongoing public awareness and consultations, especially with the nearby community, on aspects of the Landfill Facility including the proposed work and operations.

12. That the Engineer train:
    (a) all site staff working at the Landfill Facility on the content and implementation of the Landfill Facility Management Plan prior to the Landfill Facility operation.
    (b) all Government Organisations involved with the operation and monitoring of the Landfill Facility.

13. That the approval is for the proposed work only and if the Engineer or PMU desire to deviate from or vary the proposed work, the approval of the Environment Council must be obtained to such deviation or variation.

This Project Permit is valid for a period of **18 months** from the Issue Date, and is not transferable.

Mr Ian Karika-Wilmott
CHAIRMAN
ENVIRONMENT COUNCIL

Appendix 2.2

Safe Working in a Confined Space

Safety in Confined Spaces

Safe Working in a Confined Space

TOGETHER to ZERO eliminating workplace deaths

OSH
OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR
TE TARI MAHI

Safety in Confined Spaces

Introduction

to confined space safety

OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR
TE TARI MAHI

Information Sheet No. 1

Working in a confined space is potentially one of the most dangerous of all workplace hazards. It's been calculated that working in a confined space is 150 times more dangerous than doing the same job outside.

Over the years, many workers, in a range of occupations, have lost their lives or suffered serious harm while working in tanks, vats, sumps, sewers, pits, traps and other types of confined space. All of these deaths and injuries could be averted by following the established procedures for such work and using proper personal protective equipment.

AUSTRALIAN STANDARD

The key document is AS 2865: 1995 *Safe working in a confined space*. This Standard was prepared to meet the need for requirements and procedures for the prevention of occupational illness, injuries and fatalities associated with persons entering and working in a confined space. It is designed not only to ensure that confined spaces are made safe for those entering them, but also to highlight the likely hazards associated with such work areas and the relevant safe work processes necessary to deal with those hazards.

The Standard emphasises the responsibilities for safety before entry and during the entire operation. Such responsibilities cover conditions of work for an organisation's own employees, as well as for any contractors or other persons on the premises. This Standard requires that adequate steps be taken to eliminate or control hazards. It also requires that all persons involved in the entry of a confined space be trained and instructed on the nature of the hazards and the precautions to be followed.

This Standard conforms with the hierarchy of controls set out in the Health and Safety in Employment Act 1992 and its use is endorsed by the Occupational Safety and Health Service. It is recommended that this Standard form the basis of procedures adopted in all industries where work is performed in confined spaces.

WHO NEEDS THIS INFORMATION?

Industries where work has to be undertaken in a confined space include:

- Chemical industries
- Telecommunications
- Underground services
- Food and beverage industries
- Construction,
- Energy industries,
- Railways.
- Shipbuilding and repair

This set of information sheets provides general, non-technical information on safe working in a confined space, and includes examples of accidents. It is intended to supplement the Standard. As well as assisting employers, some of these sheets may be useful as employee information and for training purposes.

OTHER INFORMATION

There is a large literature on the subject of work in confined spaces. AS 2865 lists various key documents that were consulted in the development of the Standard, and articles on aspects of the subject are published in health and safety journals, in New Zealand and overseas. Manufacturers and suppliers of safety equipment also provide relevant information.

Every industry and place of work needs to have all the technical information relevant to the work carried out in confined spaces, and to document its procedures fully. If expertise is not available to do this within the organisation, it is recommended that assistance be sought from a suitably qualified consultant.

Safety in Confined Spaces

Essential facts

on confined space safety

OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR TE TARI MAHI

Information Sheet No. 2

Serious accidents have occurred and continue to occur to people working in confined spaces. A significant number of such accidents are fatal, and multiple fatalities are not uncommon. If you must work in a confined space, you must observe special precautions.

WHAT IS A CONFINED SPACE?

A confined space is any area that is not intended for human occupancy and that also has the potential for containing a dangerous atmosphere. A confined space:

- is large enough for a worker to enter and perform assigned work;
- has limited entries and exits;
- may contain a hazardous atmosphere, arising from chemicals, sludge or sewage;
- is constructed so that anyone who enters could be asphyxiated or trapped by walls or floor that converge to a small cross-section, such as a hopper;
- contains a material, such as sawdust or grain, that could engulf anyone who enters.

Examples of a confined space include a tank, vessel, vat, silo, bin and vault. Others which are less obvious can be equally dangerous, e.g. open- top tanks and vats (particularly where heavier than air gases or vapours may be present), closed and unventilated rooms, or furnaces and ovens in which dangerous accumulation of gases can build up because of restricted air circulation even though the door is left open.

This information sheet is not a substitute for special training on confined space entry, but gives an overview of the common hazards and suggests where specialist information and standards may be found.

AUSTRALIAN STANDARD

The recommended document for establishing good systems and practices is the Australian Standard AS 2865 :1995 *Safe working in a confined space*. The Standard was prepared for the prevention of occupational illness, injuries and fatalities associated with persons entering and working in confined spaces. It is designed not only to ensure that confined spaces are made safe for those entering them, but also to highlight the likely hazards associated with such work. Besides covering the conditions of work for an organisations own employees it also covers contractors or others on the premises.

Additionally, by complying with the Standard, the principles for eliminating or controlling hazards will be compatible with obligations under the Health and Safety in Employment (HSE) Act 1992.

LEGAL RESPONSIBILITIES

The Health and Safety in Employment Act 1992 places responsibilities on employers, employees, people who hire contractors, and others.

If you are an employer

Under the HSE Act, if you are an employer then you must take all practical steps to:

- Ensure your employees are safe while at work;
- Identify all hazards in a place of work; and
- Where the hazards identified are significant- eliminate, isolate or minimise your employees exposure to the hazard.

You must involve your employees in the development of procedures for identifying and managing hazards in your business, including emergency plans.

If your employees are still exposed to significant hazards, you must provide protective clothing and equipment for them and monitor their exposure to the hazard.

In addition, you must inform your employees about the hazards in your business and the results of any monitoring of their health or the work environment. You must take all practicable steps to train your employees to work safely, or have them supervised by someone with adequate qualifications and/or experience.

You must also take all practical steps to ensure that while your employees are at work, they do not harm other people.

If you are an employee

You must not do anything at work that will harm yourself or other people.

If you engage a contractor

You must ensure that the contractor, the contractor's employees and any subcontractors are not harmed while doing any work (other than residential work) that the contractor was engaged to do.

RISK ASSESSMENT

The Standard emphasises that the employer must ensure that a risk assessment is undertaken by a competent person before work begins. As far as practicable, the assessment should be in writing and take into account at least the following:

- the work required to be done;
- the range of methods by which the work can be safely done;
- the hazards involved and the associated risks;
- the actual method selected and plant proposed; and
- emergency and rescue procedures.

The assessment should be revised whenever there is evidence to indicate that it is no longer valid. It does not, in itself, make the job safe, but is dependent for its effectiveness on the persons concerned carrying it out. (For a sample risk assessment, see Appendix C of the Standard.)

SECURING A SAFE ATMOSPHERE

Employers should ensure that a competent person assesses the atmospheric contaminants before entry.

The initial assessment should include, where appropriate, an analysis of the atmosphere for contaminants and oxygen. Forced ventilation with a blower fan is the preferred method of displacing contaminated air.

After withdrawing the plant from service, precautions should be taken to prevent potentially dangerous materials from entering it while workers are inside. The safest course is to completely disconnect the space from every other item of plant and to seal off every inlet pipe. If isolation is not possible, and the space is likely to be seriously re-contaminated during occupancy, continuous ventilation and continuous monitoring is called for.

All materials— solids, liquids or gases — which are liable to present a hazard inside the space must be removed. Potentially dangerous materials may be trapped in sludge, scale or behind loose linings or brickwork.

Special care should therefore be exercised and cleaning processes adopted to meet each set of circumstances. Where it is necessary to enter the space to remove sludge etc. which is liable to give off dangerous fumes, suitable breathing apparatus and, where practicable, a safety line should be worn, and rescue equipment and personnel should be available.

With steam-volatile substances, steam cleaning will be found to be effective to remove residues. Solvents and neutralising agents may be employed before steam cleaning to remove non-volatile materials. Areas containing flammable vapour may be purged with an inert gas (e.g., nitrogen, carbon dioxide) to prevent formation of explosive mixtures with air. The inert gas should then, in turn, be purged with air and the area thoroughly tested for oxygen deficiency.

Atmospheric testing should always be considered before entering a confined space. All spaces where flammable gases, toxic vapours and abnormal oxygen content are suspected should be tested before an entry permit is issued. Contractors, who may be unaware of any special risks, should be included in the permit to work system.

Atmospheric testing using an explosiometer is not normally satisfactory for assessing possible toxic risks. In most cases, the safe explosive limits (LELs) are many times higher than the toxic limits. Testing is a highly technical skill and it is particularly important that the competent person with this responsibility is thoroughly trained.

Gas detection instruments should be recalibrated at regular intervals, e.g. weekly, or in certain circumstances, each time the instrument is used. This is to check for sensor poisoning and sensor response.

RESPIRATOR CHOICE

The responsible person controlling the operation should aim to achieve a safe atmosphere where respirators are not necessary. If this is not practicable, an appropriate respirator should be considered. The decision of what constitutes an appropriate respirator depends on the likely concentration of contaminant and/or oxygen in the confined atmosphere.

- Air-purifying respirators offer no protection against oxygen deficiency or oxygen enrichment. However, they can remove contaminants from the air you breathe. To safeguard against dusts, fumes and mists, respirators must be fitted with particulate filters. To protect against chemical vapours and gases, respirators must be fitted with the appropriate chemical filter. Some atmospheres require respirators fitted with a combination of both.
- Negative-pressure air purifying respirators should *not* be used when the concentration of contaminant exceeds ten times the maximum recommended level for unprotected breathing. Atmospheric monitoring is requirement for this decision.
- Air-supplied respirators help protect against temperature extremes and heavy concentrations of dust fumes and chemical vapours.
- Airline respirators can protect against oxygen deficiency when used with a small self-contained compressed air supply (sometimes called an escape bottle or a self-rescue bottle).
- A self-contained breathing apparatus is useful in atmospheres that can't be tested or where the suspected contaminant has not been identified. This form of protection is the only acceptable type for emergency rescue personnel.

PERMIT TO WORK

A permit is essentially a document which sets out the work to be done and the precautions to be taken. Having completed the assessment above, the permit specifies work methods. It predetermines a safe procedure and a clear record that all foreseeable hazards have been considered in advance. An example of a typical permit is shown in Appendix G of the Standard. This permit is to be signed by a person with the authority to represent the employer.

A common error is to omit contractors from the permit system. Contractor's employees may be completely unaware of the risks in an unfamiliar workplace. The responsibility in law is with the principal management to ensure a safe workplace. No person should enter a confined space without a permit from the employer.

ATMOSPHERIC TESTING

The standard emphasises that before a person enters a confined space, testing is carried out to ensure that:

(a) the confined space contains a safe level of oxygen;

(b) atmospheric contaminants in the confined space are reduced to a safe level;

(c) the confined space is free from extremes of temperature;

(d) the concentration of flammable contaminant in the atmosphere is 0% of the Lower Explosive Limit (LEL) if hot work is to be carried out, or 10% if cold work is to be carried out.

The employer should ensure that the atmospheric testing is carried out consistent with the risk assessment. If it is not practicable to provide a safe oxygen level, or safe level of air contaminant, suitable protective equipment, including air-supplied respirators are to be worn, as specified on the entry permit.

STAND-BY PERSON AND RESCUE CONSIDERATIONS

A stand-by person should be stationed at the entrance to the confined space to ensure that communication is constantly maintained when the risk assessment indicates that:

(a) there may not be a safe level of oxygen;

(b) atmospheric contaminants are present or may be present in concentrations above the safety exposure standards;

(c) there is a risk of fire or explosion;

(d) there is a risk of entrapment or engulfment;

(e) conditions outside the confined space threaten the safety of people inside, e.g. respiratory air supply, vehicles and weather.

RETRIEVAL EQUIPMENT

To facilitate entry into and exit from a confined space, it is essential to have a proper retrieval system for both workers and equipment. Proprietary systems are available consisting of a heavy-duty lifeline, tripod and personnel winch. Typically, a winch has a mechanical advantage of between 2:1 and 6:1, which makes it possible for a worker to be quickly extracted from the confined space should the need arise.

All equipment must be carefully checked before use. Harnesses or retrieval lines showing any signs of wear should not be used.

Employers should ensure that the appropriate rescue and first aid procedures and provisions are planned, established and rehearsed.

COMMUNICATION

It is essential to have an appropriate means of communication between the person working inside a confined space and the person stationed outside, whether by voice, rope tugging, tapping or by a battery-operated communication system specially designed for confined space use.

Note that radio frequency/wireless devices do not work effectively in confined spaces such as tanks or sewers, where there is metal or concrete shielding between the interior of the space and the outside.

Body alarm devices may be useful in a confined space where communication between workers and attendants is difficult. These are designed to sound if the wearer does not move during a specified period of time.

EDUCATION AND TRAINING

Training is necessary for supervisors, stand-by person, workers entering confined spaces and rescue personnel. In practice, some of these functions will be fulfilled by the same person, but it is important that everyone involved must be properly trained by a competent trainer. The training programme should include at least the following:

(a) the hazards of confined spaces;

(b) assessment procedures;

(c) control measures;

(d) emergency procedures; and

(e) the selection, use, fit and maintenance of safety equipment.

The employer should record the topics covered in the training and the names of trained employees.

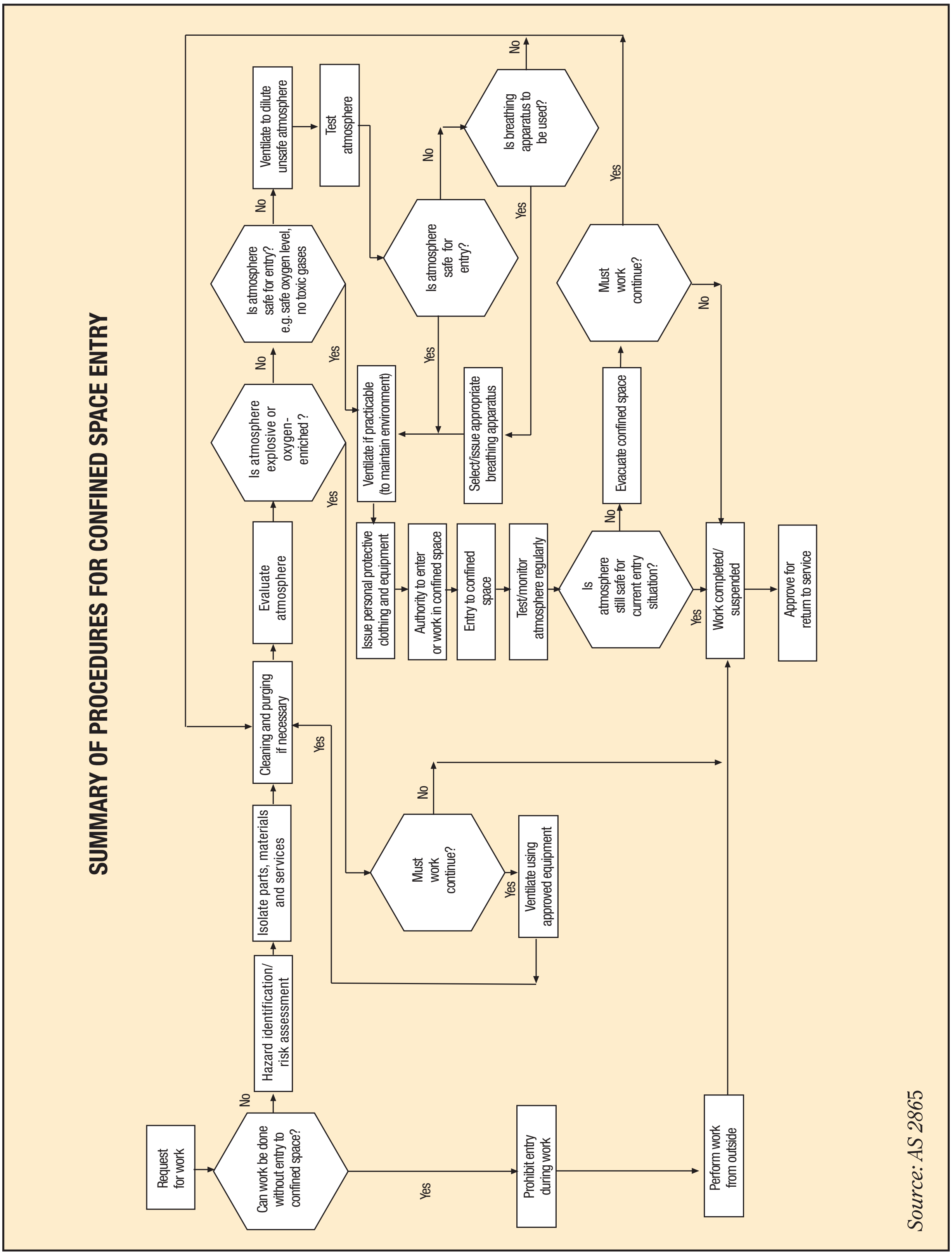
Safety in Confined Spaces

OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR
TE TARI MAHI

Summary of confined space
Entry procedures

Information Sheet No. 3



TOGETHER to ZERO eliminating workplace deaths

ISSUED BY THE OCCUPATIONAL SAFETY AND HEALTH SERVICE, DEPARTMENT OF LABOUR, WELLINGTON, NEW ZEALAND

OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR TE TARI MAHI

Confined space safety in Construction work

Information Sheet No. 4

The following information is reproduced from the OSH publication *Guidelines for the Provision of Facilities and General Safety in the Construction Industry* (pp. 52-53).

Legislation: HSE Act 1992

6. Employers to ensure safety of employees—Every employer shall take all practicable steps to ensure the safety of employees while at work; and in particular shall take all practicable steps to—
(a) Provide and maintain for employees a safe working environment;

(d) Ensure that while at work employees are not exposed to hazards arising out of the arrangement, disposal, manipulation, organisation, processing, storage, transport, working, or use of things—
(i) In their place of work; or
(ii) Near their place of work and under the employer's control;

"Confined spaces" are not limited to closed tanks with restricted means of entry and exit. Also included are open manholes, trenches, pipes, flues, ducts, ceiling voids, enclosed rooms such as basements and other places where there is inadequate ventilation and/or the air is either contaminated or oxygen deficient.

Before entry to any confined space it shall be tested to determine that there are adequate levels of oxygen present, and that dangerous amounts of flammable and or poisonous gases are not present. (Proprietary meters are available.)

No one is to enter any space if testing shows that the air is dangerous inside. Forced ventilation should be used to remove or dilute the gases and supply fresh air. The air shall be tested again prior to entering, and monitoring continued while work is being conducted inside the space.

TYPES OF CONFINED SPACE

Confined spaces may be inherently unsafe. Alternatively, different types of work being completed in the confined space may also make the atmosphere dangerous.

Some examples of confined spaces in which the work being done can make the space dangerous, are given below:

- Some painting work, and the application of certain adhesives, and liquids such as paint thinners. These can produce dangerous amounts of solvent vapour, which can cause dizziness and impair judgement. Such solvents are often flammable, so there is an accompanying risk of fire.
- The use of LPG appliances and petrol or diesel engines can lead to the build-up of poisonous carbon monoxide gas. There is also a risk of fire resulting from leaks.

Among the confined spaces that may be inherently hazardous are:

- Manholes, tunnels, trenches set in chalk soil, which can partly fill with carbon dioxide gas, displacing breathable air.
- Poisonous or flammable gases can collect in manholes in contaminated ground (e.g. near underground petrol tanks or refuse tips).
- In manholes, pits or trenches connected to sewers, there can be a build-up of flammable and/or poisonous gases and/or insufficient oxygen in the air.
- Sludges and other residues in tanks or pits, if disturbed may partially fill the confined space with dangerous gases.
- Rotting vegetation, rusting metal work, and similar natural oxidation processes may lead to an oxygen-deficient atmosphere inside the space.

PTO

ISSUED BY THE OCCUPATIONAL SAFETY AND HEALTH SERVICE, DEPARTMENT OF LABOUR, WELLINGTON, NEW ZEALAND

PRECAUTIONS

If work in a confined space could be potentially dangerous, entry shall be strictly controlled and detailed precautions taken.

Preferably employers should adopt an entry permit system, so as to ensure that employees and others are aware of the location of anyone required to enter confined spaces. As mentioned above, tests may be required to identify any dangerous amounts of flammable or poisonous gases.

Where the work being carried out could cause danger:

- The hazard should be kept out of the confined space. For example, petrol or diesel engines should not be used inside the space, but sited outside in a well ventilated area; and
- Paints and adhesives should be avoided which give off dangerous solvent vapours. (Use water-based adhesives where possible.)

  If these steps cannot be taken, then provide adequate ventilation (forced ventilation may be required), or mechanical extraction to ensure that fumes are expelled in a safe area free from potential sources of ignition.

Where the confined space itself may be dangerous (regardless of the work carried out):

- People who are required to work in or enter the space should receive training and instruction in the precautions to be taken inside the area.
- At least one person should be stationed outside the space to keep watch and communicate with anyone inside.
- Rescue harnesses should be worn by all those inside the confined space, with a lifeline attached to the harness and a suitable winching mechanism at or near the point of entry.
- Rescue procedures should be included in the training of workers. Reliance should never be placed on one person alone to lift injured or unconscious people out of a confined space during rescue, unless they are equipped with special lifting appliances. Rescue equipment, including emergency breathing apparatus, should be available near the entrance at all times.
- No attempt should ever be made to clear fumes or gases with pure oxygen.
- Appropriate respiratory protection shall be provided where the results of monitoring assessment indicates that a safe atmosphere cannot be established.

FURTHER INFORMATION

AS 2865-1995 *Safe working in a confined space*

Occupational Safety and Health Service, *Approved Code of Practice for Safety in Excavation and Shafts for Foundations*

Safety in Confined Spaces

Confined space safety in Ship building and repair

OSH
OCCUPATIONAL SAFETY & HEALTH SERVICE
DEPARTMENT OF LABOUR
TE TARI MAHI

This information sheet provides additional information to employers and employees involved in ship building, repair and breaking. The term shipbuilding means any work on any size vessel, including cargo ships, tankers, pleasure boats (especially fibreglass and aluminium), barges, tug boats, ferries and military vessels. This information sheet should be read in conjunction with Australian Standard AS2865:1995 *Safe working in a confined space*.

EXAMPLES OF CONFINED SPACES

There are many shipboard spaces that obviously fall into the category of a confined space, and others which are not so obvious. Some shipboard confined spaces are:

- Spaces which must be entered through small hatchways or access points;
- Cargo tanks and holds;
- Cellular double-bottom tanks;
- Duct keels;
- Ballast and oil tanks;
- Void spaces.

Because of their nature, other spaces such as cabins and walkways may also become a confined space when other work restricts access, or work is being carried out that may give rise to fumes.

HAZARDS OF MARITIME CONFINED SPACES

The hazards of enclosed and confined spaces are a daily rather than an occasional concern in the marine industry.

- Shipbuilding is an intensive, high-skilled industry. It involves the simultaneous application of dozens of industrial processes to the vessel, including solvent-based spray painting, welding, gas-freeing, product tank cleaning, fuel loading, ship fitting, burning, abrasive blasting, etc.
- The sizes and types of vessels may vary with every repair or construction job. The products carried as cargo may vary.
- Since tanks on vessels generally directly adjoin each other (as opposed to being separated by significant spaces as in land-based petroleum terminals), the attention to adjacent spaces is important to the repair activities. Poorly planned hot work applied to one side of a bulkhead might initiate a fire or explosion on its other side.
- Despite differences between the risks of confined spaces and enclosed spaces, many enclosed spaces are treated with the same respect as confined spaces on ships. Large petroleum product tanks and vessel pump rooms may be very easily entered and exited. The enclosed space may even be designed for extended occupancy. However, they are always treated with extreme caution as potential sources of fire, explosion, or places that can quickly incapacitate and kill.
- The turnover of vessels in shipyards involves severe time limitations. Unlike a land-based facility, no matter how limited the repair, the entire vessel is out of service and no part of it earns money for its owner.
- Ship repair, causing most of the serious accidents, involves a one-way transfer of an active vessel to an inactive state. In eliminating the hazards delivered with the vessel, the shipyard's responsibility changes to monitoring the hazards introduced during the repair process.

PTO

SAFETY GUIDELINES

Shipyards need to have suitably trained people who have access to appropriate testing equipment to inspect, test and certify confined spaces as safe for the work planned. Only after such inspection and testing can a permit for entry and work be issued.

With permit-required spaces, work at making physical changes that can eliminate the permit-required criteria. These changes may include:

- Installation of permanent ladders, forced ventilation systems and permanent internal barriers;
- Additional or better barriers;
- Valves that can eliminate potential atmospheric, energy or uncontrolled material problems from being introduced to the space;
- Better lockout and isolation equipment.

In short, work to eliminate the possible conditions associated with the space that might quickly incapacitate and kill the entrants.

Acknowledgement: Abridged from: E.J. Willwerth, Maritime Confined Spaces, *Occupational Health & Safety*, January 1994.

Safety in Confined Spaces

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Accidents
in confined spaces

Information Sheet No. 6

The following cases from the investigation files of the Occupational Safety and Health Service illustrate the varying nature of some fatal and near-fatal accidents involving entry of workers into confined spaces.

- A worker was overcome by fumes and died when he climbed into a degreasing bath containing the solvent 1,1,1-trichloroethane, in order to remove articles which had fallen out of a wire mesh basket into the bottom of the bath. He had ignored instructions not to enter the bath, was unsupervised and did not use any respiratory protective equipment.
- The preparation of a large steel tank for use in electroplating required it to he lined with acid-resistant ceramic tiles which were to be stuck to the bottom and sides of the tank using a solvent-based adhesive. Prolonged breathing of the solvent vapour caused the unsupervised worker to slump unconscious into the bottom of the tank. He was working late and alone after normal working hours in order to finish the job, and he was not using respiratory protection. His body was discovered the next morning.
- A worker was cleaning out a paint vat in a hurried job, where the vessel was urgently needed for a different paint batch. Safety precautions regarding entry into the vat were completely ignored. The worker was overcome after prolonged inhalation of the paint solvent and was not noticed for some time, even though activity continued in the vicinity. Attempts at resuscitation were unsuccessful.
- An unsupervised worker died while cleaning out sludge from a freezing works holding tank which was used to store bulk blood. No tests were carried out on the atmosphere within the tank and no precautions of any sort were taken during the work. In fact, cleaning could easily have been done from outside the vessel either through the top hatch or a side manhole, using high-pressure hoses.
- A worker dropped his pen into a small mixing vessel at a paint manufacturing factory and entered the vessel in order to retrieve it. The action was a spontaneous unsupervised entry into an area which was never entered in the normal course of events. The worker was rendered unconscious on inhalation of the paint solvent vapour, and although he was discovered and was helped out and revived, he suffered serious and apparently permanent damage to his brain and central nervous system.

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Paint fumes ignite in Fishing vessel maintenance

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TE TARI MAHI

Two serious accidents involving workers spray painting in fishing vessels highlight the need for owners of vessels, contractors and employees to be aware of the dangers of working in confined spaces such as the holds of vessels.

WORKER BURNED TO DEATH

Two employees were spray painting in the hold of a fishing vessel. Because of the fumes, they took breaks at five-minute intervals.

A portable light being used kept falling off its attachment. The skipper of the vessel decided to hold the light, at a spot where the worker had spray painted. An explosion occurred. The worker was enveloped by the ensuing fire and burned to death.

The investigating inspector's report concluded that the accident was caused by the confined space being filled with solvent vapours, with no mechanical ventilation or extraction provided to vent the space.

When the vapours mixed with oxygen and the mixture was at the lower explosive limits, it is most likely that a spark from the short-circuiting light lead raised the mixture to local ignition temperature and ignited the vapours and an explosion/fire occurred.

SERIOUS BURNS TO HEAD AND ARMS

Two employees were spray painting in the fore peak chain locker on a fishing vessel. One of the employees left the vessel, while the other started to pack up the gear. As he stepped over a hatch to switch off the power, a light he was using fell and broke, igniting the paint fumes and causing serious burns to the worker's head and arms.

The accident occurred because the worker had been spray painting in a confined area with no means of mechanical ventilation to extract paint solvent fumes or introduce fresh air.

The paint was a 31% solvent mix, consisting of four solvents with a flash point range of less than 0°C to 36°C, with 64% of the solvent mix at less than 0°C flash point. With no air being extracted from the chain locker, there would have been no dilution of the solvent in the atmosphere.

The average solvent concentration in the chain locker was calculated at about 0.2% volume. As the solvent vapour density was higher than air, it would have tended to settle nearer to the floor, and the concentration would have varied with the distance from the floor.

A 75-100 watt light bulb breaking after an hour's use would have been hot enough to ignite the fumes.

PREVENTATIVE MEASURES

To prevent such accidents, these precautions should be followed:

1. Staff painting in enclosed spaces need to know the hazards of solvents from paints:

   (a) The hazard to health, i.e. asphyxia, skin damage, neurological damage.

   (b) The danger of a flammable mix occurring when adequate ventilation is not provided.

2. Electrical equipment such as light leads and cables need to be intrinsically safe. All other sources of ignition must be eliminated.

3. Mechanical ventilation must be provided to ensure fumes are diluted to a level well below the flammable limit. In the case of solvents that are heavier than air, the extraction system needs to remove vapours from floor level, allowing fresh air to be treated from above.

4. A confined space entry permit system should be adopted. It should take into account all the possible hazards likely to arise with work done in chain lockers or other confined spaces.

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5. An entry permit system should be used for all work to be performed in confined spaces, i.e. welding.
6. Vapour levels should be monitored while the work proceeds to determine the effectiveness of the venting and extracting procedures.
7. Suitable protective equipment should be provided and worn.
8. Suitable equipment must be on hand in the event of an emergency, i.e. fire extinguisher, rescue equipment.

Safety in Confined Spaces

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Entry into Septic and sewage holding tanks

Information Sheet No. 8

While working in a sewage holding tank, two workers were overcome by toxic gas and drowned in the sewage. There have been other fatalities following entry into such tanks and also in situations where improperly equipped individuals have attempted to rescue workers in distress.

Oxygen is depleted when sewage decomposes. Toxic and flammable gases such as hydrogen sulphide and methane are produced and can be trapped in the sludge at the bottom of the tank. When this sludge is disturbed, the trapped gases are often released into the atmosphere. High concentrations of hydrogen sulphide or lack of oxygen can cause unconsciousness and death.

Entry into septic and sewage holding tanks is extremely hazardous and suitable precautions must be taken. AS2865 *Safe working in a confined space* details the precautions to be taken during entry into confined spaces.

These precautions include, among other things:

- Test the air for oxygen as well as toxic and flammable gases.
- Use suitable breathing equipment in spaces that cannot be purged and ventilated.
- Provide safety harnesses and ropes.
- Have a second worker stationed outside the confined space.
- Have a person trained in artificial respiration.

Sewage and holding tanks should be designed so that cleaning, maintenance and repairs can normally be done from the outside. This will reduce the need for workers to enter these tanks.

Safety in Confined Spaces

Fire hazard in Enriched oxygen atmospheres

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Information Sheet No. 9

Three men working in a confined space were burned to death when hot welding slag ignited a worker's clothing.

Investigation showed that an enriched oxygen atmosphere had developed in the confined space because of a leaking rubber hose in an oxy-acetylene cutting torch.

When working with gas welding or cutting equipment in a confined space, all fuel and oxygen hoses should be inspected prior to work being started.

Oxygen and fuel hoses fed from a manifold system shall be disconnected when work is completed, either during a shift or after a shift. This will eliminate the possibility of a build-up of dangerous gas concentrations due to leaking hoses.

There are several things to remember prior to entry into a confined space:

- Test for oxygen content and the accumulation of hazardous gases;
- Provide adequate ventilation when welding or cutting is done; and
- Comply with the provisions for confined space entry set out AS2865.

It's important to know that clothing can be easily ignited and will burnt fiercely if it is saturated with oxygen. Oil and grease can ignite spontaneously in an enriched oxygen atmosphere.

Safety in Confined Spaces

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Worker in confined space Overcome by toxic fumes

Information Sheet No. 10

A 42-year-old maintenance fitter was overcome by toxic fumes while working in a confined space. He was in the process of painting the inside of an air receiver with a zinc-based paint.

Investigation of the accident revealed the following contributing factors:

- The injured worker had not been provided with appropriate training, instruction and information for entry into a confined space.
- The worker was not adequately supervised.
- A safe system of work was not provided.

Preventative measures in this case are as follows:

- Workers should be provided with suitable instruction, information and appropriate training.
- Workers should be adequately supervised.
- A safe system of work in accordance with AS 2865: 1988 *Safe working in a confined space* should be adopted.

Farmer collapsed and died after entering offal pit

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TE RATONGA ORANGA

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TE TARI MAHI

A self-employed farmer collapsed and died after descending into an offal pit to retrieve a grubber. Subsequent tests by the Occupational Safety and Health Service (OSH) found that the atmosphere in the offal pit was severely deficient in oxygen.

SUMMARY OF ACCIDENT

The offal pit was drilled nearly five weeks before the accident, but remained unused for three weeks.

The day before, the farmer had dropped two lamb carcasses into the offal pit, and by accident a grubber was also dropped into the pit.

The farmer and his adult son discussed how to retrieve the grubber. After considering a lasso method, they decided to use a ladder to descend into the pit. The ladder was lowered through the central opening and secured in place.

The farmer climbed down the ladder and recovered the grubber. He had climbed most of the way up, when he fell back down. The son realised the seriousness of the situation and called for help with a cellphone.

The volunteer fire brigade arrived and rescued the farmer from the pit. Ambulance officers and a doctor attempted to resuscitate him, but were unable to do so.

FURTHER TRAGEDY NARROWLY AVERTED

The volunteer firefighter who rescued the farmer from the pit had a narrow escape. He was lowered down on a rope and at about 2.5 metres down, he couldn't breathe and called out to be raised. Wearing a self-contained breathing apparatus set, he was then able to effect the rescue.

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OSH INVESTIGATION

As part of their investigation, OSH Health and Safety Inspectors carried out tests to establish the likely atmospheric conditions in the pit at the time of the accident.

The tests found that the oxygen concentration at the bottom of the pit was only 3%. This level of oxygen would not sustain life, with death occurring in a matter of minutes. The normal concentration of oxygen in the atmosphere is 21%.

HAZARD MANAGEMENT

Both the farmer and his son were aware of the hazards of offal pits. They thought it would be safe to enter because the pit was relatively new.

Farmers need to identify the hazards associated with entering confined spaces such as offal pits, water tanks, septic tanks, grain silos, milk vats and other similar enclosed spaces. The likelihood of an oxygen-deficient or toxic atmosphere in such areas may not be realised.

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Safety in Confined Spaces

Test yourself
on confined space safety

OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR
TE TARI MAHI

Information Sheet No. 11

How much do you remember about working safely in confined spaces? Take the following 5-minute quiz. If you get more than one answer wrong, go back and read the material again. This will help you learn all you can about how to protect yourself in confined spaces.

1. It's not necessary to lock out/tag out mechanical equipment before entering a confined space.
   True ☐ False ☐

2. Using a radio is the ideal way for an entrant to stay in touch with an attendant while working in a confined space.
   True ☐ False ☐

3. Entry permits are necessary only when a confined space is known to be dangerous.
   True ☐ False ☐

4. Air purifying respirators are the ideal choice for use against unknown hazards, oxygen deficiency, or toxic atmosphere in confined spaces.
   True ☐ False ☐

5. In an emergency, it's okay to enter a confined space without respiratory protection, a safety harness or a lifeline, as long as you'll be inside for only a few minutes.
   True ☐ False ☐

6. A self-contained breathing apparatus is the only form of protection acceptable for emergency rescue personnel.
   True ☐ False ☐

1. (False) Be sure to lock out/tag out mechanical equipment before entering a confined space. This can help prevent injuries from motors and other moving parts. 2. (False) A radio is only one communication option when voice or visual contact is impractical. Other options include hand or rope signals and a sound-powered telephone. 3. (False) An entry permit from a trained and authorised person is necessary to enter any confined space 4. (False) Air-purifying respirators offer no protection against unknown hazards, oxygen deficiency or enrichment, or highly toxic atmospheres in confined spaces. A better choice is a self-contained breathing apparatus (SCBA) or a supplied-air respirator combined with an SCBA. 5. (False) Even in an emergency, it's never permissible to enter a confined space without respiratory protection and a safety harness or a lifeline. 6. True. It's also useful in atmospheres that can't be tested or where the suspected contaminant has not been identified

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RECOMMENDED STANDARD

We recommend you purchase your own copy of AS 2865: 1995 *Safe working in a confined space* and keep it in this folder, together with any other relevant documentation.

The Standard is available from:

Freepost 1573

Standards New Zealand

Private Bag 2439

Wellington 6020

Phone: (04) 498-5991

Fax: (04) 498-5994

Price: $69.75 (Retail)

$55.80 (Members)

"Working in a confined space is potentially one of the most dangerous of all workplace hazards. It's been calculated that working in a confined space is 150 times more dangerous than doing the same job outside."

The information in this folder could save someone's life.

Appendix 2.3

Example Confined Space Entry H&S Plan

Example Confined Space Entry H&S Plan

This example Health and Safety Plan is taken from Manukau Waters ‘Health and Safety Plan for Consultants’. Manukau Water is a large water supply company in Auckland, New Zealand.

MANUKAU WATER

HEALTH AND SAFETY

CONFINED SPACES SAFE WORK SYSTEM

INDEX

CONFINED SPACES SAFE WORKS SYSTEM

1.0 OVERVIEW - WORKING IN A CONFINED SPACE

1.1 Foreword

The Health Safety and Employment Act 1992 and Regulations 1995 set out to promote the management of hazards in work places, by requiring employers to identify and control hazards that may cause harm, and for employees and others to take steps to ensure their safety and the safety of others.

1.2 Introduction

This document outlines Manukau Water's requirements, based on AS2865: 1995 for *Safe Working in a Confined Space.* All Contractors working for Manukau Water must comply with these procedures. Contractor's shall be responsible for supervision of their personnel and subcontractors to ensure that they strictly adhere to all applicable safety requirements written in this document. The basis of safe working is to recognise the hazard and to take appropriate steps to eliminate and control it in such a way that worker and public safety is maintained. This document aims to assist in hazard recognition and describes the safe working practices recognised by Manukau Water to deal with the identified hazards. It relates Wastewater and Stormwater drains and associated structures (pumping stations, tanks, outfalls, septic tanks, etc.).
Note that only personnel who have been adequately trained in safe procedures may enter confined spaces.

1.3 Definition Of A Confined Space

AS/NZS 2865:2001 defines a Confined Space as:

"An enclosed or partially enclosed space that is at atmospheric pressure during occupancy and is not intended or designed as a place of work, and Is liable at any time to

- Have an atmosphere which contains potentially harmful levels of contaminant;
- Have an oxygen deficiency or excess; or
- Cause engulfment; and
- Could have restricted means for entry and exit"

AS/NZS 2865:2001 also defines entry into a Confined Space as occurring when:

"A persons head i.e. the breathing zone, or upper body is within the boundary of the confined space"
In a practical sense, a confined space is any area that is not intended for human occupancy and that also has the potential for containing a dangerous atmosphere. Therefore it:

- will be large enough for a worker to enter and perform assigned work;

- will have limited entries and exits;
- may contain a hazardous atmosphere, arising from chemicals, sludge or sewage;
- will be constructed so that anyone who enters could be asphyxiated or trapped by walls or floor that converge to a small cross-section;

Confined Spaces include: pipes, shafts, ducts, manholes, pump stations and similar structures.

2.0 ENTRY PRACTICES

MANUKAU WATER REQUIRES THAT THE FOLLOWING PROCESS BE UNDERTAKEN FOR ENTRY INTO CONFINED SPACE:

2.1 An assessment of all risks be undertaken in the following order:

- Structural Integrity
- Entry and Egress conditions
- Flow Conditions
- Ventilation Provisions
- Atmosphere

2.2 An assessment of the equipment and manpower required for the entry

2.3 Completion of entry form

2.4 Sign off of Entry Form on completion

3.0 HAZARD IDENTIFICATION

NOTE: Hazards typically associated with underground structures are most commonly ascribed to wastewater systems, however stormwater systems are potentially just as dangerous and even underground structures associated with water supply should be treated with caution. Typical hazards and their associated risks are as follows:

3.1 Atmospheric hazards:

Toxic Atmospheres

- Common Sources:
  - Hydrogen sulphide from anaerobic sediments and sewerage.
  - Carbon monoxide from adjacent road traffic or petrol driven compressors.
  - Chemical discharges from industry.
  - Chemical spillage on roads.
  - Drycleaning fumes.
- Risks:
  - Poisoning, asphyxiation, disorientation.

Flammable Atmospheres

- Common Sources:
  - Methane from sediments and sewerage.

- Petrol fumes from urban surface drainage (eg. petrol station forecourt spillages).
- Chemical discharges from industry.
- Chemical spillage on roads.
- Risks:
  - Explosion, burns.

Oxygen Deficient Atmospheres
- Common Sources:
  - slow oxidation reactions of either organic or inorganic substances;
  - rapid oxidation (combustion);
  - the dilution of air with an inert gas;
  - absorption of oxygen by grains, chemicals or soils;
  - physical activity
  - Carbon dioxide displacement of oxygen following acidic rainfall percolation through limestone subsoil.
- Risks:
  - Asphyxiation.

Oxygen Rich Atmospheres
- Common Sources:
  - Leakage from oxygen supply fittings.
- Risks:
  - Fire hazard increases dramatically as combustion processes are much more ferocious.

Contaminated Atmospheres
- Common Sources
  - the presence of contaminants on surfaces or in the atmosphere in the form of solids, liquids, sludges, gases, vapours, fumes or particulates.
  - Manufacturing processes
  - Substances stored or by-products (for example, disturbing decomposed organic material in a sewer can liberate toxic substances such as hydrogen sulphide) while biological hazards such as bacteria, viruses or fungi may also be present
  - Operations performed in the Confined Space (for example, painting with coatings containing toxic or flammable substances, welding or brazing with metals capable of producing toxic fumes)

3.2 **Hydraulic Hazards:**

Flooding and Surcharge
- Common Sources:
  - Rainfall **anywhere** within the wastewater serviced catchment (even low intensity long duration events may cause problems in the lower catchment).
  - Downstream blockage.
  - Upstream works.
- Risks:
  - Drowning or physical injury.

High Flow Velocities

- Common Sources:
  - High discharges.
- Risks:
  - Loss of balance,
  - inhalation of aerosols.

3.3 **Structural hazards:**

- Common Sources:
  - Old structures with perished mortar joints,
  - corroded reinforcing,
  - root penetration,
  - unshored trenches.
- Risks:
  - Injury from falling masonry,
  - falling due to step-iron corrosion
  - collapse of trench walls.

3.4 **Health hazards:**

- Common Sources:
  - Infection via ingestion, inhalation, inoculation or skin contact.
- Risks:
  - Leptospirosis.
  - Cholera, typhoid, dysentery, hepatitis B, Salmonella, gastroenteritis, etc, as examples of
  - ingestion of enteric pathogens in faeces/urine.
  - Fungal skin infections.
  - Chemical irritation of exposed skin.

3.5 **Electric Shock**

- Common Sources:
  - Hand held electrical apparatus,
  - Mains powered electrical apparatus earthed to exposed metal.
  - Penetration of buried power cables by drill, pick, etc.
- Risks:
  - Electrocution,
  - secondary injury,
  - unconsciousness

3.6 **High Pressure Water Jets**

- Common Sources:
  - Sewer jetting lances for scale/sediment cleaning.
- Risks:
  - Inhalation of contaminated aerosol,
  - Inoculation of contaminant if played directly on exposed skin,
  - Eye or ear damage.

3.7 **Tools**

- Common Sources:
  - Hammers, nails, drills.
  - Concrete saw

- Pipe cutters
- Risks:
  - Accidental impact injury.
  - Abrasion

3.8 Noise

- Common Sources:
  - Mechanical equipment,
  - electrical equipment
- Risks:
  - Impaired hearing;
  - Long-term hearing loss.

3.9 **Other hazards:**

- Common Sources
  - Dislodged masonry or falling tools.
  - Moving Objects
  - Introduction of hazards into environment
  - Falling
  - Slipping from step irons,
  - step iron breakage,
  - slipping on slime coated surfaces,
  - stepping into uncovered manholes.
- Risks
  - Injury to persons below falling objects.
  - Direct injury due to fall,
  - Possible drowning due to unconsciousness
  - Infection due to open wounds

4.0 RISK ASSESSMENT

The Contractor must ensure that a risk assessment **(Appendix CS_1)** is undertaken by a competent person before work begins. As far as practicable, the assessment should be in writing and take into account the following:

- The work required;
- The range of methods by which the work can be safely done;
- The hazards and the associated risks;
- The actual method selected and the plant proposed;
- Emergency and rescue procedures;

This shall be combined with the entry Form **(see Appendix CS_2)** used in conjunction with the hazard provided, plus general safe work guidelines.

5.0 ENTRY FORM

5.1 The Entry Form is essentially a document that sets out the precautions to be taken. It predetermines a safe procedure and a clear record that all foreseeable hazards have been considered in advance. <u>No</u> person is to enter a confined space without an entry form that:

- Includes precautions or instructions necessary for the safe entry and execution of the work;
- Is provided to the person responsible for the direct control of the work in a confined space, and records which persons enter the confined space; and
- Confirms that the persons involved in the work are advised of, understand and comply with the contents of the entry form.

5.2 The atmosphere must have been tested to ensure that:

- The confined space contains a safe oxygen level (19.5 – 22.5%).
- The atmosphere contaminants in the confined space are reduced to below the relevant exposure standards.
- The confined space is free from extremes of temperature.
- The concentration of flammable contaminant in the atmosphere of the confined space is below 10% of its L.E.L. (Lower Explosive Level)

5.3 Information that should be on the entry form should include but is not to be limited to:

Location of Work	Equipment in use
Description of work to be under taken	Employees
Atmospheric testing results	Date and Time for validity
Understanding of rescue procedures	Stand by person
Conformance that gas is continuously monitored	Personal protective equipment in use
Signatures of work team stating that they understand all procedures to be undertaken for safe entry.	Isolation controls that are in place

Confirmation that the site has been exited safely and is fit for return to service.	

Note: See **Appendix CS_2** for a sample Entry Form

The Entry Form should state the date of its validity and should be revalidated whenever it becomes evident that the duration of work will involve one of the following

- A change in the person responsible for the direct control of the work in a confined space.
- A significant break in work continuity
- A significant change in atmosphere or work to be performed

The safety precautions shown on the following pages shall be implemented for Confined Spaces:

6.0 CONFINED SPACE ENTRY CONDITIONS

Pre-conditions for safe work

The following process must be followed prior to entry into any confined space.

(See process chart attached as **Appendix CS_3** for guidance.)

- Complete a risk assessment on the confined space, initiate entry form.
- Assemble and test safety equipment for “High Risk Entry”. Allocate equipment to dedicate workers.
- Ventilate proposed working area as appropriate prior to entry.
- Lower gas detector. Test atmosphere at descending intervals to ensure any air pockets containing gases are identified.
- Enter gas concentrations on entry form, and confirm if confined space is safe for entry.
- At least one 'Standby' person must be present during the entire period of work in the confined space. If the confined space is deep, has platforms / debris traps or consists of a chamber construction, there must be sufficient persons present so that a constant visual contact is maintained at all times.
- Standby employees should communicate with workers in the sewer environment at regular (2 minute) intervals to ensure all is well, and determine progress.
- The gas detector(s) must be with all personnel working in the sewer environment and must be on at all times. This may necessitate personal units.
- No smoking or naked flame allowed at any time in the hazardous area.

- All personnel must return to the surface immediately if: A gas detector alarms Standby person/s signals them to exit
  - rainfall begins in the catchment
  - personnel in the sewer experience nausea or dizziness
  - an accident or injury occurs

- Complete and sign off entry form.

- A Copy of this Entry Form must be kept on file (available for inspection if requested). Records should be kept for a minimum of one month and preferably longer (i.e. some records should always be available for inspection at all times).

7.0 CONFINED SPACES ENTRY RESOURCES

7.1 Basic equipment

The following basic equipment, precautions and resources shall be provided at the location of any proposed confined space entry.:

- First Aid Kit available
- Trained First Aider on site
- Overalls worn
- Safety Footwear worn
- Safety Helmet worn
- Communications from/to confined space established
- Cellphone/Radio available
- Ensure natural Ventilation
- Gas Detector available
- Resuscitation Equipment available
- Any specialist equipment or resources that are identified during the pre-entry hazard identification process.

7.2 Entry to spaces <1.5m deep

Entry may be undertaken with basic equipment as listed above

7.3 Entry into spaces >1.5m <3m deep

The following resources additional to the basic list shall be provided:
- Safety harness and line shall be worn
- Tripod (5:1 ratio winch) shall be available
- Emergency respirator available

7.4 Entry to spaces >3m deep

All the above resources plus:
- Tripod (5:1 ratio winch) shall be set up and used
- Emergency respirators must be worn

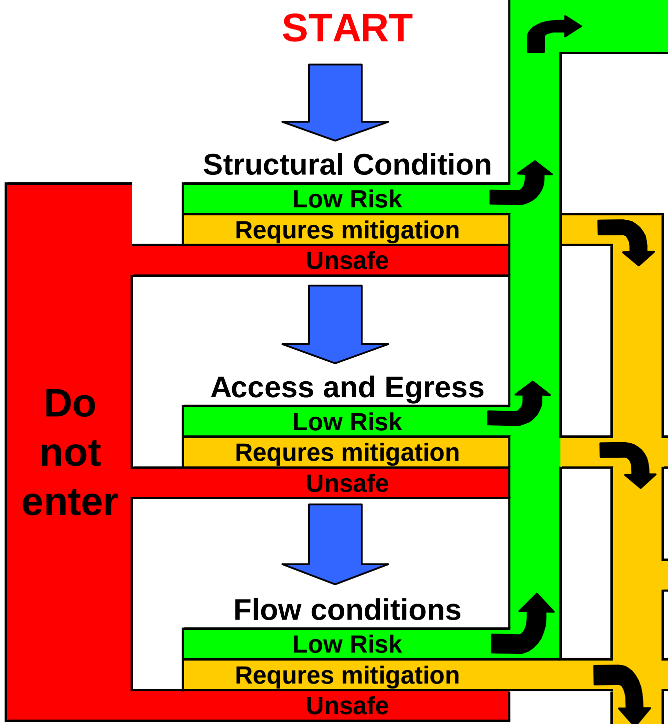
7.5 Entry when out of direct visual contact (any depth)

All the above resources plus:
- Helmet lamp worn
- Fixed safety line from entry to exit installed

7.6 Entry when atmosphere is unsafe (any depth)

All of the above resources plus:
- Full breathing equipment worn
- Mechanical ventilation equipment used

7.7 CONFINED SPACES REQUIREMENTS



	Conditior		
Safety Requirements/Equipment	Depth <1.5m	Depth 1.5m to 3m	Depth >3m
First Aid Kit			
Trained First Aider			
Overalls			
Gloves			
Safety Footwear			
Helmet			
Communication from/to confined space			
Cellphone/Radio			
Ensure natural ventilation			
Gas Detector			
Resuscitation Equipment			
Special Requirements			
Wear Safety Harness and Line			
Tripod (5:1 ratio winch) available			
Emergency respirators available			
Special Requirements			
Tripod (5:1 ratio winch) set up			
Emergency respirators worn			
Special Requirements			
Helmet lamp			
Fixed Safety Line entry to exit			
Special Requirements			
Full Breathing Equipment			
Mechanical Ventilation equipment			
Special Requirements			
Minimum Crew outside confined space	1	1	2
Manning Ratios (up:down) - sewer	1:1	1:1	1.5:1
Manning Ratios (up:down) - stormwater	1:1	1:1	1.25:1

8.0 CLEANING OF CONFINED SPACES

8.1 General.

The following general practices should be observed where practicable:

Whenever possible, cleaning shall be undertaken from outside the confined space.

Where this is not possible, initial cleaning should be performed from outside the confined space.

Each person entering the confined space should be provided with suitable protective suits, safety footwear, safety helmet with face shield (appropriate eye and face protection) and where necessary, an appropriate respiratory protective device. (NOTE: work involving compressed air, or a respiratory medium other than air, is classified as notifiable work)

Hose couplings should be of such a design that they are unable to loosen or be accidentally dislodged during operation.

8.2 Hydrojetting

General

The following general precautions should be observed when Hydrojetting is undertaken in a confined space.

- Hydrojetting should always be carried out by trained personnel.
- Warning signs complying with AS1319 and indicating that Hydrojetting is in progress should be displayed in conspicuous locations outside the confined space.
- The area affected by the Hydrojetting should be barricaded while work is in progress.
- Where there is a possibility of a flammable environment, the nozzle of the hydrojetting equipment should be earthed to decrease the generation of static electricity.
- Nozzle operators should have direct visual or audible communication with the pump operators.
- Removal of fluids from the confined space should be continuous during the operation.
- A high pressure/low volume gun should be used to intermittently clean, rather than operating continuously, thus allowing adequate replacement of air.

All high pressure cleaning equipment should be fitted with actuating devices which require positive effort by the operator, hand or foot, to keep the supply valve open. In addition, the following recommendations for hoses should be observed.

Hoses used for high pressure cleaning should have a bursting pressure of at least two and a half that of intended operating pressure.

Hoses should be tagged to indicate working pressure and age.

Hoses with broken exposed reinforcing wire should be disposed of immediately.

Care should be taken when laying out hydrojet hoses on the ground to avoid constant pulsation damage, especially from corners.

8.3 Steam Cleaning

Where a confined space is to be cleaned by steam, the following precautions should be observed.

- Where there is a possibility of a flammable environment, the pipe or nozzle of the steam hose should be bonded to the confined space enclosure to prevent the build up of static electricity (see also AS 1020).
- Where there is a possibility of a flammable environment in the confined space, steam temperatures should be significantly lower than the auto-ignition temperature of previously stored products.
- The confined space should be allowed to return to an acceptable thermal environment prior to entry.

8.4 Abrasive Blasting

Cleaning by abrasive blasting should only be undertaken where suitable air-supplied respirators are used and regulations for the particular jurisdiction are followed.

Consideration should also be given to the need to provide the following:

- Illumination and visibility adequate to allow safe working to continue.
- Suitable hearing protection against static hazard.
- Protection of the breathing air-line to the respirator.
- Escape equipment.
- Actuating devices that require positive effort by the operator to keep the blasting apparatus supply valve open.

8.5 Chemical Cleaning

In addition to creating toxicity hazards, chemicals used in cleaning operations may also be capable of producing a flammable atmosphere. Accordingly, the safety of the atmosphere should be re-evaluated after cleaning and prior to the commencement of further work. Appropriate safety data sheets should be available for all such chemicals/toxic substances.

9.0 EDUCATION AND TRAINING

All personnel working within or on a confined space shall have completed an approved training course dealing with entry to confined spaces and must be physically fit. The training programme shall include at least the following:

- the hazards of confined spaces
- assessment procedures
- control measures
- emergency procedures, and
- the selection, use, fit and maintenance of safety equipment

Training should be conducted by persons knowledgeable in all relevant aspects of confined space entry, hazard recognition, use of safety equipment and method of rescue. Confirmation of this training must be available in the form of photo ID cards.

Retraining at appropriate intervals must be included.

Training of each individual should be recorded (in addition to the individual photo ID cards).

Training should be evaluated and reviewed in consultation with relevant employees and subcontractors, in order to ensure that the contents of the training programme is clearly understood by all employees and subcontractors.

- Hazards of confined spaces
- Assessment procedures
- Control measures
- Emergency procedures
- Selection, use and Maintenance of safety equipment

Evidence of training must be provided to Manukau Water on request (photo ID cards)

Entering confined spaces can be hazardous as well as physically demanding. Therefore the aptitude and physical competence of persons involved in entry work, or appointed to standby duties, shall be appropriately evaluated by the Contractor or representative prior to commencement of work.

10.0 RESCUE AND FIRST AID

All persons who may be involved in any way with rescues from a confined space shall discuss a rescue plan. All persons should be made aware that:

- Well-planned and well-rehearsed rescue procedures are essential and are to be followed at all times.

- In an emergency, the spontaneous reaction to immediately enter and attempt a rescue from a confined space may lead to the deaths or serious injury of those attempting the rescue.

- All persons involved in Confined space work and first aid procedures shall be appropriately trained in First Aid in addition to confined space entry and this should be reflected on their photo ID cards.

11.0 RECORD KEEPING

The Contractor shall keep and maintain

- Entry Forms for one month
- Any recorded risk assessment reports for work in a confined space for 5 years from the time of their validity.
- Training record for the term of the employee's employment

Contractors are required to keep all records concerning all training of an employee, which may be used as a reference point at a later date. It is important that all these documents can be called on to be presented in a court of law.

12.0 GENERAL CONSIDERATIONS FOR SAFE SYSTEM OF WORK

Irrespective of the confined space classification, there are a number of occupational safety and health related matters which must be considered:

12.1 Staff Numbers

No person may enter a confined space unless the resources available and support systems comply with the requirements of this document (with the exception of above ground ventilated pumping stations).

12.2 Personal Protection

In addition to protective clothing, personnel should use barrier creams for skin protection where appropriate (eg. contact with foul sewerage).

12.3 Personal Hygiene

Personnel must wash as necessary on returning from a site visit as soon as possible after leaving sewer, washing must be repeated before eating, smoking, or entering an office.

12.4 Decontamination

Soiled items from a sewer environment must be suitably decontaminated at the site after use, and stored in an appropriate location. Such items should not be brought into an office. Washing with soap and water followed by a period of desiccation is sufficient. If a more comprehensive decontamination is necessary, immersion in weak hypochlorite solution is sufficient.

12.5 Ladders

When negotiating ladders, hands must be kept free of equipment to reduce the risk of falling. Equipment such as torches, samplers, hammers, etc. must either be lowered prior to descent (and removed after exit), or attached to a belt or harness.

Only one person may use a length of ladder (or step irons) at one time. The base of any ladder must be kept clear during ascent and descent.

12.6 Structural Integrity

Before entering a structure such as a manhole, it is important to check the step irons, masonry and safety chains, etc. are secure, before applying full body weight to them. It may be necessary to effect repair works prior to the main purpose of entry.

12.7 Restricted Access

Where an access shaft or manhole is so narrow as to restrict normal entry or egress, a winch should be installed to assist those entering and leaving the hazardous zone.

12.8 Field personnel must have contact numbers for the nearest emergency services, and an established liaison.

12.9 Lifting

When raising manhole covers or lifting heavy items, adopt correct lifting posture (straight back). Use lifting apparatus as appropriate and do not attempt to lift excessive weights.

12.10 High Pressure Water Jetting

Personnel must use respirators to protect themselves against the inhalation of aerosols. Other protective clothing is necessary to prevent skin, eye or ear contact with the jet.

12.11 Health Surveillance

Employees must report any illnesses they feel were contracted in a sewer environment to their manager and doctor.

12.12 Electrical Apparatus

Where there is a likelihood of a flammable atmosphere, electrical apparatus (where practicable) should be certified ’Intrinsically Safe’ (ie. incapable of igniting a flammable gas mixture). This includes torches and flow survey apparatus. Wherever possible, safe alternatives to electrical apparatus should be employed. If it is not practicable, attempts should be made to control gas source.

13.0 PREVENTATIVE HEALTH CARE

Personnel working in sewer environments must have current vaccinations for tetanus, hepatitis A and hepatitis B. All cuts and abrasions must be immediately cleaned and protected with water-proof dressings. Any cuts or accidents are to be reported to the supervisor who will complete an accident report.

APPENDIX CS1- RISK ASSESSMENT FORM

Work to be undertaken		
Range of work methods that could be used	a.) b.) c.) d.)	
Hazards Identification		
Atmospheric/Biological Chemical Agents Present	Estimated risk level	Control of Hazard
a.)	High...Med…Low	
b.)	High...Med…Low	
c.)	High...Med…Low	
d.)	High...Med…Low	
e.)	High...Med…Low	
f.)	High...Med…Low	
Physical Hazards	Estimated risk level	Control of Hazard
a.)	High...Med…Low	
b.)	High...Med…Low	
c.)	High...Med…Low	
d.)	High...Med…Low	
e.)	High...Med…Low	
f.)	High...Med…Low	
g.)	High...Med…Low	

Details of chosen work method	
Emergency and Rescue Procedures	

APPENDIX CS2 -CONFINED SPACE ENTRY FORM

Valid only for date of issue. CONTRACTOR: DATE:

CONTRACT #	CONTRACT NAME:	DESCRIPTION OF WORK:

Entry Team — I/we understand all the procedures and safe working practices for this entry and the protective and rescue measures used.

WORK METHOD TO BE USED:

ACKNOWLEDGEMENT:

	#	*Name*	*Initial*
Responsible Person in Control:	1		
Entry Team	2		
	3		
	4		
Stand-by	5		
	6		
	7		
Observer	8		

All the following items Checked and Discussed: Manhole categorisation: **High Risk / Low Risk**

Protective clothing & equipment	☐	Lighting or touches (insulated)	☐	Escape respirators	☐
Gas monitoring equipment	☐	Communication equipment	☐	Intrinsically safe equipment	☐
Safety harnesses with life-lines	☐	Mechanical ventilation	☐	First aid kit	☐
Retrieval device (tripod or hoist)	☐	Warning signs and barriers	☐	Cell phone/Radio Telephone	☐
Emergency procedures understood	☐	Fire fighting equipment	☐	Hazard ID/Controls completed	☐

Specific items to check :

Weather forecast checked and considered satisfactory ☐ Gas monitors checked and zeroed before first use ☐

All persons trained in Confined Space entry (ID cards) ☐ Meter readings in clean air [20.8% O2] [0 ppm H2S] [0% LEL] [0 ppm CO]

SITE INFORMATION: SUSPEND / CANCEL PERMIT – **REASON:** **Signature:**

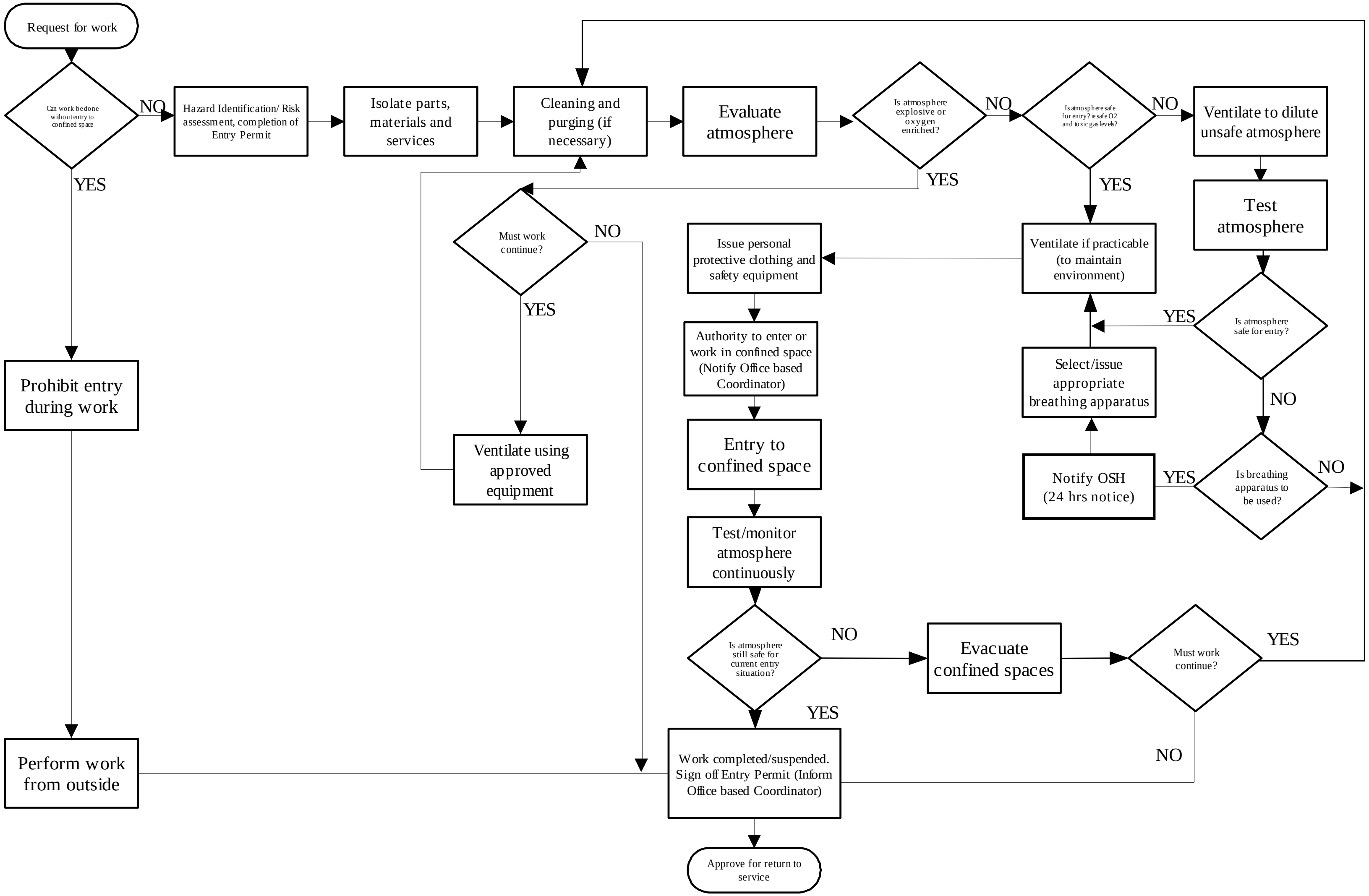
(Tick box where appropriate)

In Emergency dial 111 and give the Following details: * SERVICES REQUIRED *DETAILS OF LOCATION *TYPE OF EMERGENCY *NUMBER OF PEOPLE INVOLVED *CLEAR DIRECTIONS TO SCENE *CONTACT NAME/NUMBER **ADDRESS OF CONFINED SPACE**		**PRE-ENTRY** Entry TEAM (Use number from List)	Stand-by PERSONNEL (Use numbers From list Above)	All PRE-ENTRY CHECKS PASSED Hazards identified communication With Control Team and emergency Procedures agreed	ALL TEAM USING correct protective clothing and equipment	LOCKS & TAGS FITTED to pipelines water/steam gas etc. and/ or drives where relevant	PRE-ENTRY ATMOSPHERIC CONDITIONS IN CONFINED SPACE (Enter actual figure recorded where available Or tick to indicate below alarm level) >19.5% <23% %O2	<10% %LEL	H2S	CO PPM	OTHER (Specify)	AUTHORISED AS SAFE TO ENTER Person in Control to Initial)	ENTRY TIME	**ON COMPLETION** EXIT TIME	ALL WORK FINISHED. Equipment and Team Removed. Isolations Reinstated	AUTHORISED AS WORK COMPLETED. Person in Control to Initial)
	1															
	2															
	3															
	4															
	5															
	6															
	7															
	8															

A Copy of this Entry Form must be kept on file (available for inspection if requested).
(The minimum level of compliance is that described in SAFE WORKING IN CONFINED SPACE)

APPENDIX CS3 CONFINED SPACE ENTRY FLOWCHART

Confined Space Entry Flow Chart



3.0 Site Infrastructure

3.1 Key Principles

The following are the key principles of the facilities of site infrastructure.

1. Landfill, septage and recycling facilities have been designed and constructed to an international standard.

2. The site infrastructure needs to be managed and maintained to a similar standard to achieve the environmental protection that the facility is designed to deliver.

3.2 Description

3.2.1 Size

Within the 4 hectare site, the landfill footprint occupies an area of approximately 1 hectare on the eastern part of the site. The two septage ponds at the western end of the site have an area of 940m^2 each.

3.2.2 Intended Operation Period

The expected landfill life is estimated to be 15 years. However, this life can be extended up to 20 years if the procedures outlined in this management plan are followed closely.

3.2.3 Future Expansion

Future expansion of the landfill can occur through developing the Contractor's yard and extending the landfill through or alternatively diverting the stream and road to the other side of the ridge and filling right across the valley. Future planning to enable both options should be instigated now.

3.3 Waste Acceptance Controller Office

The MOW will supply a hut/office and install it in the location indicated on Figure 2-1 . The hut/office must have windows positioned so that the Waste Acceptance Controller can see both the septage receiving facility and the landfill area while <u>sitting</u> at his desk.

3.4 Amenities

REFER SECTION 1.5

Provision will be made within the Recycling Office for record keeping and storage of monitoring equipment, and it may be used for staff training.

Welfare facilities will include:

- Personal effects storage.
- Storage for safety equipment.
- Adequately lighted staff room.
- Facilities for heating food and providing hot water.
- First aid equipment.
- Washbasin with hot and cold water.
- Shower facilities.
- Lavatories both for employees and visitors.
- Kitchen facilities (kettle, table, fridge, hob etc)

A safe and secure cupboard will be provided in the Recycling Centre for potentially harmful substances used on site such as insecticides and weed killers. This facility will be clearly labelled and will be locked so that access is limited to authorised staff. For non-complying hazardous wastes contingency plans and temporary storage protocols refer to Section 9.8.

If the Operational Contractor elects to store diesel fuel on site for mobile plant, the contractor will be required to store the fuel in a bunded tank. The capacity of the bund will be a minimum of 110% of the fuel storage capacity. Fuel tanks will be clearly labelled.

3.5 Hazardous Waste Storage Facility

REFER SECTION 1.5

3.6 Access roads

3.6.1 Main Road to Site

The access road from the main public road to the site boundary of the landfill and septage pond facility is a public road and will be maintained by the Ministry of Works.

3.6.2 Within the Site

(i) Maintenance

Ongoing maintenance of the main access road, septage pond access roads and the working face access will be undertaken by the Landfill Operational Contractor to maintain the integrity of the surface. A lesser standard of roading may be satisfactory in the dry season provided that the access is maintained and no dust nuisance arises (Refer Section 7.5.4).

The access road to the working face of the landfill will be maintained to a standard that allows vehicular access by refuse transport trucks and two wheel drive utility vehicles without getting stuck or the need for towing.

Towing up inclines may occur in special circumstances such as the final placement of refuse on the top of the landfill, subject to the agreement of the Landfill Manager.

(ii) Legal Access

The main access road within the site leading to the quarry area above the landfill is NOT a public road. The access road is a private road and is only to be used for normal landfill operations, access to the quarry and for persons wishing to access property located further up the valley.

3.7 Signage

Signs shall be prominently displayed at the site entrance to inform waste carriers and members of the public as set out in Appendix 3.1.

3.8 Visual Screening

The zones of visual screening located around the recycling facility area and to the North of the Septage Ponds (Refer Figure 3-1) will be maintained by the Landfill Operational Contractor for the duration of landfill and septage pond operation. . The following plant species were planted on the earth mound around the site as part of the construction of the facility.

- Type A – Coconut palms at 6m centres interspersed with Frangipani and Tiare Maori as follows:
  - 0m Coconut Palm
  - 1m Tiare Maori
  - 2m Tiare Maori
  - 3m Frangipani
  - 4m Tiare Maori
  - 5m Tiare Maori
  - 6m Coconut Palm

- Type B – Frangipani at 3m centres

The Landfill Operational Contractor will replace any plants that die with specimens of the same variety.

In addition to maintaining the visual screening currently in place, the Landfill Operational Contractor will also maintain the vegetation in the rest of his area of responsibility (including intermediate and final cover areas – Refer Section 5.10) by removing all noxious weeds.

3.9 Storage of Cover Material

Landfill cover material will be stored in the location shown in Figure 5-4. Landfill cover material may also be stored at times on areas where landfilling has been temporarily completed provided that the profiles in Figure 5-2 are not exceeded. Using completed lifts adjacent to the current operational area to store cover to be used on that area is particularly efficient.

3.10 The Landfill Area

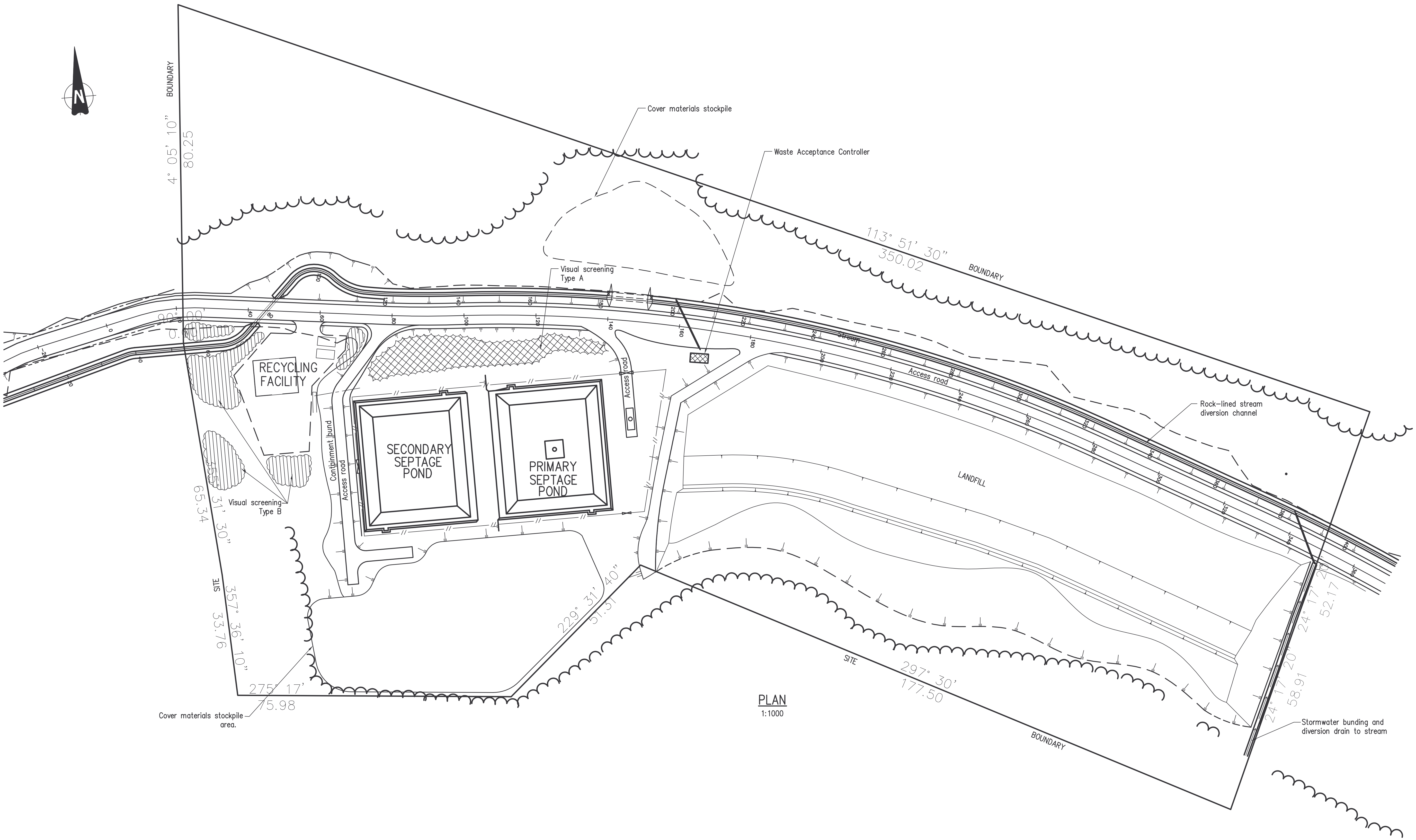
The landfill area will be operated by the Landfill Operational Contractor in accordance with the procedures defined in Section 5.0.

In addition to these procedures, the Landfill Operational Contractor will not allow tracked or wheeled plant to traverse any unprotected areas of the landfill base. An unprotected area is a zone that has not been covered with a minimum of 500mm of uncompacted selected refuse (i.e. any area still covered with the plastic cover material). Any foot traffic across these unprotected areas will be kept to a minimum.

The purpose of the plastic cover material and sacrificial geotextile is to protect the underlying leachate drainage blanket and to prevent stormwater from entering the leachate drainage system.

Figure 3-1 Visual Screening

maunsell



CAD Ref: K:\Dept_49\Projects\4964312 - COO Waste Management Project\CAD\Working\Rarotonga Management Plan\Issued\04.12.22\ Figure3-1_rev2.dwg   Last saved: Wed, 22 Dec 2004 02:39 pm

RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
ISSUE 2 – FACILITY OPERATION

Figure 3–1:
VISUAL SCREENING

3.11 The Septage Pond Area

The septage pond area will be operated and maintained by the Landfill Operational Contractor in accordance with the procedures defined in Section 6.0.

3.12 Landfill Compaction Equipment

The Landfill Operational Contractor must supply as a minimum the following:

- Excavator (minimum 20tonnes) and truck available on call to handle special waste burials, cover material transport and fire fighting (Refer Section 9.9).

Appendix 3.1

Recommended Signage

Recommended Signage - Rarotonga

Sign	Content	Location	Dimensions	Number	Est Cost
Entrance Sign	Rarotonga Waste Facility Opening Hours Monday –Friday 9.00am to 3.00pm Saturday 9.00 am to 12 noon Sundays and Public Holidays - Closed Funded by: Asian Development Bank and Government of Cook Islands Operated by Ministry of Works Contact ph 24 030 After Hours Contact ph 54 011	Outside Site Gate	2.4m by 2.4m	1	$2000
Back Road Turnoff Sign	Rarotonga Waste Facility 1km Opening Hours Monday – Friday 8.00am to 4.00pm Saturday 8.00 am to 12 noon Sundays and Public Holidays - Closed	Junction of Quarry access road with Back Road.	2.4m by 2m	1	$1500
Waste Controller Stop Sign	Rarotonga Waste Facility Please Stop at Office and Pay Landfill Charge The following wastes are prohibited: Vehicle Bodies Whole Tyres Vehicle Batteries Green Waste Tree stumps, trunks, branches The following wastes may only be disposed of by prior arrangement: Fats, Oils and Greases Odourous Wastes Asbestos Sheeting No Fires	Outside Waste Controller Office Facing Down the Road	2.4m by 2.4m	1	$2000

Waste Charges	Please Pay Landfill Charge: Car Boot - $xxx Van, Ute, Trailer - $yyyy Truck - $zzzz	Wall of Waste Controller Office Facing Road	1m by 1m	1	$1000
Tip Face Direction Signs	“Tip Face” + Arrow (pointing left) + “No Fires” “Tip Face” + Arrow (pointing right) + “No Fires” “Tip Face” + arrow (pointing ahead) + “No Fires”	Mobile Signs on stable mobile base.	0.5mH by 1mW 0.5mH by 1mW 0.5mH by 1mW	2 2 1	$2000
Tip Face Sign	Tipping Area DANGER No smoking No fires Beware of reversing vehicles Children to remain in vehicles	Mobile Signs on stable mobile base	1m H by 1m W	1	$1000
Speed Limit Sign	10km/hr Speed Limit (Round red circle with number “10” as per normal road signs)	Near the culvert facing down the road	Standard road sign size as used in Cook Islands	1	$1000
Septage Pond Gate Entry Sign	DANGER Septage Pond Disposal by Special Arrangement Only No Unauthorised Personnel	Outside Septage Pond Gate facing road	1.5m H by 1.5m W	1	$1500
Septage Pond Gate Exit Sign	Please Lock Gate	At septage pond gate facing the loadout area.	1m W by 0.5m H	1	$500
Septage Pond Washdown Sign	Please wash down truck and concrete pad area after discharging load.	At septage receiving area by hose.	1m w by 0.5m H	1	$500
Health Sign	Wash Hands Before Eating	Inside Waste Controller Office	0.2m W by 0.2m H	1	$100
No Dumping	No Dumping of Refuse	Outside Gates and along Stream Channel	0.8m W by 0.9m H	3	$1500

				Total	$14600.00

Specification:

All signs to be prepared on 16mm marine ply, prepared with primer, basecoat and topcoat exterior grade paint. . Fix with galvanised bolts.

Erection:

- Signs of max dimension less than 1m - - fix to single ground treated post.
- For signs of max dimension over 1m fix to two ground treated posts concreted into ground.

4.0 Waste Acceptance

4.1 Key Principles

The following are the key principles of waste acceptance.

1. This landfill is designed to handle certain types of waste, NOT all types of waste.
2. Some types of waste have to be excluded from the landfill as their detrimental effect on the environment is too severe (even in an engineered landfill).
3. Other types of waste are excluded from the landfill because there are other more environmentally acceptable processes available for their disposal.
4. The key factor in waste acceptance is control over the types of waste being placed in the landfill.
5. The landfill life is estimated according to a 0.21kg per person per day refuse production rate. This is the amount of refuse currently presented for disposal and is very low by international standards. It is crucial that certain materials are prohibited at the landfill otherwise the expected life will be drastically reduced.

4.2 Solid Waste Acceptance

4.2.1 General

The Waste Acceptance Controller shall strictly enforce the types of waste handled at the site (Refer Appendix 4.1). Hazardous wastes will not be accepted at the landfill. Particular notice shall be paid to the presence of any special waste within a waste load (Refer Section 4.2.4).

It is the responsibility of the generator and/or transporter of the wastes to ensure the material complies with the site waste acceptance criteria.

Should a refuse disposal vehicle arrive at the site with an unsecured load (or uncovered load) the driver will be advised that he/she is required to either use a fully enclosed vehicle or to secure the load by covering it with netting or sheeting. If a vehicle arrives at the site with an unsecured load, or is not netted or sheeted, the driver will be advised by the Waste Acceptance Controller that a second occurrence may lead to a ban from the site.

Operations staff will be encouraged to report any peculiar characteristics of any waste received to their supervisor.

A minimum of 10 loads per year of non-residential waste will undergo random inspections by the Waste Acceptance Controller to ensure the waste accepted at the site falls outside the definition of hazardous waste. These inspections will be on a random basis. Inspection will take place at the working face whilst the vehicle is still present. Should hazardous waste be detected then it will be reloaded and returned to source (Refer Section 5.7).

Should malodorous waste be received, this waste will be covered with fresh refuse or interim cover immediately after being deposited at the working face to minimise the risk of odour problems.

When working in exposed areas or during periods of high winds, temporary litter screens will be placed immediately downwind of the current working area. Regular litter picking will collect any material not captured.

4.2.2 Documentation

If there is uncertainty that a waste stream is acceptable the waste generator/contractor will be required to fill in a Waste Inspection Sheet (Appendix 4.2) with waste characteristics and submit it to the Landfill Manager who will process and decide whether further analysis is required, or the waste is to be accepted at site (Refer Section 4.2.7). The Landfill Manager will sign this form as a permit for disposal if the waste stream is found to be acceptable.

A copy of the recorded quantities and types of waste accepted at the landfill for the year ended 30 June will be forwarded to Environment Service by 31 July each year.

In the event of a waste delivery which is not accepted as it does not meet the site waste acceptance criteria, ES shall be informed in writing within 24 hours of:

- The date and time the vehicle was turned away
- The registration number of the vehicle
- The identity of the carrier
- The size and type of load
- The source of the load (if known)
- The category of hazard (if known)

4.2.3 Acceptable Wastes

Acceptable wastes are termed non-hazardous wastes.

Municipal waste may contain small quantities of hazardous substances but it is accepted practice that these are not separated from this waste stream. The waste types that will be accepted at the site will be non-hazardous wastes from the following sources:

- Domestic wastes
- Industrial wastes
- Commercial wastes

- Special wastes (Ref: Section 4.2.4)
- General medical waste as per section 3.4 and 6.4 of NZS 4304-2001 "Management of Health Care Waste" but excluding hazardous medical wastes. NZS 4304-2001 refers to Non Hazardous Waste as: General Waste, Recyclable Waste and Special Waste (Ref: Section 4.2.4).
- Inert Wastes - The landfill operator will encourage site users to remove inert waste from incoming waste. Select inert material will be set aside as cleanfill for use as cover material at the discretion of the site operator.
- Recyclable material - The site operator will encourage site users to remove nominated recyclable material from incoming wastes where practicable and provided that there is sufficient space to store the materials and that there is a facility to recycle the materials. Recyclable material will be set aside at the Recycling Centre for recycling provided it is accepted by the Recycling Centre Operational Contractor (Refer Section 1.5).
- The Recycling Centre Operational Contractor may scavenge incoming waste loads and extract any recyclable or other useful/valuable waste materials present.
- Domestic waste may include small quantities of hazardous waste of domestic origin ('Household Hazardous Waste' may include paints, cleaning agents and household batteries – NOT automotive batteries). Such wastes are acceptable as part of the domestic waste stream provided they are commingled with the domestic wastes.
- Containers that have held materials that are prohibited from the landfill are acceptable provided that the container is empty.

4.2.4 Special Waste

Special wastes consist of:

- Controlled Waste
- Difficult Waste
- Bulk Liquid Waste (excluding septage)

In all cases special wastes will be accepted only at the discretion of the Landfill Operator.

(i) Controlled Waste

Controlled waste is defined as any waste requiring special treatment. Examples are malodorous waste or potentially malodorous waste, waste with the consistency of dust, special clinical waste (non-hazardous, but potentially aesthetically displeasing to the public and may need immediate cover at the working face). These must be pre-booked by the waste carrier so that on receipt at the landfill an area has been prepared to allow immediate burial. Other examples are wastes that potentially could cause a litter problem; protected areas will be prepared so that pre-booked loads can be dealt with efficiently.

(ii) Difficult Wastes

Difficult wastes are defined as wastes that require special procedures of disposal due to their PHYSICAL nature. These wastes may be too heavy or large or exist in a form that may be difficult to handle by normal landfill handling operations, or effect normal filling procedures. Refer Section 5.6.7 for management procedures.

Difficult wastes include:

- Bulky items that can be readily crushed.
- Other large objects will only be accepted at the discretion of the Landfill Operator.
- Refrigerators will not be accepted direct from the public. These items are to be separated and degassed at the Recycling Centre before acceptance. Recycling may occur where a market exists for the materials.
- Tyres – These do not compact and tend to 'float' to the surface of the landfill. Tyres will be accepted only at the discretion of the Landfill Operator.

(iii) Bulk Liquid Wastes

Refer Section 4.3.

4.2.5 Prohibited Waste

Wastes prohibited from the landfill include:

- Whole Tyres
- Engine Oil
- Hazardous Waste (Refer Section 4.2.6)
- Greenwaste[1]
- Automotive Batteries
- Car Bodies
- Wood Waste
- Drummed Waste
- Gas Cylinders (unless fully vented)

[1] Shredded greenwaste can be accepted and used as cover material at the discretion of the Landfill Operator

All waste loads containing any of the above materials will be turned away by the Waste Acceptance Controller. The ES will be notified as per Section 4.2.2.

Sorted wood waste of suitable size to use as fuel may be stockpiled at the site near the entrance of the landfill and its use as a fuel encouraged. Stockpiling shall be at the discretion of the Landfill Manager and is to be discontinued if there is insufficient demand for the wood waste.

4.2.6 Hazardous Wastes

Hazardous wastes will not be accepted at the landfill.

As the Cook Islands is a signatory to the Waigani Convention, this management plan will use the Waigani Convention definition of Hazardous Waste. Therefore, Hazardous Waste is defined as:

"Wastes that belong to any category contained in Appendix 4.1 Part A of this management plan, unless they do not possess any of the characteristics contained in Appendix 4.1 Part B of this management plan."

The only exception to this rule is <u>ASBESTOS</u>. Asbestos will be treated as a controlled waste (Refer Section 4.2.4), in that delivery must be pre-booked and a burial pit must be excavated in advance for its immediate disposal.

4.2.7 Waste Determination

Analysis of waste from certain waste streams may be required from customers prior to acceptance.
Waste streams containing potential hazards as described in the Waigani Convention 'Y' List (Refer Appendix 4.1 Part A) and the Centre for Advanced Engineering (CAE) Landfill Guidelines 'Waste Classification for Landfill Disposal' (Refer Appendix 4.1 Part C) are of concern. The Y List contains a wide range of waste streams including those that typically exhibit hazardous characteristics and therefore fall under the definition of Hazardous Waste. The CAE waste classification guidelines include a listing of all waste types that should be prohibited from landfills.

Absence of waste types from any of the lists discussed above does not mean it is non-hazardous. The Y List and the CAE landfill guidelines waste classifications are the first steps in determining whether a waste is potentially hazardous. If there is any uncertainty that the waste may be hazardous then further evaluation including testing will be required. This could include the USEPA Toxic Characteristic Leaching Procedure (TCLP). Criteria for evaluating the results of the TCLP are listed in Appendix 4.1 Part D.

If uncertainty that a waste stream is acceptable exists, the waste generator/contractor will be required to fill in a waste inspection sheet (Appendix 4.2) with waste characteristics and submit it to the landfill operator who will process it and then decide whether further analysis is required, or the waste is to be accepted at site. The

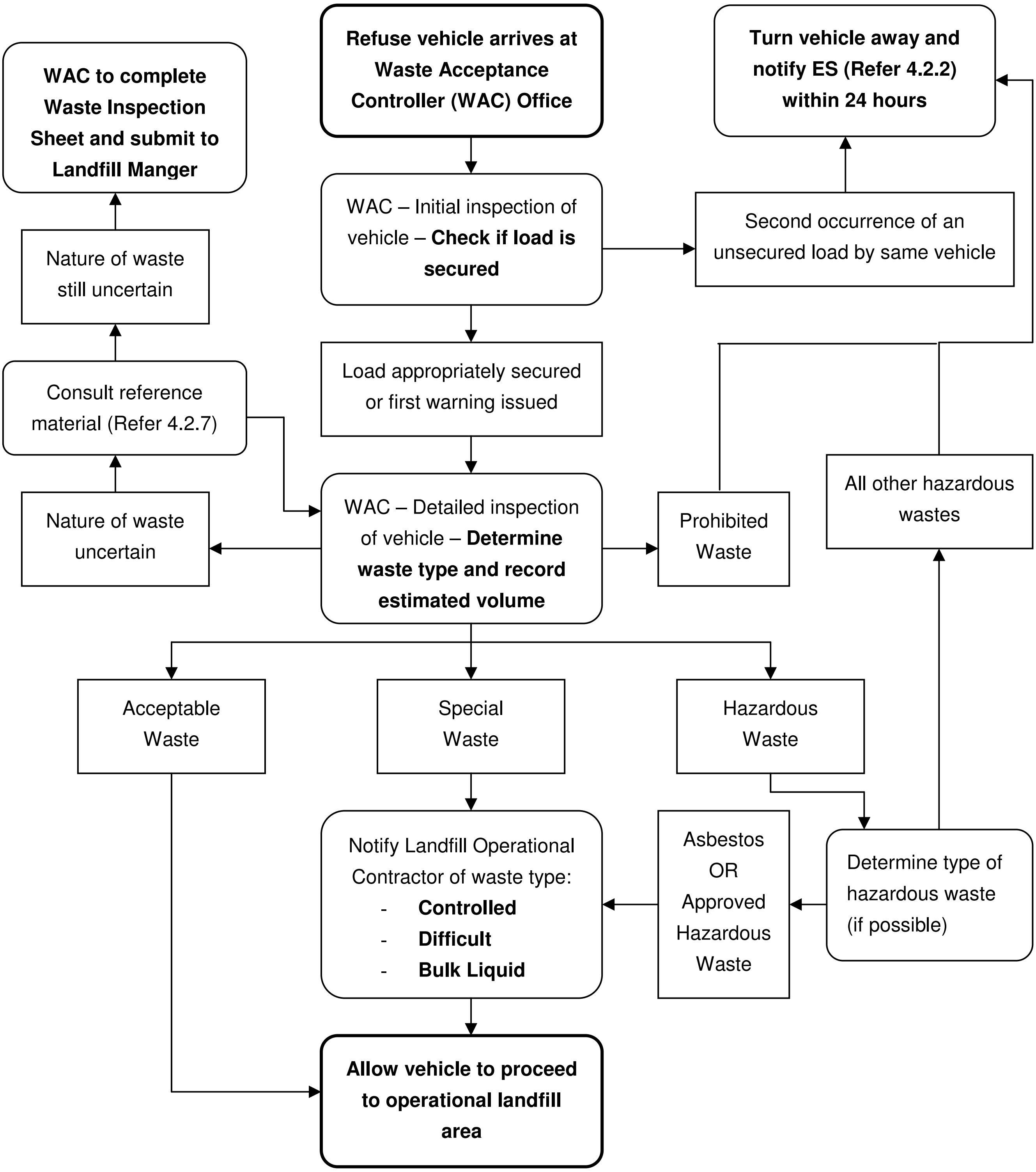
Landfill Manager will sign this form as a permit for disposal if the waste stream is acceptable. If no relevant criteria can be found in those guidelines (for example they exclude Zinc and Copper), then the ES is to be consulted.

If doubt exists, either over the reliability of the analysis provided or material that may be of concern is received without analytical results, independent analysis of waste will be carried out by the Landfill Operational Contactor. Any “suspect” material is to be isolated until it is either confirmed as acceptable or removed for disposal or destruction at a suitable facility.

4.2.8 Summary of Solid Waste Acceptance Procedure

Figure 4-1 shows a flow chart of the Solid Waste Acceptance Procedure.

Figure 4-1 Summary of Solid Waste Acceptance Procedure



4.3 Liquid Waste Acceptance

4.3.1 General

The Waste Acceptance Controller will strictly enforce the types of liquid wastes accepted at the site. It is the responsibility of the generator and/or transporter of liquid wastes to ensure the waste complies with the site Liquid Waste Acceptance criteria.

Operational Staff will be encouraged to report any peculiar characteristics of any liquid waste received to their supervisor.

The distinction between SEPTAGE (liquid waste pumped from septic tanks- Refer Section 4.3.2) and BULK LIQUID WASTE (all other types of liquid waste – Refer Section 4.3.6) should be noted. Only septage will be discharged into the septage ponds, whereas all bulk liquid waste will be disposed of in the landfill area.

4.3.2 Classification of Septage Source

Sources of septic tank waste shall be divided into two classes:

- Schedule A – septage from these sources has a low risk of additional contamination and can be discharged into the septage ponds without further control.
- Schedule B – septage from these sources has a potential risk of containing elevated levels of contaminants that may affect the treatment process and/or the final effluent quality.

Schedules A and B are presented in Appendix 4.4. The Landfill Manager shall review both these schedules annually and update this management plan accordingly.

Sources of septic tank waste shall be classified by the Landfill Manager into Schedule A and Schedule B. The allocation of sources (by activity not premise) into Schedule A and Schedule B shall be available for inspection by any person and shall be published each year by the Landfill Manager in the Annual Report.

The criterion for allocating activities to Schedule A or B is whether the activity involves the handling of significant quantities of substances that could upset the treatment process or could produce contaminants of concern in the final treated effluent.

Where a premise has several septic tanks and some activities fall into Schedule A and others into Schedule B, then Schedule B shall apply. The exception is on large premises where the Landfill Manager is satisfied that the risk of cross-contamination is very low (eg Rarotonga International Airport). The default classification for any activity which has not been classified will be Schedule B.

4.3.3 Trade Waste Management Plan

Each operation classed as Schedule B, will be required to have a Trade Waste Management Plan (TWMP). This plan must state the methods used by the owner/operator/staff of the commercial operation to control, collect, treat and/or dispose of substances that are not to enter the septic tank system (eg oils, greases, heavy metals, biocides). TWMP s are subject to the approval of the Landfill Manager. The TWMP will be a brief document which lists:

- Hazardous substances handled on site and approximate annual quantity handled at the site.
- Processes that the hazardous substances are used for.
- Disposal method for the hazardous substances that are out of specification, spent, used or designated for disposal for any other reason.
- Procedure for clearing up spills.
- Responsibilities for management.

The TWMP shall focus on substances that are in liquid or powdered form which could enter the septic tank and which would effect the treatment process and/or final treated effluent quality.

To approve the TWMP, the Landfill Manager must visit the site in question and shall:

- Inspect the facility
- Inspect the methods used to store and handle hazardous substances.
- Inspect disposal documentation for wastes sent overseas for disposal.
- Meet the staff responsible for implementing the TWMP and satisfy himself that they are aware of how to act in accordance with the TWMP.
- Satisfy himself that the TWMP is being followed in practice.

The Landfill Manager is required to visit the site within 20 working days of receiving a draft TWMP for approval and shall either:

- Approve the TWMP at the time of the site visit by signing the TWMP
- Approve the TWMP within 10 working days of the site visit
- Decline approval within 10 working days of the site visit by written notice giving reasons for declining the TWMP.

The TWMP must be signed by:

- The Author
- The Manager on site with direct responsibility for TWMP implementation
- The Landfill Manager

The TWMP approval shall be valid for a period of 24 months from the date of signature by the Landfill Manager. Copies of the approved TWMP are to be held by:

- The premise owner
- On site
- The Landfill Manager

Upon approval of the TWMP the Landfill Manager shall notify the Waste Acceptance Controller of the approved premise and date of approval. The Waste Acceptance Controller shall maintain an up to date list of approved TWMP s and shall use this to determine the acceptability of Schedule B septage. The Waste Acceptance Controller shall provide a copy of the list, highlighting lapsed TWMP s and TWMP s due to lapse within the next 6 months, to the Landfill Manager every 3 months.

For Schedule B wastes with an approved TWMP, the owner/operator of the commercial site is to supply a TWMP Compliance Certificate certifying that the Trade Waste Management Plan has been adhered to before septage is accepted at the Landfill. The form of this certificate is presented in Appendix 4.5. Once the Landfill Manager has approved the TWMP, the septage from a Schedule B site may be brought to the septage ponds for disposal. Schedule B waste will only be accepted by the Waste Acceptance Controller from approved sites upon production of a Compliance Certificate. The certificate shall be retained by the Waste Acceptance Controller.

Should a Schedule B waste not have a satisfactory Trade Waste Management Plan, then disposal must be pre-arranged with the Landfill Manager. The Landfill Manager will request that a sample of septage from this site be tested for the parameters listed in Table 4-1.

Table 4-1 lists the parameters that samples of septage from Schedule B may need to be tested for and the corresponding levels of acceptance.

The approximate cost for this suite of analyses is estimated to be approximately $NZ200 plus sample collection and transport. Results from the analyses should be forwarded to the Landfill Manager for consideration. Acceptance limits for these parameters shall be reviewed as appropriate.

Table 4-1 Septage Analysis Parameters and Acceptance Limits

Parameter	Comment	Acceptance Level 2006	Acceptance Level 2010
pH [1]	Process	6 to 9	6 to 9
Ammoniacal-Nitrogen [2]	Process	400 g/m^3	300 g/m^3
Nitrate-Nitrogen [3]	Receiving Environment	100 g/m^3	50 g/m^3
Chemical Oxygen Demand [4]	Process	100,000 g/m^3	50,000 g/m^3
Oil and Grease [5]	Process	<2%	<1%
Heavy metals [6]			
Arsenic	Receiving Environment	15 g/m^3	3 g/m^3
Cadmium	Receiving Environment	3 g/m^3	1 g/m^3
Chromium	Receiving Environment	90 g/m^3	30 g/m^3
Copper	Receiving Environment	30 g/m^3	10 g/m^3
Lead	Receiving Environment	30 g/m^3	10 g/m^3
Nickel	Receiving Environment	30 g/m^3	10 g/m^3
Mercury	Receiving Environment	3 g/m^3	1 g/m^3
Zinc	Receiving Environment	75 g/m^3	25 g/m^3

Notes:

1 Based on the Auckland Regional Council Trade Wastes Bylaw (Auckland Regional Council, 1991), which suggests a pH range of 6 to 10. Upper limit is reduced to 9 to compensate for a tropical climate and the associated risk of increased production of ammonia at elevated pH due to higher temperature.

2 Ammoniacal-N is representative of ammonia. Ammonia can be toxic to algae. A 400 mg/L ammoniacal-N limit is set based on Heiss and Strauss (1999). This level is assumed to contain 5% ammonia (equivalent to 20mg/l) which is regarded as a safe level of ammonia in septage ponds.

3 Nitrate influent control is desirable to minimise the nitrate outputs in the effluent. Some nitrates will be removed by plant uptake in the disposal field. Maximum desirable nitrate level in Pond 1 is assumed to be 10g/m^3 which is based on the rate of sodium nitrate addition used to stimulate algae growth in facultative ponds under some conditions. Assuming a 10:1 dilution ratio then the maximum influent nitrate concentration is 100g/m3.

4 Chemical Oxygen Demand (COD) is a measure of the strength of the septage. Too much COD will overload the ponds. The maximum 2006 level is set at three times the mean COD levels found in septage samples from the United States as recorded in the Septage Treatment and Disposal Handbook (USEPA, 1984).

5 Oil and grease will interfere with the pond operation. The 2006 level has been set at four times the average of grease levels found in septage in the United States (USEPA, 1984).

6 Based on Auckland Regional Council (ARC) Trade Wastes Bylaw (Auckland Regional Council, 1991). 2006 acceptable heavy metal levels are the ARC levels increased by a factor of 3 to accommodate current practices in Rarotonga and will be reduced to ARC levels in 2010 as septic management improves.

4.3.4 Septic Tank Acceptance Criteria

The objectives of the septic tank acceptance criteria are:

1. To establish the septage facility as the location where septic tank waste is treated and disposed of.
2. To create a system to encourage good management for 'at risk' sources of septic tank effluent.
3. To tighten standards in well signalled steps to reduce risks as the load on the septage ponds increases over time.

The schedule of septage acceptance criteria is presented in Table 4-2.

Table 4-2 Septage Acceptance Criteria

Period	Criteria
2004 – June 2006	• All septic tank waste is accepted provided that oil and grease is less than 2% by volume.
July 2006 – June 2010	• Schedule A sourced waste accepted • Schedule B sourced waste accepted with approved TWMP and Compliance Certificate. • Schedule B sourced waste accepted if it passes 2006 test criteria
July 2010 – onwards	• Schedule A sourced waste accepted • Schedule B sourced waste accepted with approved TWMP and Compliance Certificate • Schedule B sourced waste accepted if it passes 2010 test criteria

4.3.5 Septage Receiving Procedure

The following procedure will be followed when a septage tanker arrives on site:

1. The Waste Acceptance Controller will record:

    a) Source of Waste
    b) Time and date of arrival
    c) Volume of septage[2]
    d) Fees Charged

[2] Trucks hauling septage will be presumed to be full for volume recording purposes unless documented otherwise by the septage tanker driver.

2. If the septage is of residential origin or from a Schedule A source, the hauler will then proceed to the septage receiving area and discharge the load.

3. If the septage is from a Schedule B source, a landfill operations staff member will supervise the discharge of septage into the ponds, noting any unusual odour, colour or consistency. If the staff member notes that the septage load is of a suspect quality then the discharge will be stopped and the septage returned to the commercial site until a sample of the septage has been collected and analysed in accordance with Table 4-1 at a cost to the commercial operator.

4. If the landfill operations staff member observes a septage load with a high oil and grease content, then the staff member will undertake a quick test of the oil and grease content. The test for oil and grease content is as follows:

    a) Collect a representative sample of the septage.
    b) Pour 500mL of the mixed sample into a graduated 500mL measuring cylinder.
    c) Leave the sample to settle for a minimum of 5 minutes, allowing the oil and grease to separate out and rise to the top.
    d) Remove any large floatable items (eg. sticks, bark).
    e) Measure the depth of the oil / grease film at the top of the sample.
    f) The septage load is rejected if the depth of this film is greater than 2% of the total volume (ie 10mL).

4.3.6 Bulk Liquid Wastes

Bulk liquid waste includes:

- Non-hazardous (Refer Section 4.2.6) liquid wastes not suitable for disposal in the septage ponds.
- Sludges of non-spreadable consistency.
- Grease trap pump-out wastes.

The Landfill Operational Contractor is obliged to accept bulk liquid waste provided that the following ratios are met. The acceptable ratio of bulk liquid waste to refuse will be reviewed annually but will initially be set as:

- Dry Season – 1m^3 of bulk liquid waste to 5m^3 of refuse placed in the preceding week.
- Wet Season – 1m^3 of bulk liquid waste to 10m^3 of refuse placed in the preceding week.

If there is a shortfall of space for bulk liquid waste, these shall be disposed of in order of application. This may be varied on a case by case basis upon the direction of the MOH or ES if the delay would pose a serious risk to human health or the environment. Such instructions must be given to the Landfill Manager in writing stating the wastes that the directive applies to, the term of the directive and the reasons for the directive.

A prior booking system will operate for receiving bulk liquid wastes as follows:

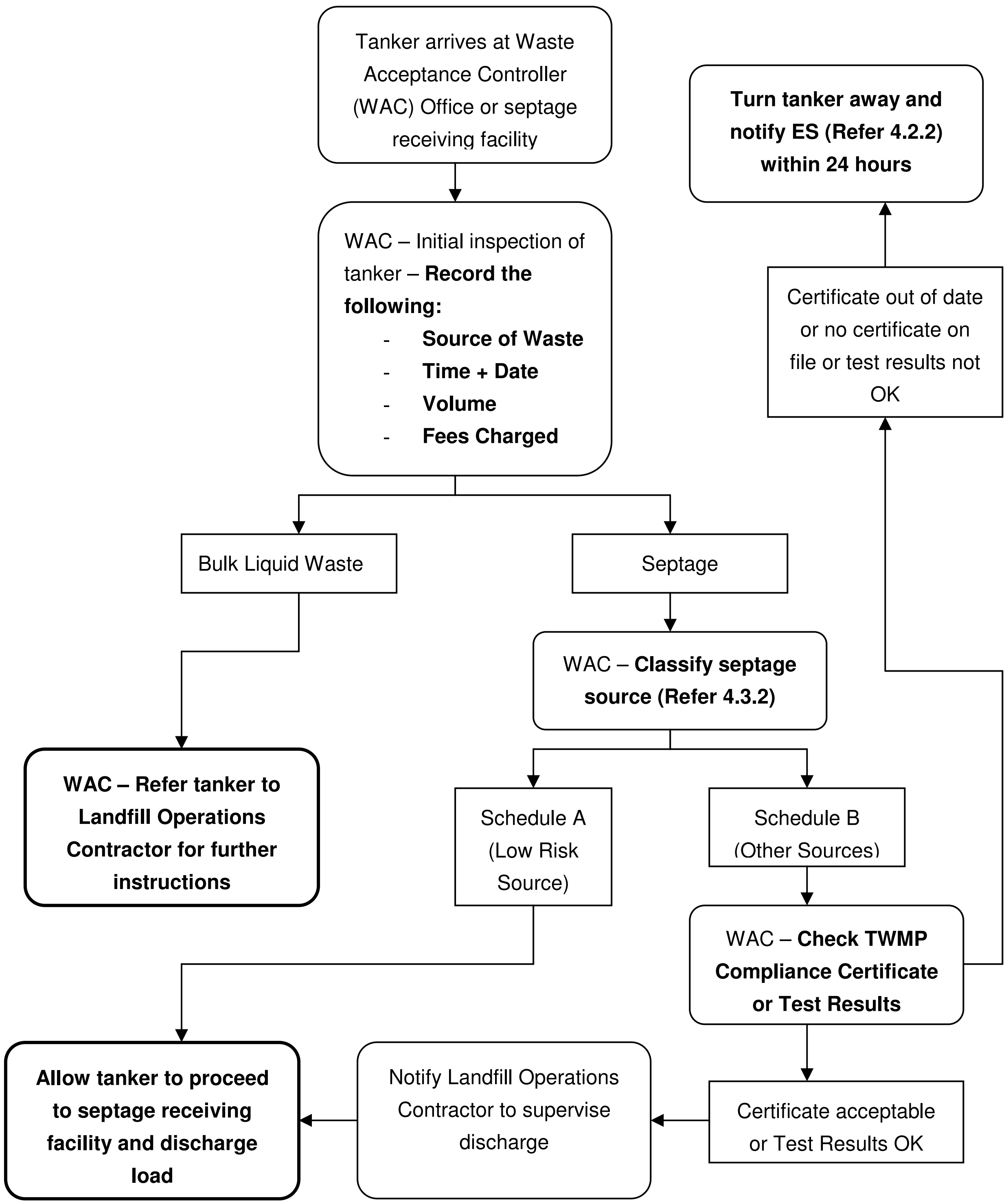
- The customer will contact the landfill operator and note interest in disposing of bulk liquid waste at the landfill. An application document (Refer Appendix 4.3) will be faxed or sent by letter.
- The customer must fill out the application document in full providing amongst other items a description and volume of the material they wish to dispose of, and when they wish to dispose of it.
- The operator will confirm either its acceptance or otherwise. If acceptable, a time and date for its delivery will be confirmed.

All correspondence pertaining to liquid waste disposal will be filed and will be made available to the Landfill Manager on request.

4.3.7 Summary of Liquid Waste Acceptance Procedure

Figure 4-2 shows a flow chart of the Liquid Waste Acceptance Procedure.

Figure 4-2 Summary of Liquid Waste Acceptance Procedure



Appendix 4.1

Waste Acceptance Criteria

Part A – Waigani Convention: Categories of Wastes which are Hazardous Wastes

Note: This ‘Y’ list was adopted from the Basel Convention of 1989.

Wastes Streams:

Y1 Clinical wastes from medical care in hospitals, medical centres and clinics.

Y2 Wastes from the production and preparation of pharmaceutical products.

Y3 Waste pharmaceuticals, drugs and medicines.

Y4 Wastes from the production, formulation and use of biocides and phytopharmaceuticals.

Y5 Wastes from the manufacture, formulation and use of wood preserving chemicals.

Y6 Wastes from the production, formulation and use of organic solvents.

Y7 Wastes from heat treatment and tempering operations containing cyanides.

Y8 Waste mineral oils unfit for their originally intended use.

Y9 Waste oils/water, hydrocarbons/water mixtures, emulsions.

Y10 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs).

Y11 Waste tarry residues arising from refining, distillation and any pyrolytic treatment.

Y12 Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish.

Y13 Wastes from production, formulation and use of resins, latex, plasticisers, glues/adhesives.

Y14 Waste chemical substances arising from research and development or teaching activities which are not identified and/or are new and whose effects on human health and/or the environment are not known.

Y15 Wastes of an explosive nature not subject to other legislation.

Y16 Wastes from production, formulation and use of photographic chemicals and processing materials.

Y17 Wastes resulting from surface treatment of metals and plastics.

Y18 Residues arising from industrial waste disposal operations.

Y46 Wastes collected from households, including sewage and sewage sludges with the exception of clean sorted recyclable wastes which do not possess any of the hazardous characteristics defined in Part B of this Appendix.

Y47 Residues arising from the incineration of household wastes.

Wastes having as constituents:

Y19 Metal carbonyls.

Y20 Beryllium; beryllium compounds.

Y21 Hexavalent chromium compounds.

Y22 Copper compounds.

Y23 Zinc compounds.

Y24 Arsenic; arsenic compounds.

Y25 Selenium; selenium compounds.

Y26 Cadmium; cadmium compounds.

Y27 Antimony; antimony compounds.

Y28 Tellurium; tellurium compounds.

Y29 Mercury; mercury compounds.

Y30 Thallium; thallium compounds.

Y31 Lead; lead compounds.

Y32 Inorganic fluorine compounds excluding calcium fluoride.
Y33 Inorganic cyanides.

Y34 Acidic solutions or acids in solid form.

Y35 Basic solutions or bases in solid form.

Y36 Asbestos (dust and fibres).

Y37 Organic phosphorus compounds.

Y38 Organic cyanides.

Y39 Phenols; phenol compounds including chlorophenols.

Y40 Ethers.

Y41 Halogenated organic solvents.

Y42 Organic solvents excluding halogenated solvents.

Y43 Any congenor of polychlorinated dibenzo-furan.

Y44 Any congenor of polychlorinated dibenzo-p-dioxin.

Y45 Organohalogen compounds other than substances referred to in this Part of this Appendix (e.g. Y39, Y41, Y42, Y43, Y44).

Part B – Waigani Convention: List of Hazardous Characteristics

UN CLASS*	CODE	CHARACTERISTICS
1	**H1**	**Explosive** An explosive substance or waste is a solid or liquid substance or waste (or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such speed as to cause damage to the surroundings.
3	**H3**	**Flammable liquids** The word “flammable” has the same meaning as “inflammable”. Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5 degrees C, closed-cup test, or not more than 65.6 degrees C, open-cup test. (Since the results of open-cup tests and of closed-cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowance for such differences would be within the spirit of this definition).
4.1	**H4.1**	**Flammable solids** Solids, or waste solids, other than those classed as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.

* Corresponds to the hazard classification system included in the United Nations Recommendations on the Transport of Dangerous Goods (ST/SG/AC.10/1/Rev.5, United Nations, New York, 1988)

4.2	**H4.2**	**Substances or wastes liable to spontaneous combustion** Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up on contact with air, and being then liable to catch fire.
4.3	**H4.3**	**Substances or wastes which, in contact with water, emit flammable gases** Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.
5.1	**H5.1**	**Oxidizing** Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen cause, or contribute to, the combustion of other materials.
5.2	**H5.2**	**Organic peroxides** Organic substances or wastes which contain the bivalent-O - O-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.
6.1	**H6.1**	**Poisonous (Acute)** Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.
6.2	**H6.2**	**Infectious substances** Substances or wastes containing viable microorganisms or their toxins which are known or suspected to cause disease in animals or humans.
8	**H8**	**Corrosives** Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.

9	**H10**	**Liberation of toxic gases in contact with air or water** Substances or wastes which, by interaction with air or water, are liable to give off toxic gases in dangerous quantities.
9	**H11**	**Toxic (Delayed or chronic)** Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.
9	**H12**	**Ecotoxic** Substances or wastes which, if released, present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
9	**H13**	Capable, by any means, after disposal, of yielding another material, e.g. leachate, which possesses any of the characteristics listed above.

Part C – The Centre for Advanced Engineering Landfill Guidelines 2000: Appendix 4 “Waste Classification for Landfill Disposal”.

Appendix 4
Waste Classification for Landfill Disposal

NOTES: Numbering and terminology used are generally consistent with the ANZECC classification system and refer in the first instance to untreated wastes. As the system contains both waste types and constituents, more than one category may be applicable to a particular waste and therefore all categories need to be checked to determine whether landfill disposal may be appropriate.

A Waste Prohibited from Landfills

1 Characteristics

- H1 Explosives
- H2 Gases
- H3 Flammable liquids
- H4.1 Flammable solids
- H4.2 Substances or wastes liable to spontaneous combustion
- H4.3 Substances or wastes, which in contact with water emit flammable gases
- H5.1 Oxidising substances
- H5.2 Organic peroxides
- H6.2 Infectious substances
- H7 Radioactive materials[1]
- H8 Corrosives
- H10 Liberation of toxic gases in contact with air or water
- H13 Capable, by any means after disposal, of yielding another material, e.g. leachate, which possess any of the above characteristics

2 Waste types which may exhibit the above characteristics

Cyanides, surface treatment and heat treatment wastes

- A100 Cyanide containing waste from treatment of metals
- A110 Cyanide containing waste from heat treatment and tempering
- A120 Complexed cyanides
- A130 Other cyanides

Acids

- B100 Sulphuric acid
- B110 Hydrochloric acid
- B120 Nitric acid
- B130 Phosphoric acid
- B140 Chromic acid
- B150 Hydrofluoric acid
- B160 Sulphuric/hydrochloric acid mixtures
- B170 Other mixed acids
- B180 Organic acids

Alkalis

- C100 Caustic soda, potash, alkaline cleaners
- C110 Ammonium hydroxide
- C140 Other (hazardous substances must be specified)

Inorganic chemicals

- D100 Metal carbonyls
- D120 Mercury
- D280 Alkali metals
- D330 Sulphur

Reactive chemicals

- E100 Oxidising agents
- E110 Reducing agents
- E120 Explosives
- E130 Highly reactive chemicals

Paints, lacquers, varnishes, inks, dyes, pigments, adhesives

F200 Uncured adhesives or resins

Organic solvents

G100 Ethers

G110 Non-halogenated (FP>61°C), n.o.s.

G120 Non-halogenated (FP<61°C), n.o.s.

G130 Halogenated (FP>61°C), n.o.s.

G140 Halogenated (FP<61°C), n.o.s.

G150 Halogenated n.o.s.

G160 Wastes from the production and formulation of organic solvents

G180 Others (hazardous substances must be specified)

Pesticides

H100 Inorganic, organometallic pesticides

H110 Organophosphorus pesticides

H120 Nitrogen-containing pesticides

H130 Halogen-containing pesticides

H140 Sulphur-containing pesticides

H150 Mixed pesticide residues

H160 Copper-chrome-arsenic (CCA)

H170 Other inorganic wood preserving compounds

H180 Organic wood preserving compounds

Oils, hydrocarbons, emulsions

J100 Waste mineral oils unfit for their original intended use (lubricating, hydraulic)

J110 Waste hydrocarbons

J120 Waste oils/water, hydrocarbon/water mixtures, emulsions (mainly oil and or hydrocarbons, i.e. >50%)

J130 Waste oils/water, hydrocarbon/water mixtures, emulsions (mainly water, i.e. >50%)

J140 Transformer fluids (excluding PCBs)

J150 Other (cutting, soluble oils)

J160 Tars and tarry residues (including tarry residues arising from refining and any pyrolytic treatment)

Putrescible, organic wastes

K100 Liquid animal effluent (poultry and fish processing)

K150 Liquid vegetable oils and derivatives

K170 Liquid animal oils and derivatives

K180 Abattoir effluent

K200 Food processing effluent

Industrial washwaters, effluents

L100 Truck, machinery washwaters with or without detergents

L101 Car wash waters with or without detergents

L120 Cooling tower washwater

L130 Fire wastewaters

L140 Textile effluent

L150 Other industrial plant washdown water

Organic chemicals

M100 Polychlorinated biphenyls (PCBs) and/or polyterphenyl (PCTs) and/or polybrominated biphenyls (PBBs)

M110 Equipment containing PCBs and/or PCTs and/or PBBs

M120 Solvents and materials contaminated with PCBs and/or PCTs and/or PBBs

M150 Phenols, phenol derivatives including chlorophenols

M160 Halogenated compounds n.o.s.

M170 Any congener of poly-chlorinated dibenzofuran

M180 Any congener of poly-chlorinated dibenzo-p-dioxin

M210 Organic cyanides

M250 Liquid surfactants and detergents

Clinical and pharmaceutical wastes

R100 Infectious substances

R110 Pathogenic substances

R130 Cytotoxic substances

Miscellaneous

T100 Waste chemical substances arising from research and development or teaching activities, which are not identified

B Wastes possibly suitable for municipal landfill disposal — solids and sludges

1 Characteristics

H6.1 Poisonous substances

H11 Toxic substances (chronic or delayed effects)

H12 Eco-toxic

2 Waste types which may exhibit the above characteristics

Alkalis

C120 Waste lime and cement

C130 Lime/caustic neutralised wastes containing metallic constituents

Inorganic chemicals

D110 Inorganic fluoride compounds

D120 Mercury compounds

D121 Equipment and articles containing mercury

D130 Arsenic, arsenic compounds

D140 Chromium, chromium compounds

D141 Tannery wastes containing chromium

D150 Cadmium, cadmium compounds

D160 Beryllium, beryllium compounds

D170 Antimony, antimony compounds

D180 Thallium, thallium compounds

D190 Copper compounds

D200 Cobalt, cobalt compounds

D210 Nickel, nickel compounds

D220 Lead, lead compounds

D230 Zinc compounds

D240 Selenium, selenium compounds

D250 Tellurium, tellurium compounds

D260 Silver compounds

D261 Photographic waste containing silver

D270 Vanadium, vanadium compounds

D280 Alkali metal containing compounds

D290 Barium, barium compounds

D310 Boron, boron compounds

D320 Inorganic non-metallic phosphorus compounds

D330 Inorganic sulphur containing compounds

D340 Other inorganic compounds and complexes

Putrescible, organic wastes

K100 Animal residues (poultry and fish processing wastes)

K101 Scallop processing residues

K120 Grease interceptor trap waste – domestic

K130 Bacterial sludge (septic tank)

K132 Sewage sludge and residues

K140 Tannery wastes not containing chromium

K150 Vegetable oil derivatives

K160 Vegetable wastes

K170 Animal oil derivatives (e.g. tallow)

K180 Abattoir residues

K190 Wool scouring wastes

Organic chemicals

M130 Non-halogenated (non-solvent) n.o.s.

M140 Heterocyclic organic compounds

M190 Organic phosphorus compounds

M200 Organic sulphur compounds

M220 Organic isocyanates

M230 Amines and other nitrogen compounds (aliphatic)

M240 Amines and other nitrogen compounds (aromatic)

M250 Surfactants and detergents

M260 Highly odorous (eg. mercaptans, acrylate)

M270 Methacrylate compounds

M280 Other (hazardous substances must be specified)

Solid/sludge requiring special handling

N100 Drums which have contained hazardous substances (and which have been triple-rinsed)

N110 Containers and bags which have contained hazardous substances (hazardous substances must be specified)

N120 Contaminated soils (hazardous substances must be specified)

N130 Spent catalysts (contaminants must be specified)

N140 Fire debris

N150 Fly ash

N160 Encapsulated wastes

N170 Chemically fixed wastes

N180 Solidified or polymerised wastes

N190 Ion-exchange column residues

N200 Industrial waste treatment sludges and residues n.o.s.

N210 Residues from pollution control operations

N220 Asbestos[2]

N230 Synthetic mineral fibres

Clinical and pharmaceutical wastes[3]

R120 Pharmaceuticals and residues

R140 Wastes from the production and preparation of pharmaceutical products

Miscellaneous

T120 Scrubber sludge

T130 Photographic chemicals which do not contain silver

T140 Inert sludges/slurries (eg. clay, ceramic suspensions)

T150 Used tyres/tyre wastes

T190 Other (hazardous substances must be specified)

[1] Some radioactive wastes may be able to be landfilled-refer Guidelines for Disposal of Radioactive Substances – National Radiation Laboratory

[2] Refer to Asbestos Regulations 1983

[3] Some clinical wastes such as non-sharp, non-infectious and non-pathological wastes may be able to be landfilled —Department of Health

Part D – Toxicity Characteristic Leachate Procedure Limits

In the case of Category A or B waste (as detailed in Part C of this Appendix) that has received treatment, if the following limits are exceeded by a leachate extract of the waste with respect to any of the listed constituents, then the material is not suitable for unrestricted landfill disposal.

Contaminant Examples	Maximum Concentration (mg/L)
Arsenic	5.0
Barium	100.0
Benzene	0.5
Cadmium	1.0
Carbon Tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
Chromium	5.0
Endrin	0.02
m-Cresol	200.0*
o-Cresol	200.0*
p-Cresol	200.0*
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
1,1-Dichloroethylene	0.7
2,4-Dinitrotoluene	0.13
2,4-Dichlorophenoxyacetic Acid	10.0
Heptachlor	0.008
Hexachloro - 1,3-butadiene	0.5
Hexachlorobenzene	0.13
Hexachloroethane	3.0
Lead	5.0
Lindane	0.4
Mercury	0.2
Methoxychlor	10.0
Methyl ethyl ketone	200.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Selenium	1.0

* Total of all cresols not to exceed 200mg/L

Silver	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,5-Trichlorophenoxypropionic acid	1.0
2,4,6-Trichlorophenol	2.0
Vinyl Chloride	0.2
Sulphides	50 ppm
Cyanides	50 ppm
Asbestos	Any amount if unbound in matrix (so as to prevent fibres being airborne)
Total Halogenated Compounds	**1,000 ppm**
Total Synthetic Non-Halogenated Compounds	**10,000 ppm**
Polychlorinated Biphenyls	**50 ppm**

Appendix 4.2

Solid Waste Inspection Sheet

Rarotonga Landfill: Solid Waste Inspection/Pre-Booking Application Sheet

General Information

Proposed/Actual Delivery Date: _______________ Time: _____________________

Registration of Vehicle: ____

Name of person inspecting/booking waste: ________________________________

Name Of Waste Generator: _____________________ Contact No:______________

Name Of Waste Carrier: _____________________ Type of Vehicle: _____________

Weight & Volume of Waste (as measured in the vehicle): _____________________

Description of Waste/process____

____

Source of Waste (Y-List): ________________Booking No:____________________

Waste Type/Description of Contents of Load (Refer Section 4.0 of LMP)

HAZ	NON-HAZ	ACCEPTABLE	CONTROLLED	DIFFICULT
☐	☐	☐	☐	☐

Potentially Hazardous Waste Contained?

YES	UNCERTAIN	NO
☐	☐	☐

If UNCERTAIN seek advice from Landfill Manager

If YES has a test (TCLP) been undertaken?

Yes(Attached)	No
☐	☐

Landfill Operator to Complete

Quantity of Hazardous Waste ________________ Y-Code ____________________

Action Taken in Dealing with the Hazard: __________________________________

____

Confirm Delivery Date and Time: ____

Refuse Delivery?

Yes ☐ No ☐

Reason for Refusal:____

____

Sent to Regulatory Authority

Yes ☐ No ☐

Signed by Landfill Operations Manager

____

Other Comments:

____

____

____

____

____

Appendix 4.3

Liquid Waste Inspection Sheet

Rarotonga Landfill: Liquid Waste Inspection/Pre-Booking Application Sheet

General Information

Proposed/Actual Delivery Date: _______________ Time: _____________________

Registration of Vehicle: ____

Name of person inspecting/booking waste: ________________________________

Name Of Waste Generator: _____________________ Contact No:______________

Name Of Waste Carrier: _____________________ Type of Vehicle: _____________

Volume of Waste (as measured in the vehicle): _____________________

Description of Waste/process____

____

Source of Waste: ________________ Booking No:____________________

Waste Type/Description Of Contents of Load (Refer Section 4.0 of LMP)

SEPTAGE ☐ OTHER BULK LIQUID WASTE (including grease trap waste) ☐

HAZARDOUS ☐ NON-HAZARDOUS ☐

Potentially Hazardous Waste Contained (Other Bulk Liquid Waste only)

YES ☐ UNCERTAIN ☐ NO ☐

If UNCERTAIN seek advice from landfill manager

If YES has a test (TCLP) been undertaken?

Yes(Attached) ☐ No ☐

Landfill Operator to Complete

Quantity of Hazardous Waste ________________ Y-Code ____________________

Action Taken in Dealing with the Hazard: _________________________________

____

Method of Disposal (Bulk Liquid Waste only):________________________________

____

____

Confirm Delivery Date and Time: ____

Refuse Delivery?

Yes ☐ No ☐

Reason for Refusal:____
____

Sent to Regulatory Authority

Yes ☐ No ☐

Signed by Landfill Operations Manager

____

Other Comments:
____
____
____
____
____

Appendix 4.4

Classification of Septage Source

Schedule A

Activities Not Requiring Special Management

Activity
Residential
Accommodation
Retail
Office
Schools
Churches
Community Halls
Sports Facilities

Schedule B

Activities Requiring Special Management

Activity	Potential Risks
Electroplating	Heavy Metals
Automotive Dismantlers	Oil, Grease, Battery Acid
Garages	Oil, Grease, Battery Acid, Solvents
Transport Depots	Oil, Grease, Battery Acid, Solvents
Petrol Stations	Oil, Grease, Battery Acid, Solvents
Drycleaners	Solvents
Marine Repair and Construction	Oil, Grease, Battery Acid, Solvents
Engineering Works	Oil, Grease, Battery Acid, Solvents
Food Processing	Disinfectants, Biocides, Fats, Grease

Appendix 4.5

TWMP Compliance Certificate

Trade Waste Management Plan Compliance Certificate

This is to certify that ________________________ *(Applicant name)*

Of ____________________________________

(Applicants address)

is classed as a Schedule B source of septage and has a Trade Waste Management Plan approved by the Rarotonga Waste Facility Landfill Manager.

This certificate is valid for a period of 24 months after the date of signing by the Rarotonga Waste Facility Landfill Manager.

Signed _______________

Rarotonga Waste Facility Landfill Manager

Date _____________

5.0 Landfill Operational Procedures

5.1 Key Principles

The following are the key principles of the procedures for operation of the Landfill.

1. The landfill facility is designed to deliver international standard environmental performance.
2. In order for the landfill to achieve these environmental performance standards, it must be operated using the recommended procedures*.
3. This is a form of 'bioreactor' landfill in which the decomposition of waste is promoted by recirculating leachate. The objective is for the waste to be thoroughly decomposed by microbial action and for the waste to decompose to a stable state as soon as possible. This will reduce the period over which the landfill has to be maintained once it closes.
4. Properly engineered landfills are expensive to construct so it is important to make good use of every cubic metre of space
5. Always consider the possibility of wet weather and how this may affect operations.

5.2 Design and Construction Principles

The landfill has been designed as a form of 'bioreactor' landfill in which the decomposition of waste is promoted by recirculating leachate. The objective is for the waste to be thoroughly decomposed by microbial action and for the waste to decompose to a stable state as soon as possible. This will reduce the period over which the landfill has to be maintained once it closes.

The landfill capacity comprises a relatively small below ground volume in an excavated area below the level of the main access road and a more extensive above ground volume which will be built up against the southern highwall. The main elements are:

- An earth bund to form the western end of the below ground volume.
- Subsoil drainage to collect and drain groundwater and reduce the risk of liner uplift.
- An impermeable base liner to prevent leachate escape to groundwater. This is shown in Figure 5-1 and Figure 5-3. The liner is laid on a prepared subgrade shaped so that leachate will drain to the pump station at the western end. The liner components are:
    - A 50mm clay blinding layer
    - A geo-synthetic clay liner (GCL) as a secondary waterproofing
    - A flexible membrane liner (FML) as primary waterproofing
    - A cushion protection layer
    - A 150mm drainage blanket of graded gravel incorporating leachate collection pipes
    - A sacrificial geotextile layer to protect the rain cover and to prevent clogging of the drainage blanket.

* Note that the FMP is a living document and that recommended procedures will change as construction techniques advance and circumstances change. This FMP provides a mechanism to change these procedures as set out in Section 1.3

Figure 5-1 Liner Details

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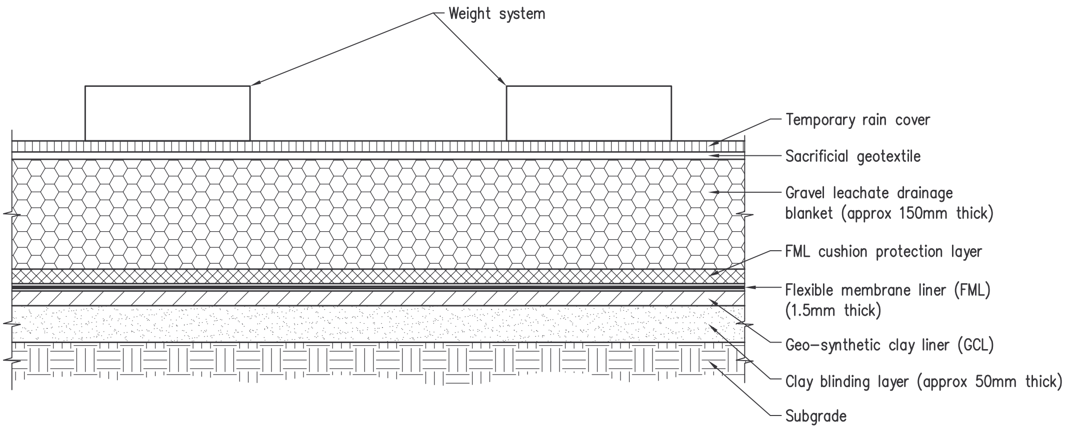

LINER DETAILS
N.T.S.

NOTES

1. Weight system and temporary cover to be removed prior to placing refuse
2. Sacrificial Geotyextile to remain in place..

Figure 5-1:
LINER DETAILS

  - A temporary rain cover to keep stormwater out of the drainage blanket. It is held down by weights (timber and old tyres). It is to be removed prior to placing refuse on any area.
- The liner with minor modifications extends up the northern, eastern and western sides and for the first 3m of the southern (highwall) side. The upper part of the highwall will be lined as the refuse is placed with a 1.5m layer of compacted clay, two sheets of low density polyethylene (LDPE) and a permeable protection/drainage layer.
- A temporary fence system to deter walking or driving on the temporary rain cover. It extends around the outer edge of the unused areas of the landfill and around the current operating area. It is to be moved to suit as filling proceeds.
- A leachate pumping station to collect the leachate and pump it back into the landfill to assist the breakdown of the refuse and to reduce the strength of the leachate. A portion of the leachate will be delivered to the septage ponds for treatment and ultimate disposal to land.
- A network of perforated pipes laid within the refuse for the recirculation of leachate. These will be installed at various levels as the refuse level rises.
- A final cover on all exposed final surfaces comprising 300mm of clean fill, 600mm of compacted clay and 200mm of topsoil (Figure 5-6) to be installed once final profiles are reached on any section.

The following series of photos show various elements described above during construction.

Photo 5-1 Placing of the black Flexible Membrane Liner over the white Geocomposite Liner

This view is towards the fillet and side liner against the southern (Arorangi side) high wall. In this picture, the white Geocomposite Liner (GCL) has been placed, and the Flexible Membrane Liner (FML) is being placed over the top. Note the watering can used to spread a dry granular bentonite dust along the edge of the GCL before placing the next sheet of GCL. Note also the rope ladder used to access the top of the steep (45^{o}) fillet or side liner.

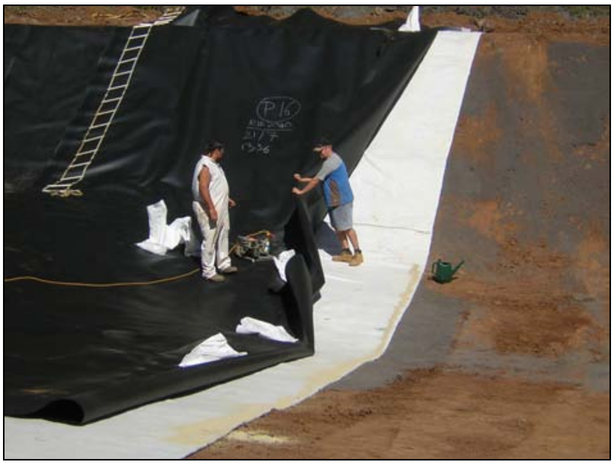

Photo 5-2 GCL, FML and Leachate drainage gravel

Viewed from the bund at the sea end of the landfill, this photo shows the GCL, FML and leachate drainage gravel having been placed to the right hand third of the landfill floor.

Photo 5-3 Leachate Drainage Gravel placed by Excavation

The leachate drainage gravel was placed by excavator to avoid damage to the lining system by vehicles driving over it. (This view is from part way along the quarry access road. T&M Heather's building is visible in the top left corner of the photo).

Photo 5-4 Temporary Rain Cover

In this photo (viewed from the quarry access road with the location of the Waste Acceptance Controller office where the excavator is visible in the photo), the temporary rain cover is being rolled out over the floor and end batter of the landfill. The sacrificial geotextile (matt black) can be seen extending under the rest of the temporary rain cover already placed to the left. The white material up the side batters is the cushion protection layer.

Photo 5-5 Typical view of Electrofusion Welding of Flexible Membrane Liner

Typical view of electrofusion welding (400^{o}C) the Flexible Membrane Liner 'panels' up side of landfill batter

Photo 5-6 Air Pressure Test

Typical view of air pressure test (30 PSI) of electrofusion-welded Flexible Membrane Liner double welds.

Photo 5-7 Leachate Collector Drain Outlet from Landfill

View of Leachate Collector Drain outlet from the landfill. In this photo the water-tight liner penetration is being prepared using gaskets and galvanised steel plates bolted to the concrete slab. The Flexible Membrane Liner has been laid up to the penetration, ready for the ‘boot’ over the two pipes to be welded to it. . These two drains collect the leachate from the floor of the landfill and convey it to the leachate pump station, which is on the other side of the landfill bund.

Photo 5-8 Typical View of Welding of FML around Leachate Collector Drain

Typical view of the welding of the Flexible Membrane Liner 'boot' around the two leachate collection drains.

Photo 5-9 Typical view of electrofusion welding of leachate collector drains

Typical picture of the Electrofusion Welding of the leachate collector drains. A line of drilled holes are just visible along the lower edge of the pipe to allow the leachate to enter the drain. (A second pipe was placed alongside).

Photo 5-10 Formation of the Clay Fillet

The first step in the construction of the first lift of the side liner was the formation of the clay fillet. In the foreground the fillet has been placed and compacted by roller. In the middle distance, the fillet has been trimmed to a 45^{o} face slope. This view is from the lower end of the landfill – note T&M Heather's gate in the background.

Photo 5-11 Cutting of Trench to Anchor Lining System

After forming the fillet, a trench has been cut to anchor the lining system. This photo was taken half way along the fillet length. The excavator in the background is standing on the landfill bund at the lower end of the landfill.

Photo 5-12 Landfill Liner Anchored to Trench.

Temporarily, sand bags are used. For permanent anchoring, the trench is backfilled and compacted with clay. This view is from near the quarry end of the landfill looking in the direction of the Ponds.

5.3 Landfilling Operations

The objective is to place refuse in the landfill in an effective and efficient manner and, in particular, to maximise the utilisation of the available volume. The basic sequence of operations is:

For the first lift on any area of liner:

- Strip back the rain cover from the landfill base
- Form a small bund at the downslope edges of the cleared area to define the edge of the fill and to prevent leachate and contaminated water from running on to the adjacent rain cover
- Place the temporary rope fence around the edge of the cleared area to restrict access to the rain cover
- Lay a 300mm thick layer of soil to protect the side liner – except when working against the Highwall.
- Build out a 0.5m deep layer of lightly compacted municipal refuse to protect the liner. Machinery must not track on to the uncovered liner.

For all lifts:

- Build up and compact refuse in layers to a depth of 3-4 metres keeping the working face as small as possible to minimise rainwater ingress and to reduce litter, bird and rodent nuisance. The principle is to get as great a depth as possible for the surface area to minimise cover requirements.
- Place cover twice weekly, or as necessary, over all refuse as economically as is possible to avoid litter, bird, rodent and odour problems. A nominal 300mm intermediate cover is placed on areas that are not to be overfilled within three months.
- Make sure that at least 20% of a covered surface is opened up to allow free circulation of gas and leachate before placing the next layer of refuse against it.
- Place portable litter screens on the downwind side of the tipping area to control litter. Move as necessary.
- During placing and compacting, layers should be graded towards the centre of the landfill to reduce the likelihood of leachate percolating to the outside
- Maintain all weather access for customers vehicles to tipping areas. Plan all work to take account of wet weather.

For outside faces:

- Peg or bund the bottom edge of filling making due allowance for final cover
- Use profile boards to define the final profile at 1 to 3.5
- Take particular care to avoid overfilling when forming the outer slope.
- Avoid placing difficult or controlled waste near the outer slope.

- Use drainage channels to divert clean stormwater from finished slopes clear of the biomass
- If leachate breakouts occur use subsoil drains to drain it back towards the drainage blanket.

Against the highwall:

- Keep the toe of the refuse at least 2m clear of the unlined rock wall and 300mm clear of the lined wall to allow for the construction of the side liner and/or drainage layer.
- Construct the side liner in stages by cleaning back the rock face, compacting clay against the face, trimming the clay to receive the LDPE liner, installing a two sheet LPDE liner and filling the gap between the refuse and the liner with graded sand (refer Section 5.15.5)
- Construct and maintain a drainage channel on top of the clay sideliner to channel stormwater clear of the refuse.

5.4 Sequence of Development

Refuse will be placed in 'cells'. The cells will be typically 3-4m high and will progress across and along the landfill in an orderly manner. The area will be determined by the size and shape of the area and access considerations. Typically a cell will be sized to accommodate 3-12 months refuse.

Although the term 'cell' is used, the concept is that all of the waste in the landfill will eventually form one continuous mass. For this reason it is important that cover material is scraped back sufficiently to allow free percolation of water and leachate between the cells when refuse is placed over or against an old cell.

The exact order of cell development is largely predicated by access considerations. The construction of permanent and temporary access roading suitable for laden vehicles in all weathers is expensive and the sequence is developed to minimise the long term costs. Nevertheless, the following principles should be adhered to:

- Vehicles discharging refuse may not drive over the Temporary Protection Cover (refer Section 5.5.1)
- Adequate vehicular access must be maintained (Refer Section 3.6.2)
- The vehicle tipping area is to be flat (for vehicle tipping safety).
- Apart from the initial bund, refuse is to be placed in the lower portions of the slope first (for slope stability reasons). Refer Section 5.2.
- Refuse at one level cannot be more than 4m above the next level (for slope stability reasons)
- Levels must be at least 20m apart (for slope stability reasons)
- The slope of the working face must not exceed 1V:5H (for landfill compaction equipment safety reasons)

- Areas of the landfill above road level which are surfaced with intermediate cover and do not have refuse contamination are to be shaped where practicable to discharge to the stream (this is to minimise leachate production).
- Cells are arranged so that the top surface of each layer of cells slopes towards the centre of the landfill (so as to encourage leachate to move away from the landfill sides)
  - Finished outside surfaces should be at a maximum slope of 1 vertical to 3.5 horizontal and a minimum of 1 vertical to 50 horizontal.
- After the first each cell to be developed should always be above or alongside a completed cell.

Figure 5-2 Proposed Cell Development Plan

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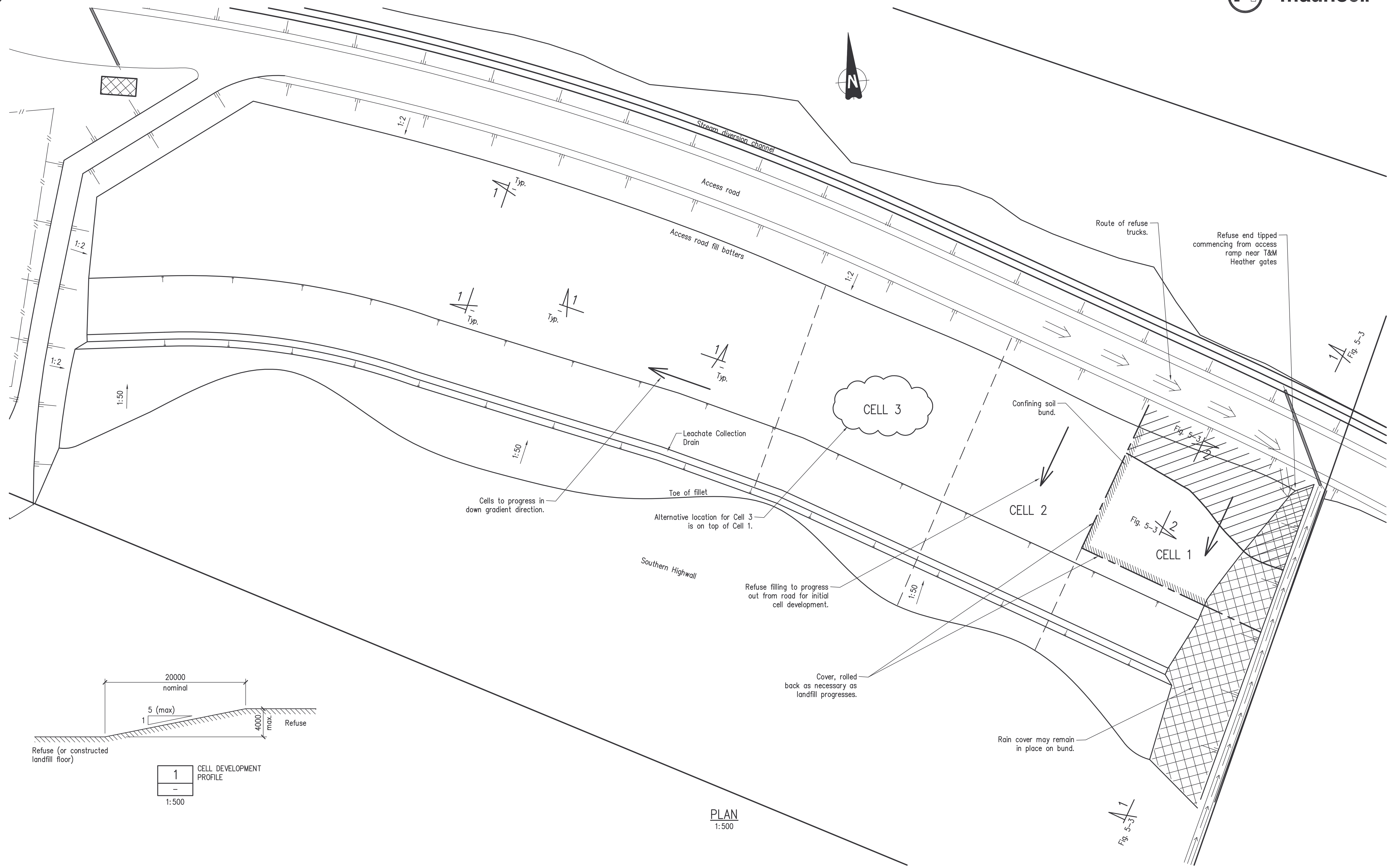


RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
ISSUE 4– FACILITY OPERATION

Figure 5–2:
PROPOSED CELL DEVELOPMENT PLAN

5.5 Temporary Protection System

5.5.1 Sacrificial Geotextile and Temporary Cover

The purpose of the Temporary Protection Cover is outlined in Section 7.4.2. The Temporary Protection Cover consists of two layers over the leachate drainage blanket – a sacrificial geotextile and a temporary plastic cover. Figure 5-1 shows a cross section of the cover system. The photos below show the construction and installation of the temporary cover.

On initial possession of the site by the Landfill Operational Contractor, the Temporary Protection Cover will already be installed with a weight system to prevent wind uplift. This weight system will be maintained by the Landfill Operational Contractor until the waste covers the entire landfill floor (as outlined in Section 5.6.1).

To maintain the integrity of the Temporary Protection Cover, the Landfill Operator will minimise the amount of traffic over the cover (both foot and vehicular) by utilising the temporary fence system in the manner described in Section 5.5.2. Nevertheless, the Landfill Operator will keep a cover repair kit on site and repair any damage to the plastic cover as required.

5.5.2 Temporary Fence System

The temporary fence system will be located on site when the Landfill Operational Contractor takes possession of the site. The purpose of the temporary fence is to deter people from walking/driving over the Temporary Protection Cover. The temporary fence will be placed around the working area of the landfill during placement of waste, and moved accordingly as the landfilling operation progresses.

When moving the fence system across the Temporary Protection Cover, care must be taken to prevent any damage to the plastic cover. Any damage must be repaired immediately.

5.6 Method of Placement

5.6.1 General

All acceptable waste delivered to the site will be disposed of within the operational area. Clean-fill may be used for cover and is to be separately stockpiled as per Section 3.9. Used aggregate or other materials suitable for temporary access roading should be stockpiled for that purpose.

Refuse delivery vehicles will proceed via the internal access road to the operational area. Loads should not be uncovered until the vehicle reaches the tipping area where the discharge of loads will be supervised by landfill operational staff. Waste will be deposited close to the working face and a machine will place and compact the refuse in a confined area.

A single working face will operate. The size of the working face will be minimised, as the requirement for cover will increase along with potential leachate production as the working face increases in size. To minimise the amount of landfill spaces used up by cover material refuse shall be placed in as small an area as is practical and shall be compacted in individual layers not exceeding 300mm thick. Ideally the refuse placed each day will occupy a small area with an overall thickness of 1 to 2 metres. At no time should the working face exceed a plan area of 100 square meters, and the target is to be much smaller than this.

A small earth bund, approximately 0.5 m high, should be formed at the downslope edge of any area from which the rain cover has been stripped. This is to prevent leachate and contaminated stormwater from the refuse running on to the top of the rain cover on adjacent sections. It also serves to define the edge of the filling which otherwise has a tendency to creep.

5.6.2 Special Requirements for Placement on Landfill Base

In order to minimise leachate production, the Temporary Protection Cover will be left in place until the area is to be filled. Under no circumstances will heavy machinery or refuse trucks be allowed on the Temporary Protection Cover as it may damage the landfill liner.

Prior to refuse placement, the plastic cover will be removed in the active area. The appropriate sections of plastic cover will be rolled-up and reused elsewhere by the MOW or disposed of within the active area. The sacrificial geotextile shall remain in place. Metal used for the traffic access will be scraped off and re-used as much as possible to conserve landfill void volume. Only 'selected refuse' may be placed in the bottom 500mm of the landfill (Refer Figure 5-3). 'Selected refuse' is ordinary household domestic refuse collected in the normal weekly municipal refuse collection. Under no circumstances should soil, bulky items, wet wastes or bulk liquid wastes be placed in this zone. This is to provide a further degree of protection to the flexible membrane liner and to reduce disturbance of the leachate collection blanket.

5.6.3 Special Requirements for Placement on Landfill Side Slopes

Waste must not be placed directly against the side liner of the landfill. The risk is that a sharp long piece of refuse (such as a piece of reinforcing steel) may be pushed through the plastic liners during compaction , or as the refuse settles under it's own weight. The side liner should therefore be protected by placing a minimum 300mm thickness (perpendicular to side liner) of protective material. The protective material can be:

- Cover material from the stockpile or excavated on site
- Any hard material (such as rubble or stones) not exceeding 50mm in size
- A soft material that will not rot away (eg shredded rubber, or shredded plastic bottles)

An ideal material is shredded rubber as it disposes of the waste tyres and re-uses their materials in a useful way. Shredded rubber also provides a drainage path down the slope inside the landfill to the leachate collection system. This is an advantage but is not essential. In practice the best way of placing the side liner protection material is usually to build it up in layers as the refuse is placed.

The first cell will run across the eastern face of the landfill which slopes up at 1 in 3.5. It is important that the outer face is not overfilled and that space is left for final cover to be placed on completion of the cell. To ensure that the correct profile is achieved it is recommended that the line of the toe of the refuse be pegged once refuse is built up to ground level and that profile boards be erected to indicate the correct slope.

5.6.4 Solid Waste

The conventional method of waste placement is to deposit the waste in front of a working face and to spread and compact it on that face using special purpose landfill compactors or bulldozers and towed rollers. However with small daily volumes this will tend to be inefficient in that compaction is only feasible on large areas and flat slopes. This leads to large exposed areas and excessive use of cover material. It also requires a good standard of temporary access roading to get customer's vehicles close to the tipping face.

If that method is adopted temporary access roads are used to allow customers to drive close to the working face. Loads are discharged close to the working face. The dozer or compactor blade is used to push the refuse to and spread it on the working face which may slope up or down from the discharge area. The area of open face is to be kept as small as is practicable.   The maximum slope is 1 in 5.

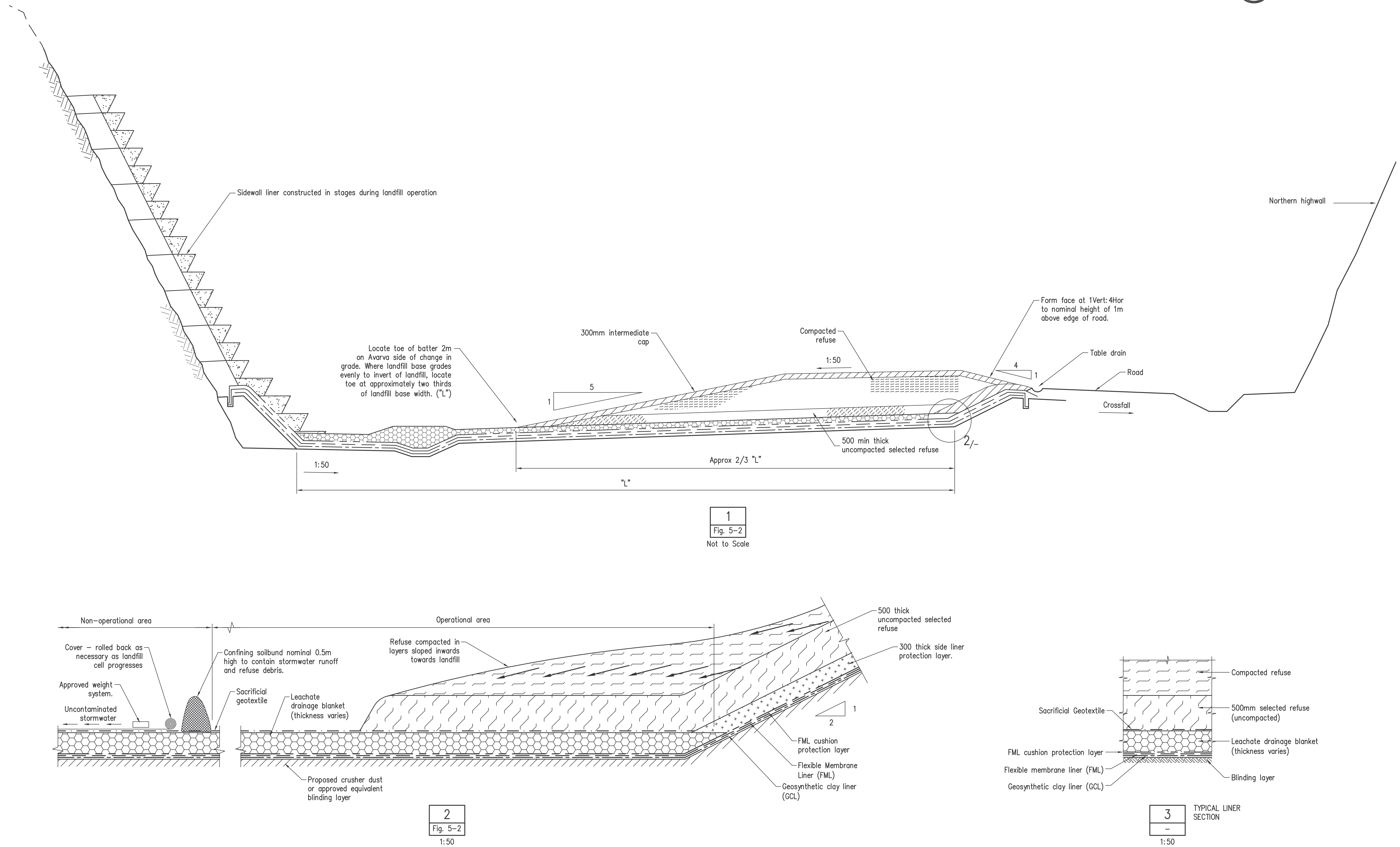
For small landfills there are many advantages in using a tracked excavator to place and compact refuse. Such a machine can place refuse and cover very accurately and to steeper slopes that that required for pushing techniques. The bucket can be used to break up large objects and to provide initial compaction to small area with its bucket. Further compaction is provided by subsequent tracking over the refuse. The ability to spread cover thinly and precisely is particularly effective and significantly reduces the amount of cover material required.

With small volumes of refuse it is likely to prove more economic to use the excavator to carry the refuse from a semi-permanent drop off area to the tip face rather than to build and maintain access roads of the standard necessary for all weather access by customers. This is also safer in that it keeps customers away from the working face.

One system is to use a transfer pit at the discharge area. The customer tips into a shallow pit, excavated in a previously filled area, from which it is subsequently lifted out by the excavator and transported in the bucket to the tipping area. The pit gives a clearly defined discharge point and provides considerable protection against wind blown litter. Except for particularly odorous wastes the pit does not have to be cleared immediately and, at the scale of this landfill, the excavator does not have to be on duty all of the time.

Further advantages of using an excavator it its versatility for other landfill tasks such as winning cover material, digging drains, forming temporary access roads, lifting loads etc. and the ready availability of replacement machinery on hire in the event of a breakdown. If the excavator method is used the customers discharge the load in a transfer pit or transfer area. From there it is picked up, carried to the working area and placed by the excavator.

Figure 5-3 Method of Placement



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CAD Ref: K:\Dept_49\Projects\4964312 - COO Waste Management Project\CAD\Working\Rarotonga Management Plan\Issued\04.12.22\ Figure5-3_rev4.dwg Last saved: Wed, 22 Dec 2004 02:48 pm

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Figure 5-3:
METHOD OF PLACEMENT

5.6.5 Bulk Liquid Waste

Customers should be required to arrange the timing of the delivery of bulk liquid wastes in advance. If this is not done they should be required to wait until the necessary preparations have been made.

Liquid waste will be discharged on to recently placed refuse, from which any cover has been stripped back, in a location where there is a minimum of one metre of refuse in place. Trenches or pits may be used where there is sufficient depth. Placing on, or using trenches in, recently disposed refuse is preferable as it is more likely to be dry and possess a higher absorptive capacity. Cover shall be placed or replaced after the liquid has dissipated but no later than the end of the same day. Malodorous liquid waste shall be covered immediately. Old refuse can be very malodorous and sites for pits or trenches shall be selected carefully.

Generally speaking this method requires customer vehicles to drive directly to the discharge area. Where dozer/compactor methods are used it is convenient to have the discharge area adjacent to the access road. If the vehicle is a tanker with a discharge hose it may be possible to discharge directly on to the working face. If excavator methods are used and the liquids are not malodorous or particularly voluminous discharge into the transfer pit is acceptable. Otherwise an area near the transfer pit should be used. If liquids or sludges arrive in bins or drums it should be possible sling them from the digger bucket and carry them for direct spreading on the tip face.

5.6.6 Controlled Waste

As required by Section 4.2.4, any person wishing to dispose of a controlled waste in the landfill must book in advance. This is to allow the landfill operator sufficient time to prepare the landfill for reception of the controlled waste. The disposal of any controlled waste should be noted on the daily diary sheet which should also note the location of filling on that day by reference to a pre-established three dimensional grid. Preparations for controlled waste types will include, but are not limited to, the following:

- Malodorous or Potentially Malodorous Waste: A pit should be excavated to sufficient dimensions to accommodate the entire load of waste (the quantity of waste should be indicated in the disposal application) plus an approximately 250mm thick layer of other refuse to cap the pit. On receipt of the pre-booked waste, the landfill operator will place the waste into the pit and cover it immediately.
- Waste with dust consistency: The landfill operator will take note of the wind conditions approximately one hour prior to the booked delivery time of the waste and delay the delivery of the waste if strong winds are prevailing. Assuming wind conditions are satisfactory, the landfill operator will follow the same procedure as for malodorous waste with the addition of keeping the waste damp during handling.
- Special Clinical Waste: The landfill operator will follow the same procedure as for malodorous waste.

- Asbestos: The landfill operator will follow the same procedure as for waste with dust consistency. In addition this, the location of the asbestos in the landfill must be recorded and filed with the controlled waste disposal application form. Topographic survey is usually the most reliable method of recording the position but other methods such as grid systems can be used instead provided that they provide a good degree of accuracy and reliability (within 10 m horizontally and within 3 m vertically).
- Paint and Paint Tins: Lead based paints should be treated as hazardous wastes (Refer Section 5.6.8). However, water based paints are acceptable. Any water based paints should be put these aside with the first option of making them available to others for use (if still liquid) or leaving lids off in a well ventilated area for them to dry out. Tins can be disposed of as normal waste if contents are solid. Another method for disposal of liquid paint is to pour the paint out across the tip face.

Because of the relatively small volumes of refuse it may be difficult to cover the controlled waste with other incoming refuse without careful planning. It may be necessary to delay the controlled waste until enough incoming refuse has been stockpiled ready to use as cover, or even to require the customer to bring the controlled waste in smaller quantities over several days. In no circumstances should a pit be excavated where the base of the pit would be within 1m of the liner or within 2m of any outside face. Pits should not be dug in refuse older than 6 months to avoid odours. Early in the life of the landfill it may be necessary to use incoming refuse to create a deeper area for the controlled waste rather than dig into a thin layer of waste.

5.6.7 Difficult Waste

Refer Section 4.2.4. Due to the variable nature of this waste type, all applications to dispose of difficult waste in the landfill will be assessed by the Landfill Operations Supervisor on a case-by-case basis. Nevertheless, items such as stoves and degassed refrigerators need to be thoroughly crushed before landfilling and under no circumstances will be placed within 1 metre of the liner or cap.

5.6.8 Hazardous Waste Management

The facility does not accept hazardous waste except for those wastes that have been pre-treated to remove their hazardous nature. After such treatment they are subject to the approval of the Landfill Manager (Refer Section 4.2.7) and are treated thereafter as a Controlled Waste in accordance with Section 5.6.6.

In the event that a load containing hazardous waste is not accepted at the site, immediate steps will be taken to inform ES as per the instructions in Section 4.2.2. In the event a truck has departed before hazardous waste is identified, the contingency procedure in Section 9.8 will be followed.

5.7 Inspection of Refuse During Discharge

Waste will be inspected by landfill operational staff as each load is discharged (whilst the vehicle is still at the working face), and as it is spread and compacted. Should it be discovered that the load contains hazardous material it will be reloaded onto the same vehicle for appropriate disposal, if possible, or otherwise treated as per Section 9.8. If it is established that a contractor has knowingly brought hazardous waste to the facility, an automatic ban will be enforced.

5.8 Traffic Management

The site is quite restricted and care will be necessary in driving and manoeuvring on the main access road. Permanent signs notifying the 10 km/h speed limit and the requirement to give way to quarry traffic shall be erected as per Appendix 3.1 and maintained in a clean and tidy condition at all times.

Specific signs directing customers to the landfill tip face shall be placed to suit the particular arrangements on any given day. Initially some manoeuvring on the access road will be required but as soon as sufficient refuse is placed manoeuvring areas shall be developed clear of the access road.

Landfill staff should take note of any vehicles observed speeding or otherwise being driven in an unsafe manner and warn the driver accordingly. Repeated offences should be reported to the vehicle owner with a warning that continued bad driving may result in the vehicle being turned away.

Many landfill customers will not be familiar with the site and may not have particularly good driving skills, particularly in terms of reversing up to a restricted tipping area. The design and construction of access roads and manoeuvring areas should take this into account. They should be maintained in good condition and in particular be kept clear of sharp objects likely to cause punctures.

Good access roading is one of the keys to good landfill development. Many customers vehicles will not be capable of traversing steep slopes particularly in wet weather. Grades should not be steeper than 1 in 10 unsurfaced or 1 in 6 with a good metal surface. Surfaces should always be shaped to shed stormwater. Unless geotextiles are used, metal access roads will need regular topping up as the metal works into the underlying refuse/cover layers. Any suitable waste aggregates or similar materials should be stockpiled for the formation and maintenance of temporary access roads. Local contractors should be advised that such materials will be accepted free of charge, subject to prior arrangement with the Landfill Manager. Any suitable aggregate can be used for temporary roading. Crushed coral can be used and has an additional benefit as it will help to reduce the acidity of leachate when the leachate is recirculated through that area later in the landfill's life.

If the excavator method is used it is likely to be practicable and economic to develop a semi permanent manoeuvring area including a transfer pit adjacent to the main road. This can be developed with a good metal surface and means that the direction signs can remain fixed for long periods. It may be able to be used for more than one cell. In effect this will create a lower platform only slightly above the access road level which can be filled at the end of the life of the cell or, if the area is used for access to higher levels, near the end of the life of the landfill.

5.9 Compaction

5.9.1 Compaction Equipment

The object of compaction is to maximise use of the landfill void volume, to assist with providing a smooth running surface for delivery vehicles and reducing windblown litter. Compaction can be provided by either of the following:

- A heavy tracked loader , or
- A heavy tracked hydraulic excavator

The tracked loader is preferred to a standard dozer as it is a more versatile mover of materials. The heavy tracked loader specifications are:

- Dozer D7 or equivalent[3] (minimum flywheel power of 170kW, minimum operating weight 25tonne)
- Standard track width (maximum ground contact area 3.25m^2)
- Tracked loader bucket and hydraulic lifting mechanism of the same functionality as the dozer manufacturers original equipment.

A hydraulic excavator is the preferred choice as it is more versatile and can place wastes more precisely into a smaller working area, and can be used to better control surface runoff. This minimises cover requirements and the attendant usage of landfill void volume. The hydraulic excavator specifications are:

- Operating weight is at least 20 tonnes
- Narrow rather than “swamp” tracks
- Wide bucket without teeth.

Waste will be placed on as small an area as possible and compacted using the bucket and the machines hydraulics. As the area increases tracking shall be used to provide additional compaction. Standard track widths are recommended instead of wider “swamp tracks” because they standard track gives a higher contact pressure on the ground which assists compaction. A steel wheeled landfill compactor is not recommended because of the large area of working face required for effective operation, the increased consumption of cover material, and the attendant loss of landfill void volume.

[3] Note that an ‘equivalent’ machine could include an excavator of similar operating weight

Initially the compaction plant should be hired and, if necessary, various options can be tried to see which is the most effective. The machinery will be one of the most significant costs and as the daily usage will be relatively light, hiring plant may be the most economic. Minimising cover material use is as least as important as compaction for maximising landfill utilisation and the selection of the compaction equipment should consider both aspects.

5.9.2 Waste Compaction

The objectives of waste compaction are to:

- make best use of the landfill volume by packing as much waste in as possible
- reduce the amount of windblown litter before the cover material is placed
- reduce access by vermin before the cover material is placed
- reduce the risk of a deep seated fire taking hold at the landfill

Ideally refuse will be compacted to a density of over 1 tonne per cubic metre and should achieve at least 0.75 t per cubic metre.

Heavy Tracked Loader

Tracked machines obtain high densities on slopes as the refuse is ground and shredded as they climb the slope. For these reasons the optimum dimensions of the face will be approximately 2 metres in height, and will be at an angle not steeper than 5H:1V. The face will be formed from thin layers of waste not more than 300mm loose thickness and compacted by the tracked loader working behind and on the face.

Hydraulic Excavator

The hydraulic excavator places refuse in a limited area by picking it up from a dumping area next to the tip face and placing it in the tip face. The excavator presses and compacts the refuse in layers approximately 300mm thick with the digger bucket as it does so. The objective is place the refuse in as small an area as is practical , ideally building it up into a compacted layer 2 m deep between applications of cover material. This will help to minimise the proportion of the landfill void that is occupied by cover material.

5.10 Cover Material

Cover material will initially be stockpiled in the area to the north of the septage pond area shown in Figure 5-4. As landfilling progresses, some cover material may be stockpiled on areas already landfilled. To ensure that there will always be sufficient cover material available to meet performance requirements, the landfill operator should maintain the stockpile (or another readily available source of cover material) so as there is adequate material to meet cover requirements of the landfill for two weeks. The drain behind the cover material stockpile is to be installed by the Landfill Operational Contractor and maintained in good working order so as to assist with stability of the slope above.

Figure 5-4 Cover Materials Stockpile Location

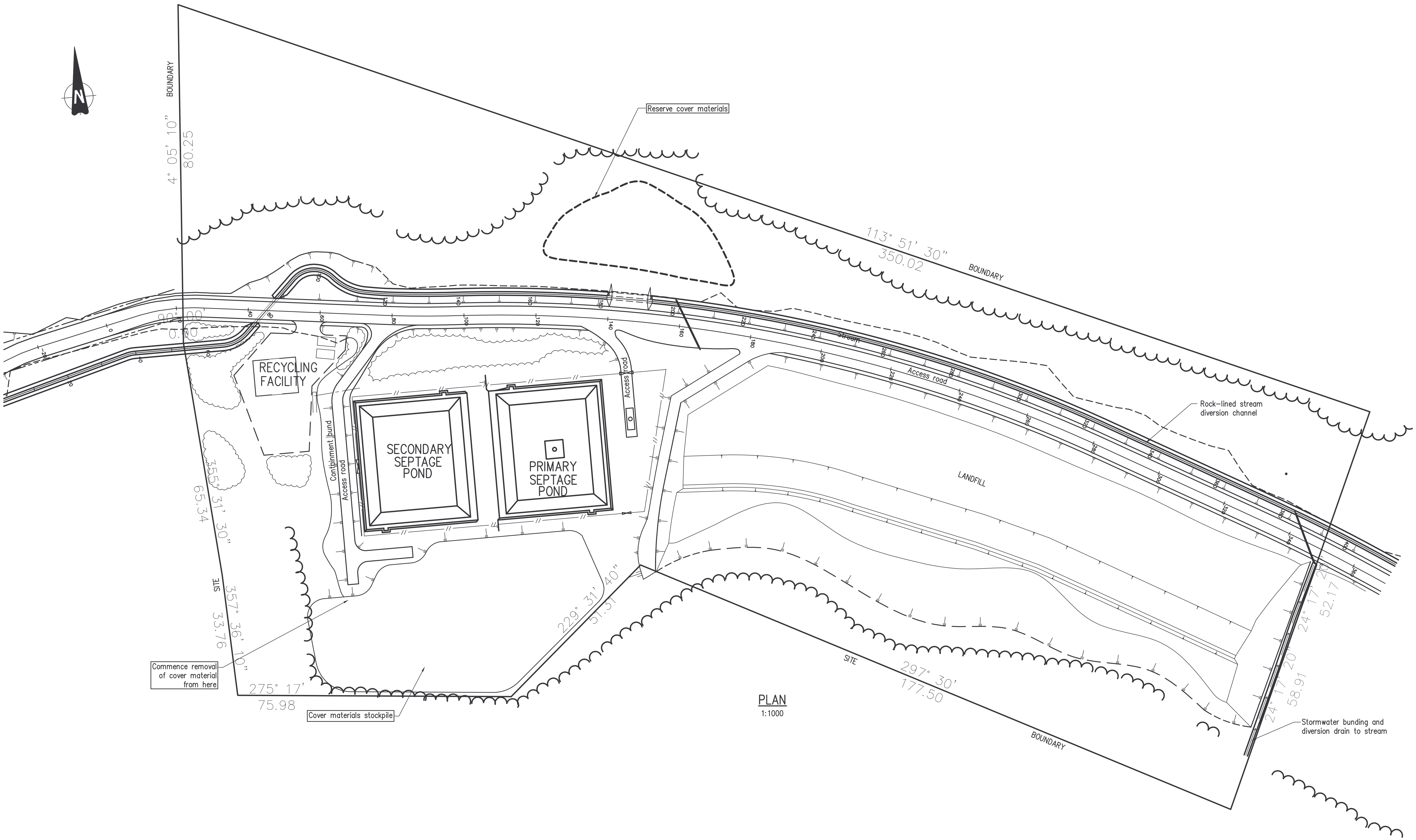

Figure 5–4:
COVER MATERIALS STOCKPILE LOCATION

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5.10.1 Twice-Weekly Cover

The purpose of twice-weekly cover is to contain odours, to deny easy access to the refuse by birds, flies, rodents and other feral animals and to reduce wind blown litter. Twice-weekly cover used is typically inert soil but can include refuse contaminated soil material, green waste/mulch, cleanfill, quarry strippings, hard fill, shredded tyres, crushed glass or any other inert material.

The active face of the landfill will be covered by a nominal thickness of 100mm of material described in the previous section on Wednesday and Saturday of every week. Cover material should be used sparingly. Place as little material as possible to deny access to the refuse by flies and other vermin. The occasional pieces of refuse will be only partly buried and items such as the ends of some plastic bags will still be visible after covering. If no refuse at all can be seen then too much cover is being applied. If fly numbers are high then more cover should be applied and other measures taken. This cover material will be scraped off at the beginning of the subsequent working day and re-used where possible.

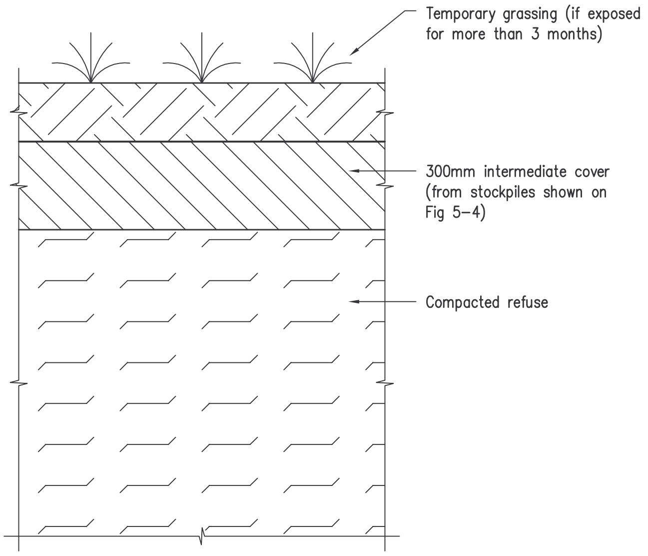
Preventing leachate outbreaks will be achieved by grading all cells towards the central leachate collection drain. Where full removal is impracticable , windows will be cut to expose a minimum of 20% of the surface area of the working face, to allow for gas and leachate movement.

5.10.2 Intermediate Cover

Intermediate cover is used to close off an area that will not receive additional refuse or final cover for some time. Intermediate cover will be 300mm thick and consist of clay or quarry strippings. If the surface is to remain exposed for more than three months, it will be temporarily grassed to minimise erosion and generation of leachate. Refer to Figure 5-5 for a typical cross section.

If additional refuse is to be placed in an area which has intermediate cover, the intermediate cover will be scraped back before refuse placement, then re-used as twice-weekly cover. This is to reduce space wastage within the landfill void and prevent the landfill becoming stratified with impermeable layers. Stratification may cause perched leachate lenses to develop, with the possibility of surface breakouts and also may cause lateral dispersion of landfill gas.

Figure 5-5 Intermediate Cover Cross Section



INTERMEDIATE COVER
CROSS-SECTION
1:25

Figure 5-5:
INTERMEDIATE COVER CROSS-SECTION

5.10.3 Final Cover

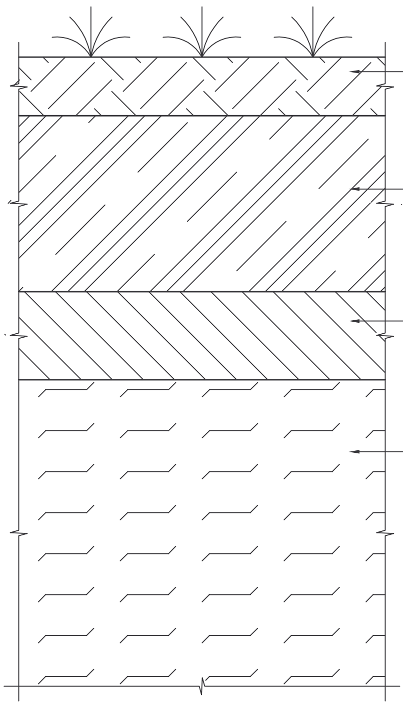
When any substantial section of the landfill reaches its design profile, the final cap of 600mm compacted clay thickness of a permeability of not greater than $1x10^{-7}$ m/s overlain by uncompacted 200mm thickness of topsoil will be placed over the refuse (Refer Figure 5-6 below), and the whole area grassed and planted as described below.

The finished profile will have maximum slopes of 1V:3.5H (and subsequently settling to approximately 1V:4H for ease of maintenance and to minimise erosion), and minimum slopes of 1V:10H to encourage stormwater runoff and to reduce ponding. The final cover design should be reviewed and confirmed at the time of final capping depending on the availability of suitable materials. Refer also to Section 10.2.

When the first section of the landfill requires a final cap, the Landfill Operational Contractor will investigate a variety of planting systems and plant types (in addition to the grass) to determine the optimum planting method for the remainder of the final cap. Factors to be considered include, but are not limited to, the following:

- Speed of plant growth
- Stability of soil during and after plant establishment
- Installation requirements
- Plant mortality rate
- Fertilising requirements
- Maintenance requirements
- Future use

Figure 5-6 Final Cover Cross Section



FINAL COVER
CROSS–SECTION
1:25

Figure 5–6:
FINAL COVER CROSS–SECTION

5.11 Leachate Management

5.11.1 General

The main aim is to control the movement of leachate and to treat it prior to discharge. During the operational life of the landfill it is possible for too much volume of leachate to be produced if the landfill is not well managed. Too much leachate will create difficulties for leachate management and disposal. Leachate production shall be minimised by the following operational procedures:

- Maintenance of the stream diversion and cut-off channel along the eastern and northern boundaries of the site to divert run off away from the operational landfill area.
- Minimising the operational area for waste acceptance (Refer Section 5.5)
- Use of intermediate capping to reduce leachate generation.
- Staged final capping as operations proceed.
- Temporary protection cover over non-operational areas of drainage blanket.

Any leachate generated will drain to the central discharge dual pipelines that pass beneath the western containment bund. The photos provided below outline the construction of the leachate drains.

5.11.2 Leachate Recirculation

The objective of leachate recirculation is to reduce leachate strength by passing it back through the landfill and to promote decomposition of the waste by keeping it moist. Various processes including adsorption onto soil particles act to remove contaminants from the leachate and therefore reduce its strength.

Some of the leachate discharging from the leachate collection system is pumped back to top of the landfill (the Eastern end) and is discharged back into the landfill via a series of trenched pipelines installed at approximately 10m intervals within the refuse mass. The pumping rate is controlled from the leachate pump station – refer Section 5.12.

With each level increase of the refuse, the series of recirculation pipes is renewed. As new recirculation pipes are placed above the old pipes the use of the older pipes will generally be discontinued. A typical cross section of a leachate recirculation trench is shown in Figure 5-7. A proposed layout for the recirculation system is also shown in Figure 5-7.

While the leachate recirculation distribution pipes are Novaflow™ and Novacoil (available from Iplex Pipeline Systems, New Zealand) or equivalent drainage pipes and will eventually crush, the pipe connection from the end of the leachate recirculation rising main to the backbone distribution pipe shall be Iplex Effluent Pipe (75mm OD, PE80B, MDPE, 65.8mm ID, 8 Bar) which can be reused as each level of pipes is installed.

Figure 5-7 Leachate Recirculation Layout and Details

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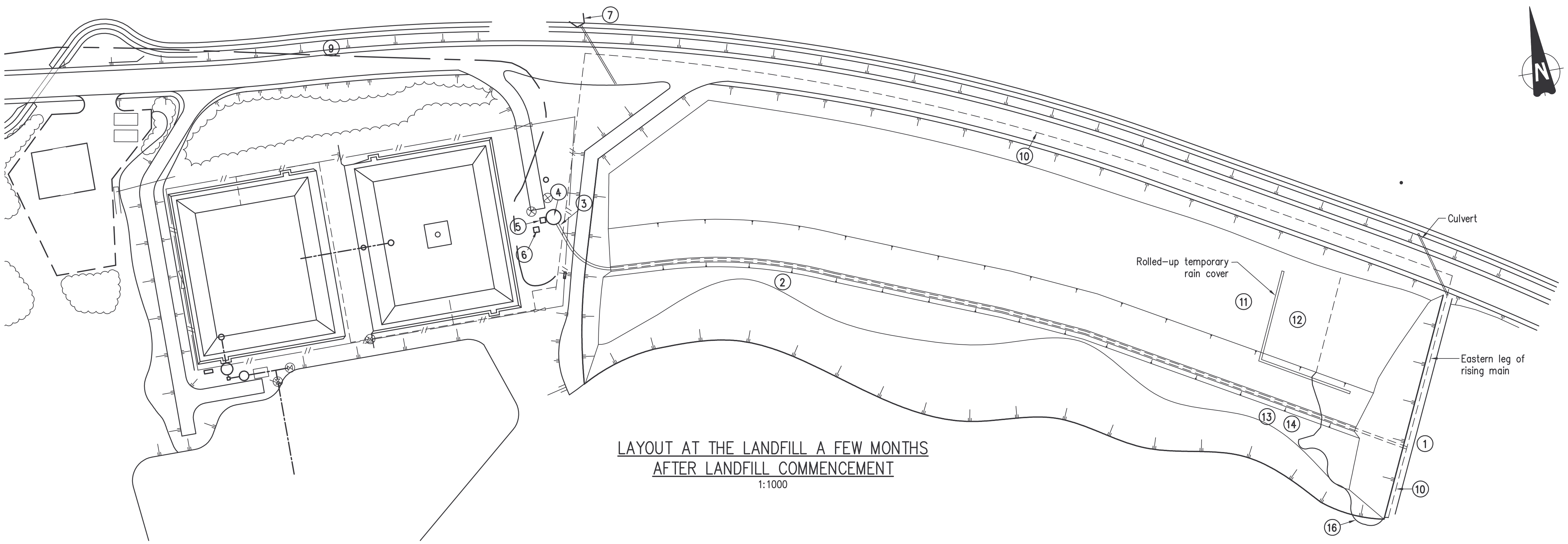
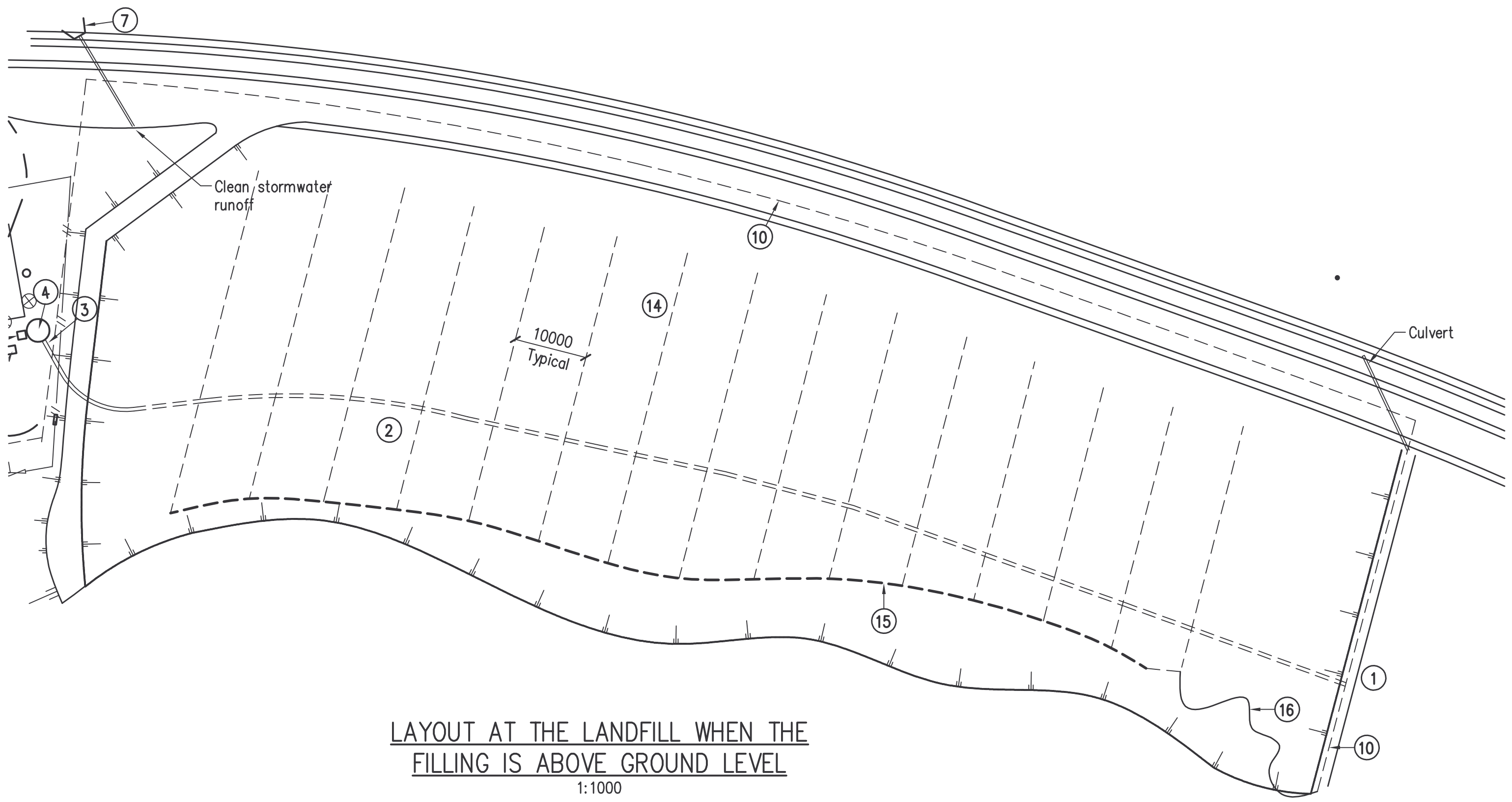


LAYOUT AT THE LANDFILL A FEW MONTHS AFTER LANDFILL COMMENCEMENT
1:1000

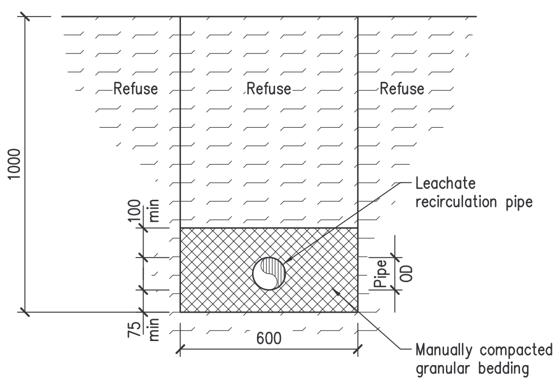
1. Rodding point
2. Leachate collection pipeline (dual)
3. Anchor block
4. Leachate pump station
5. Washdown facility standpipe and hose.
6. Electrical control panel
7. Stormwater outlet structure
8. Portable stormwater pump
9. Power supply cable
10. Leachate rising main
11. Temporary rain cover
12. Operating area
13. Area with temporary rain cover
14. Perforated recirculation pipe (Perforated Novaflo 65mm OD)
15. Recirculation backbone (Unperforated Novacoil 110mm OD)
16. Pipe from rising main to recirculation backbone

LEGEND:

— — — Trenched Pipeline
〜〜〜 Hose (Above ground)



LAYOUT AT THE LANDFILL WHEN THE FILLING IS ABOVE GROUND LEVEL
1:1000



LEACHATE RECIRCULATION PIPE TRENCH
1:25

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Figure 5–7:
LEACHATE RECIRCULATION LAYOUT AND DETAILS

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5.12 Leachate Pump Station

5.12.1 Health and Safety

The Landfill Operational Contractor will be aware of all the health and safety provisions included with this management plan in Section 2.8. In relation to the Leachate Pump Station the following provisions are VERY important:

- NO entry to the pump station without a Permit to Work signed by the Landfill Manager and appropriate Confined Space Entry training
- NO fires within or near the pump station – landfill gas is highly flammable

5.12.2 Operation

The Leachate Pump Station (PS) operation is primarily automated and for normal operations requires little operator intervention beyond initial calibration, daily inspections and daily recording of pump hours. The basic automated control for the pump is to cut-in at the top water level point and cut-out at the low water level point. The programmed control logic is as follows:

- Pump cut-in: Pump station top water level (TWL)
- Pump cut-in: Pump station High Level Alarm
- Pump cut-out: Pump station low water level (LWL)
- Pump cut-out: Pump station Low Level Alarm
- Duty / Standby: Standby to take over duty on pump fault (overload, trip)
- Alternate start of the two pumps on each emptying cycle.

After each pump has run for approximately 500 hours consideration should be given to overriding the alternate start until the one pump has run say 1,000 hours more than the other. This reduces the likelihood of the two pumps needing replacement at about the same time.

The following alarms are transmitted via a text message to a mobile phone nominated by the Landfill Operational Contractor.

- Pump station Low Level alarm
- Pump station High Level alarm
- Pump Faults (overload, failed to start)
- Control Panel Door Opening
- Power Supply Fault greater than four hours.

The main purposes of the Leachate PS are to recirculate leachate into the landfill (Refer Section 5.11.2) for initial treatment and to pump the partially treated leachate into the septage ponds for final treatment. This is achieved by setting the valves on the Leachate Rising Main to divide the flow coming out of the PS such that:

- 20% of the outflow is transmitted to the septage ponds (Refer Section 6.3.1), and
- 80% of the outflow is transmitted to the leachate recirculation rising main (Refer Section 5.11.2).

(Leachate recirculation will not be possible until a few months after commencement of landfill operations, when the first cell has been placed and filled to a depth of 3 to 4m above the floor. Until this time, 100% of the leachate arriving at the leachate PS must be conveyed to the primary septage pond.)

The means of splitting the flows at the above proportions can be set-up using the following method:

1. Using a stopwatch, measure the time required by the pump to remove the working volume from the Leachate PS – the time from cut-in top level to cut-out low level. (Add water to the pump station first if incoming leachate does not fill the working volume to the pump cut-in level, or wait until the PS has filled to the cut-in level). Using Table 5-1 the pump output flow rate and preferred the septage pond input flow rate can be determined.

2. Table 5-1 shows the target flow that should be going to the septage ponds for a particular pump flow rate. To set this flow going to the septage ponds, the control valve on the 50mmOD (falling) pumped main from Leachate Pump Station to the Septage Ponds needs to be adjusted. This control valve is located on the left-hand branch just after the Leachate Pump Station valve chamber. This is done using the following procedure:
   (a) Start with the valve in an almost closed position and slowly increase the flow until the target flow rate is achieved by repeating steps (b) and (c)
   (b) Using a bucket or container of known volume (at least 20 litres) and a stopwatch, time how long (in seconds) the bucket or container takes to fill from the standpipe located at the Arorangi side of the Primary Septage Pond.
   (c) Calculate flow rate by dividing the bucket/container volume (in litres) by the time it took to fill (in seconds). Check this flow rate against the target flow rate Table 5-1 and adjust the valve accordingly.
   (d) When the target flow rate is achieved, measure the flow at least two more times to verify that measured rate is consistent.

3. The flow to the septage ponds can then be divided between the primary and secondary ponds as detailed in Section 6.3.1.

Table 5-1 Leachate Pump Station Flow Rate

Time for PS to remove working volume*		Total Leachate PS Output (litres/sec)	Target Leachate PS Output to Septage Ponds (20%) (litres/sec)	Target Leachate PS Output to Recirculation (80%) (litres/sec)
min	sec			
7	0	2.9	0.57	2.29
7	30	2.7	0.54	2.15
8	0	2.5	0.51	2.02
8	30	2.4	0.48	1.91
9	0	2.3	0.45	1.81
9	30	2.2	0.43	1.73
10	**0**	**2.1****	**0.41**	**1.65**
10	30	2.0	0.39	1.58
11	0	1.9	0.38	1.51
11	30	1.8	0.36	1.45
12	0	1.7	0.35	1.40
12	30	1.7	0.34	1.35
13	0	1.6	0.32	1.30
13	30	1.6	0.31	1.26
14	0	1.5	0.30	1.22
14	30	1.5	0.29	1.18
15	0	1.4	0.29	1.14
15	30	1.4	0.28	1.11
16	0	1.4	0.27	1.08
16	30	1.3	0.26	1.05
17	0	1.3	0.26	1.03
17	30	1.3	0.25	1.00
18	0	1.2	0.24	0.98
18	30	1.2	0.24	0.95
19	0	1.2	0.23	0.93
19	30	1.1	0.23	0.91
20	**0**	**1.1*****	**0.22**	**0.89**

Note:

* This time calculation assumes an inflow of leachate from the landfill of 15m3/day. During initial landfill operation the time required for the PS to remove the working volume may be less than the minimum time value in this table as leachate inflow from the landfill may be lower than this. (If there is no flow from the landfill, then the time to remove the working volume will be 1 to 2 minutes quicker.)

** This is the design value for the PS, and is based on a 1500mm wet well internal diameter and a vertical distance between the cut-in and cut-out floats of 640mm (as per the design drawings). Adjustment of the floats will cause a different flow rate for a particular time from cut-in to cut-out.

*** If this value is reached (and the distance between the floats is still 640mm), the pump requires a full shop service.

5.12.3 Monitoring

(i) Work Day Inspections

The Landfill Operational Contractor will make inspections of the following on every day that the landfill is open:

- Visual Inspection of PS particularly that the floats are hanging free and that there is no debris.
- Check that the level of leachate within pump station is between the floats
- Read and record pump hours of both pumps
- If the pump hours indicate that one pump is not operating normally check using the manual override.

(ii) Leachate Production

The Landfill Operational Contractor will measure the rate of leachate production once per month using the following method:

1. Using a stopwatch, measure the time required for the working volume within the Leachate PS to be filled with leachate (i.e. measure the time between low level cut-out and the high level cut-in of the pumps).
   The working volume can be calculated as follows:
   a. The internal diameter of the wet well is taken as 1,500mm (1.5m). Hence, water surface area is 1.77m^2.
   b. Measure the difference in elevation between the cut-in and cut-out floats. (The design drawings show this as being 0.64m but this may have been constructed differently, or altered by Landfill Operational Contractor or previous operators).
   c. Multiply the surface area by the difference in levels to find the working volume. If the volume is within +/-10% of 1.13m^3, (ie between 1.02 and 1.24 m^3), then Table 5-1 may be used. (Table 5-1 is a summary of the tables in Appendix 5.1. All of the tables in Appendix 5.1 are based on a working volume of 1.13m^3. These tables will need to be revised if the floats have been adjusted to cause the working volume to go outside the range 1.02 and 1.24 m^3.)

2. Compare the time measured to the ranges in Table 5-2 and take the appropriate action. (NOTE: Time ranges and recommendations shown in Table 5-2 only apply if the leachate PS output flow rate is 2.1L/s – detailed tables showing lower output flow rates and action recommendations are included in Appendix 5.1).

(iii) Leachate Composition

Refer Section 8.7.1.

Table 5-2 Leachate Production Table

Leachate PS Working Volume Fill Time (minutes)	Recommended Action
Over 110	No action required – Leachate production is within design parameters
110 to 70	Ensure Temporary Protection System is in place in all non-operational areas of landfill. Check that the temporary stormwater pump is functioning well and not causing a ponding depth of greater than 300mm over the lowest point on the temporary cover (as ponded stormwater could be getting through small leaks in the rain cover). Check landfill area for any sources of extra leachate production – leachate production is close to exceeding pump station capacity.
70 to 40	Find source of extra leachate production – Leachate production will soon exceeded pump station capacity
Less than 40	Find and eliminate source of excess leachate production – Leachate production has exceeded pump station capacity and will overflow into septage ponds

Note:

1. These fill times are based on a 1500mm wet well internal diameter and a vertical distance between the cut-in and cut-out floats of 640mm (as per the design drawings). Adjustment of the floats will cause a different fill time for a given flow rate.
2. The time ranges and recommendations shown in Table 5-2 only apply if the leachate PS output flow rate is 2.1L/s – detailed tables showing lower output flow rates and action recommendations are included in Appendix 5.1. The leachate PS output flow rate is determined according to Section 5.12.2.

5.12.4 Maintenance

The process described in Section 5.12.1 will be repeated every 6 months to ensure the correct proportion of leachate is being is being recirculated to the landfill and to monitor the efficiency of the leachate pumps.

All other maintenance requirements are detailed in Table 5-3.

Table 5-3 Leachate Pump Station Maintenance Schedule

Activity Description	Frequency					
	Work Day	Weekly	Monthly	6-Monthly	12-Monthly	Other
Visual inspection of pumps		✓				
Check level of leachate	✓					
Check operation of primary pump (using manual override)	✓					
Check operation of standby pump (using manual override)	✓					
Read and record pump hours	✓					
Check oil level and consistency in primary and standby pumps				✓ (One week after installation, one month after installation, and 6 monthly thereafter)		(1) If the seals have been replaced, one week after replacement (2) One week after an oil change
Visual inspection of lifting handle and chain			✓			
Check operation of telemetry system			✓			
Visual inspection of valve chamber			✓			
Check bearings and seals on primary and standby pumps				✓		
Perform drawdown test and record pump outputs				✓		
Detailed inspection of complete primary and standby pumps, full service and oil change, by a local mechanic trained by Trimate					✓	
Major overhaul in service shop in Auckland by Trimate or Trimate approved service agent						Once per 3 years

5.12.5 Failure Contingency

Refer Section 9.7.

5.13 Landfill Gas Management

As refuse decomposes in a landfill it gives off landfill gas. Landfill gas is a mixture of carbon dioxide and methane together with hydrogen sulphide and other minor organic constituents that give the gas its characteristic odour. Landfill gas is dangerous because:

- It can cause asphyxiation (suffocation due to lack of oxygen)
- It is flammable and burns with a very hot but INVISIBLE flame.
- It can form an explosive mixture in air.

For these reasons, landfill gas poses a serious potential risk to health and safety.

5.13.1 Passive Gas Wells

The estimated peak landfill gas production is in the order of 80 m^3/hr, which would occur towards the end of the landfill life. At the time of producing this management plan, this volume is too small for energy recovery/utilisation via generation of electricity, or for heating/cooking purposes. It is expected that the high rate of decomposition due to the tropical climate would mean that most landfill gas will be produced during the operational life of the landfill, leaving little landfill gas to be practically harnessed upon completion of the landfill.

The proposed landfill gas management system is to install three vertical passive gas wells, mid height along the length of the landfill, spaced 50 metres apart. Refer to Figure 5-8 for well layout and well construction details.

The wells will be installed during the later phases of landfill operation (ie after the landfill is half full) or upon completion of filling the landfill. Refer to Section 8.5 for landfill gas monitoring provisions.

At this time the Landfill Manager shall evaluate whether destruction of the landfill gas is required for odour, health, safety or climate change concerns. If destruction is required, the gas risers should be fitted with passive flares.

5.13.2 Safety Provisions

Landfill gas poses safety risks primarily in the following areas during all stages of landfilling:

- Explosions or fires due to gas collecting in confined spaces, such as culverts, buildings, ducts or manholes within 200m of the refuse edge or leachate pipeline. Any confined space entry should only be undertaken after receiving the proper training and with good judgement as to what safety measures are required.

- Asphyxiation of people entering culverts, trenches or manholes on or near (within 200m) of the landfill.
- Concentrations of gas at the surface of the landfill may be ignited with a risk of setting fire to the waste.

It is quite possible that landfill gas will collect at the upper end of leachate drainage system. The rodding chamber should be checked for signs of landfill gas every month. Landfill gas has a characteristic odour which is readily distinguishable from the odour of fresh refuse. If gas is detected in the chamber a vent pipe extending 2-3m above ground level should be fitted to the end of the leachate drain.

The only manholes are the chambers for the leachate and septage pump stations and the septage receiving facility, and they are outside the landfill footprint. The leachate pump station nearest to the landfill will be provided with a water seal, primarily, for minimising air infiltration into the leachate system and the landfill. The water seal will also prevent gas infiltration to a limited extent (until a gas pressure higher than the water seal depth is built up within the leachate system).

The risk of asphyxiation of people working in confined spaces will be greatly reduced by thorough training and following appropriate procedures. A Permit to Work system (Refer Section 2.8.2) will operate for work in confined spaces and hot work. For these operations the contractor or employee will have to fill in a form requesting permission to carry out the work intended, this will be authorised by the Landfill Operations Supervisor only when he is satisfied that adequate precautions will be taken and the person/s requesting permission have received adequate instruction.

No smoking or flames will be permitted within the landfill area. This coupled with comprehensive compaction and covering of the waste will significantly reduce the risk of fire.

Figure 5-8 Landfill Gas Layout and Details

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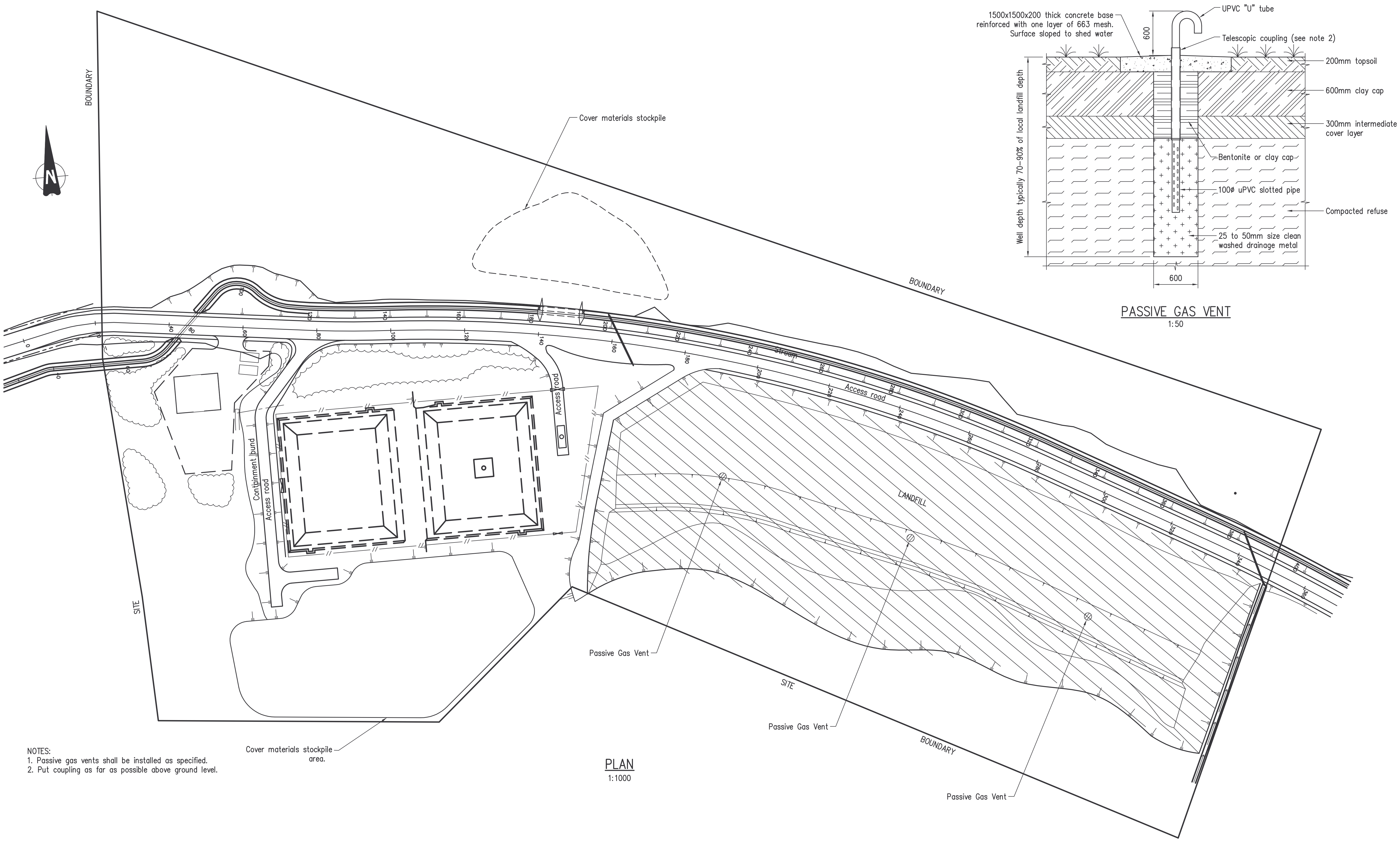

PASSIVE GAS VENT
1:50

PLAN
1:1000

NOTES:
1. Passive gas vents shall be installed as specified.
2. Put coupling as far as possible above ground level.

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RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
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Figure 5–8:
LANDFILL GAS LAYOUT AND DETAILS

5.14 The Quarry/Landfill Interaction

The landfill operation will be coordinated with the quarry operations. Weekly meetings will be held between the Landfill Operations Supervisor and the quarry production manager, the co-ordination of blasting, and other activities will be agreed.

The main risks associated with the quarry are:

- Personnel on foot being run over by quarry traffic
- Vehicle accident with quarry vehicle
- Fly rock from the quarry blasting striking site personnel
- Blast shock waves dislodging materials from slopes above both Northern and Southern highwalls leading to slope failure or falling rocks.

The quarry access road through the landfill has a posted speed limit of 10 km/hr and both managers will need to remind their staff and customers of this. The use of STOP signs and "Give Way to Quarry Traffic" signs as per Appendix 3.1 will assist but quarry drivers must be warned not to rely on public compliance and to drive accordingly.

Prior to blasting, the landfill will be completely cleared of personnel and the blast gates secured and manned until the 'all clear' has been sounded by the shot firer. A notice board will be erected in a prominent position near the kitchen facility of the Site Office displaying the date and time of the next blast.

5.15 Side Liner Construction

5.15.1 General

The sideliner will comprise that portion of landfill liner constructed above the 3m high fillet at the base of the southern highwall. The sideliner will be constructed in lifts approximately 2m high using the landfill surface as a staging area. The sideliner will consist of the following:

1. Trimming / scaling of highwall to remove loose rocks. This is limited to rocks which are able to be moved by hand.

2. A compacted clay liner with target permeability less than 1 x 10^{-9} m/s, having a minimum width of 1500mm measured in the horizontal plane.

3. Two layers of low-density polyethylene (LDPE) sheets.

4. Sand (or approved equivalent) drainage / protection blanket.

Figure 5-9 shows the construction details of the side liner.

Figure 5-9 Side Liner Construction Details

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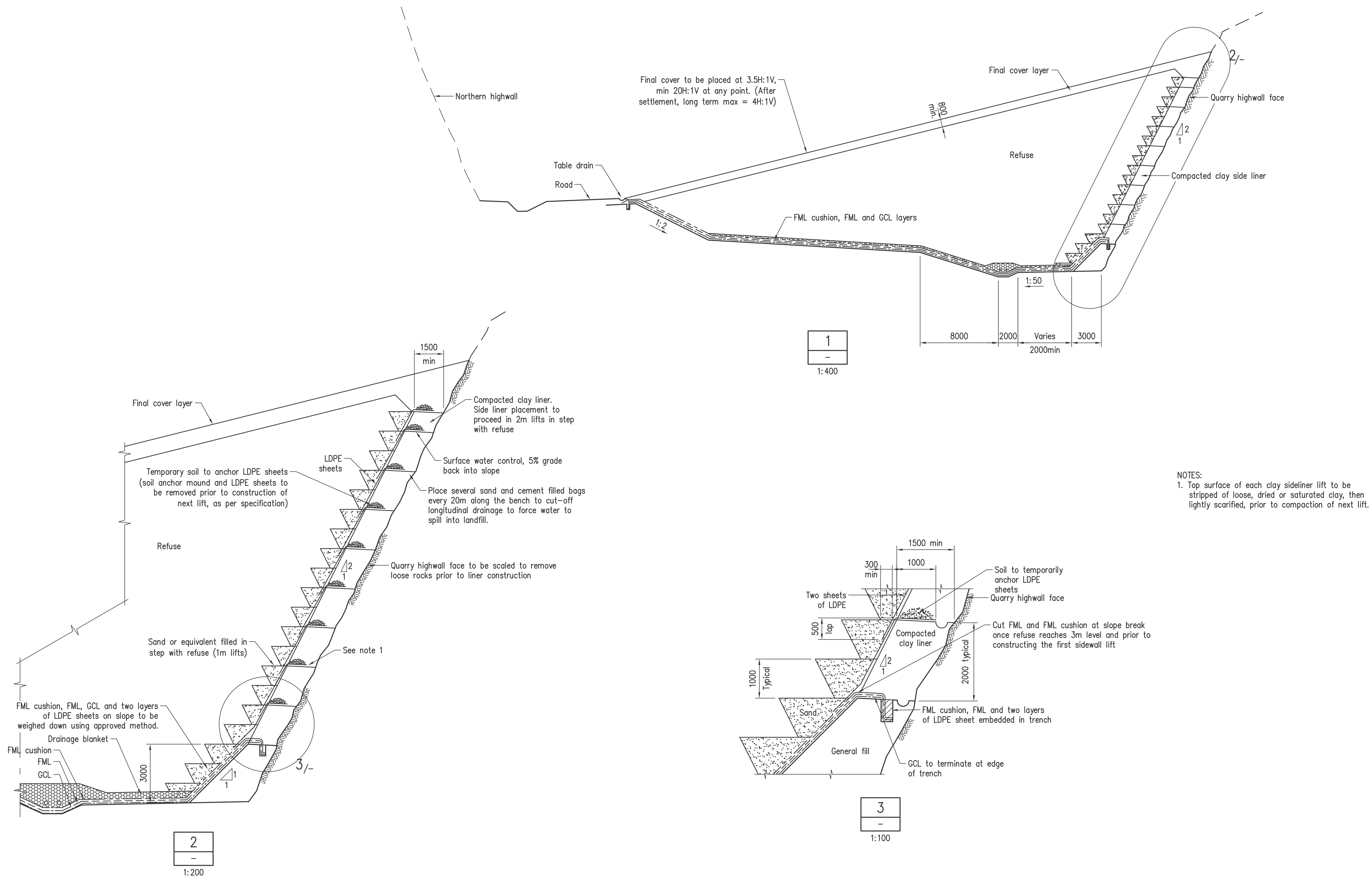

RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
ISSUE 2 – FACILITY OPERATION

Figure 5–9:
SIDE LINER CONSTRUCTION DETAILS

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5.15.2 Trimming / Scaling of Highwall

Prior to construction of the sideliner, all soil and vegetation will be removed from the rock surface. Any unstable rock masses will either be scaled to remove any loose fragments that may dislodge during the process of liner placement or alternatively stabilised with remedial works such as rock bolts, shotcreting or netting.

5.15.3 Compacted Clay Side Liner

(i) Source Material

Prior to construction commencing, the proposed borrow source is to be tested to determine compaction and permeability characteristics. The table below outlines the type and quantity of tests required to verify the suitability of any borrow material for construction of the compacted clay side liner.

Table 5-4 Pre-Construction Test Frequency

Parameter	Test & Standard	Frequency
Maximum Dry Density Optimum Water Content	NZS 4402: 1986 Test 1.1.1	2 per distinct material type
Plasticity index	NZS 4402: 1986 Test 2.4	2 per distinct material type
Permeability	BS1377: 1990 : Part 6 : Test 6	2 per distinct material type

(ii) Material Conditioning

The material for the compacted clay side liner will be free from all vegetation, other organic matter and rock fragments. Before placement and compaction, material will be broken up into particles not greater than 50mm maximum size and brought to the target water content. These requirements will be achieved by conditioning materials in the borrow area. Conditioning means breaking up clods, drying, wetting and blending materials. This shall involve the use of towed construction discs, tynes, rotary hoes, water cart, graders or bulldozers as appropriate. Target water content for the liner is 3% above NZ Standard Compaction Optimum Water Content (OWC).

(iii) Material Placement

Achieving the required specification will require field trials to determine optimum compaction conditions (eg type of equipment and number of passes), and the minimum period to allow the material to dry or absorb any additional water, as required.

It is important to ensure that clay material is adequately compacted against the highwall rock, and in particular, cavities and hollows in the rock surface. It is likely that hand compaction techniques will be required to achieve this.

Conditioned materials shall be spread on the sideliner in layers not exceeding 150mm loose thickness. Each layer shall be levelled by a blade before or during the first pass of the compactor. Compacted material shall comply with the criteria specified in the table below.

Table 5-5 Clay Liner Test Requirements and Compaction Criteria

Parameter	Test & Standard	Location & Frequency	Single Test Value	Average of any 10 consecutive Tests
In situ density	NZS 4402: 1986 Test 5.1.1 & NDM Endorsed method	Each compacted layer 1 per 100 m3	-	-
Water content	NZS 4402: 1986 Test 2.1	Each compacted layer 1 per 100 m3	-	-
Vane Shear Strength	Pilcon Vane Manufacturers notes NZGS (2001)	Each compacted layer 1 per 100 m3	120 kPa minimum	140 kPa minimum
Solid density	NZS 4402: 1986 Test 2.7.2	1 per 5000 m3	-	-
Air voids	NZS 4402: 1986 Test 5.1.1	Each compacted layer 1 per 100 m3	5 percent maximum	3 percent maximum
Plasticity index	NZS 4402: 1986 Test 2.4	1 per 1000 m3	>15	-
Residual Weave	Straight edge.	As required	30mm max	Not applicable

Notes:

- During the initial stages of side liner construction, testing will be carried out to establish a correlation between the laboratory water content and in situ density obtained from the sand replacement test and the density and water content obtained from the Nuclear Density Meter (NDM) test. For construction, the NDM test frequency will be as specified except that a Sand Replacement Test will be performed with every tenth NDM test and density and water content correlations updated. At each density measurement site, a water content sample will be taken and Pilcon shear vane test carried out

- Seed replacement or Balloon density methods may be used if the Contractor has difficulty with sand calibration for the Sand Replacement Test
- A NDM density/water content test will comprise the removal of at least 50 mm of compacted fill to give a smooth, level surface. Pre formation of the NDM probe hole to extend 100mm into the underlying layer. Seat the NDM and record a set of density and water content readings. Rotate the NDM 120 degrees about the inserted probe and repeat. Rotate the NDM a further 120 degrees about the inserted probe and repeat. In the event that the NDM probe strikes rock and cannot extend to full depth, the NDM will be moved and the test repeated. The presence of the rock will be recorded on the test sheet.
- A Vane Shear Strength test will comprise 6 individual measurements taken over the test site after completion of density testing. The Vane Shear Strength of the compacted soil at each test site will be the average value. The Pilcon vane(s) to be used for testing shall be calibrated before use on the site. The Vane Shear Strength is to be defined as per NZ Geomechanics Society Guidelines for Hand Held Shear Vane Test (2001).
- The air voids of the compacted soil at each test site will be the average of the 3 air voids values determined from the NDM test. The latest solid density value for the type of soil tested will be used.
- Residual weave shall be the measured dimension from a straight edge placed over two adjacent high points and the low point between (eg a wheel rut or roller depression).

Weave may occur when the undrained shear strength is acceptable but high water content and low air voids produce high pore pressures which cause surface deformation (ie. weave). This can be avoided by appropriate control of water content, compactive effort and control of plant trafficking.

The finished top surface of each lift of the side liner will be graded toward the temporary stormwater drain to achieve the design profile with no ponding. The finished surface of each 2m lift will be rolled with a smooth drum roller to prevent saturation of near surface material. Should construction of the liner cease at any stage during construction, the surface of the liner will be graded and cut smooth and rolled with a smooth drum roller to prevent ponding and/or saturation of the near surface liner material. Compacted surfaces that have dried, been rolled smooth, eroded, softened, heaved or become damaged in any other way that will preclude a tight bond between successive layers will be removed and the exposed surface scarified so that maximum bonding between the old and new fill is achieved.

The specified 1500mm compacted clay side liner width is a minimum value. The landfill operations contractor shall ensure that survey control and initial works provide for this and ensure compliance with the specified position and level of other landfill elements.

Material and construction that does not comply with the compaction criteria will be removed and replaced until compliance is achieved.

(iv) Side Liner Surface Tolerances

The top surface of the side liner shall be trimmed to avoid the ponding of water. There shall be a crossfall into the rock face of 5%, a longitudinal V drain approximately 300mm wide and at least 150mm deep and a longitudinal gradient of approximately 5%.

The finished surface will be smooth and free from protruding rocks, stones, sticks, roots, sharp objects, or debris of any kind and will provide a firm unyielding foundation for the LDPE sheet with no sudden, sharp or abrupt changes or break in grade.

5.15.4 Two Layers of Low-Density Polyethylene (LDPE) Sheets

Two layers of low-density polyethylene (>250µm) are to be laid against the trimmed compacted clay side liner face. The LDPE sheets are to overlay by a minimum of 500mm the sheets covering the lift below and are to be temporarily anchored by lapping the sheets on the top of the compacted clay liner surface and weighted down with soil or equivalent material. Prior to construction the next 2m lift, the LDPE sheets are to be cut at the edge where the top surface of the existing lift meets the side face of the existing lift. The plastic sheet and weighting material will then be removed from the top surface of the existing lift.

5.15.5 Sand Drainage / Protection Blanket

As inferred in Figure 5-9, the refuse would be placed almost to the base of the fillet. At this time, plant travelling over the waste would place a 'wedge' of sand (or equivalent material) between the waste and the liner on the fillet. The wedges are indicated by the saw-tooth like shapes up the face of the side liner system. The protection blanket is to be a minimum thickness of 300mm measured horizontal to the side liner. The blanket material will have a minimum permeability of 1×10^{-5} m/s.

The sand can not be of coral origin due to attack by leachate. That is, sand from the harbour, lagoon, beaches and properties on the coastal flats of Rarotonga are not acceptable. The most appropriate source is from a basalt rock quarry such as T&M Heather. The sand does not need to have a specific grading, except for the requirement to meet the aforementioned permeability requirement. Crusher dust or any surplus material ranging from sand to 20mm chip (like the leachate drainage blanket) is acceptable.

5.15.6 Drainage

Refer to Section 7.4.2. Surface runoff along the bench at the top edge of the side liner shall be directed into or beyond the landfill, where possible to areas where it can be collected and diverted away from contact with refuse. The exact method will be determined on site to suit but may include sand bag diversion weirs and/or flexible pipes. Any sand bags used are to be filled with cement stabilised sand or soil so as to form a solid barrier that is not reliant on the fabric bag for long term durability.

5.16 Landfill Life Assessment

On or around 30 June each year the Landfill Manager will commission a topographic survey of the landfill and will check the following;

- Volume of landfill void consumed over preceding year

- Average refuse placed density (based on volume of air void used and refuse quantity accepted)
- Expected landfill life at current rate of void usage.
- Review disposal charges in conjunction with the CIIC.

Appendix 5.1

Leachate PS Operating Ranges

Leachate Production Tables 2.1 L/s

1.13	m3	Pump Station Working Volume
2.10	L/s	Pump Station Output Flow Rate

Leachate PS Working Volume Fill Time (min)	Leachate Production Rate			Required Recirculation Rate (m3/day)	Minimum Leachate Pump Hours	Leachate Flow to Septage Ponds			Action Required
	(L/min)	(L/sec)	(m3/day)			Flow Rate (m3/day)	Flow Rate (L/min)	Flow Rate (L/sec)	
15	75.40	1.26	108.6	542.9	71.8	108.57	75.40	1.26	Design Parameters have been exceeded
20	56.55	0.94	81.4	407.2	53.9	81.43	56.55	0.94	
25	45.24	0.75	65.1	325.7	43.1	65.14	45.24	0.75	
30	37.70	0.63	54.3	271.4	35.9	54.29	37.70	0.63	
35	32.31	0.54	46.5	232.7	30.8	46.53	32.31	0.54	
40	28.27	0.47	40.7	203.6	26.9	40.72	28.27	0.47	
45	25.13	0.42	36.2	181.0	23.9	36.19	25.13	0.42	
50	22.62	0.38	32.6	162.9	21.5	32.57	22.62	0.38	
55	20.56	0.34	29.6	148.1	19.6	29.61	20.56	0.34	Design Parameters will soon be exceeded
60	18.85	0.31	27.1	135.7	18.0	27.14	18.85	0.31	
65	17.40	0.29	25.1	125.3	16.6	25.06	17.40	0.29	
70	16.16	0.27	23.3	116.3	15.4	23.27	16.16	0.27	
75	15.08	0.25	21.7	108.6	14.4	21.71	15.08	0.25	
80	14.14	0.24	20.4	101.8	13.5	20.36	14.14	0.24	
85	13.31	0.22	19.2	95.8	12.7	19.16	13.31	0.22	
90	12.57	0.21	18.1	90.5	12.0	18.10	12.57	0.21	
95	11.90	0.20	17.1	85.7	11.3	17.14	11.90	0.20	
100	11.31	0.19	16.3	81.4	10.8	16.29	11.31	0.19	
105	10.77	0.18	15.5	77.6	10.3	15.51	10.77	0.18	
110	10.28	0.17	14.8	74.0	9.8	14.81	10.28	0.17	No Action Required
115	9.83	0.16	14.2	70.8	9.4	14.16	9.83	0.16	
120	9.42	0.16	13.6	67.9	9.0	13.57	9.42	0.16	
125	9.05	0.15	13.0	65.1	8.6	13.03	9.05	0.15	
130	8.70	0.14	12.5	62.6	8.3	12.53	8.70	0.14	
135	8.38	0.14	12.1	60.3	8.0	12.06	8.38	0.14	
140	8.08	0.13	11.6	58.2	7.7	11.63	8.08	0.13	
145	7.80	0.13	11.2	56.2	7.4	11.23	7.80	0.13	
150	7.54	0.13	10.9	54.3	7.2	10.86	7.54	0.13	
155	7.30	0.12	10.5	52.5	6.9	10.51	7.30	0.12	
160	7.07	0.12	10.2	50.9	6.7	10.18	7.07	0.12	
165	6.85	0.11	9.9	49.4	6.5	9.87	6.85	0.11	
170	6.65	0.11	9.6	47.9	6.3	9.58	6.65	0.11	
175	6.46	0.11	9.3	46.5	6.2	9.31	6.46	0.11	
180	6.28	0.10	9.0	45.2	6.0	9.05	6.28	0.10	

Leachate Production Tables 1.8 L/s

1.13	m3	Pump Station Working Volume
1.80	L/s	Pump Station Output Flow Rate

Leachate PS Working Volume Fill Time (min)	Leachate Production Rate			Required Recirculation Rate (m3/day)	Minimum Leachate Pump Hours	Leachate Flow to Septage Ponds			Action Required
	(L/min)	(L/sec)	(m3/day)			Flow Rate (m3/day)	Flow Rate (L/min)	Flow Rate (L/sec)	
15	75.40	1.26	108.6	542.9	83.8	108.57	75.40	1.26	Design Parameters have been exceeded
20	56.55	0.94	81.4	407.2	62.8	81.43	56.55	0.94	
25	45.24	0.75	65.1	325.7	50.3	65.14	45.24	0.75	
30	37.70	0.63	54.3	271.4	41.9	54.29	37.70	0.63	
35	32.31	0.54	46.5	232.7	35.9	46.53	32.31	0.54	
40	28.27	0.47	40.7	203.6	31.4	40.72	28.27	0.47	
45	25.13	0.42	36.2	181.0	27.9	36.19	25.13	0.42	
50	22.62	0.38	32.6	162.9	25.1	32.57	22.62	0.38	
55	20.56	0.34	29.6	148.1	22.8	29.61	20.56	0.34	
60	18.85	0.31	27.1	135.7	20.9	27.14	18.85	0.31	Design Parameters will soon be exceeded
65	17.40	0.29	25.1	125.3	19.3	25.06	17.40	0.29	
70	16.16	0.27	23.3	116.3	18.0	23.27	16.16	0.27	
75	15.08	0.25	21.7	108.6	16.8	21.71	15.08	0.25	
80	14.14	0.24	20.4	101.8	15.7	20.36	14.14	0.24	
85	13.31	0.22	19.2	95.8	14.8	19.16	13.31	0.22	
90	12.57	0.21	18.1	90.5	14.0	18.10	12.57	0.21	
95	11.90	0.20	17.1	85.7	13.2	17.14	11.90	0.20	
100	11.31	0.19	16.3	81.4	12.6	16.29	11.31	0.19	
105	10.77	0.18	15.5	77.6	12.0	15.51	10.77	0.18	
110	10.28	0.17	14.8	74.0	11.4	14.81	10.28	0.17	
115	9.83	0.16	14.2	70.8	10.9	14.16	9.83	0.16	
120	9.42	0.16	13.6	67.9	10.5	13.57	9.42	0.16	
125	9.05	0.15	13.0	65.1	10.1	13.03	9.05	0.15	No Action Required
130	8.70	0.14	12.5	62.6	9.7	12.53	8.70	0.14	
135	8.38	0.14	12.1	60.3	9.3	12.06	8.38	0.14	
140	8.08	0.13	11.6	58.2	9.0	11.63	8.08	0.13	
145	7.80	0.13	11.2	56.2	8.7	11.23	7.80	0.13	
150	7.54	0.13	10.9	54.3	8.4	10.86	7.54	0.13	
155	7.30	0.12	10.5	52.5	8.1	10.51	7.30	0.12	
160	7.07	0.12	10.2	50.9	7.9	10.18	7.07	0.12	
165	6.85	0.11	9.9	49.4	7.6	9.87	6.85	0.11	
170	6.65	0.11	9.6	47.9	7.4	9.58	6.65	0.11	
175	6.46	0.11	9.3	46.5	7.2	9.31	6.46	0.11	
180	6.28	0.10	9.0	45.2	7.0	9.05	6.28	0.10	

Leachate Production Tables 1.4 L/s

1.13	m3	Pump Station Working Volume
1.40	L/s	Pump Station Output Flow Rate

Leachate PS Working Volume Fill Time (min)	Leachate Production Rate			Required Recirculation Rate (m3/day)	Minimum Leachate Pump Hours	Leachate Flow to Septage Ponds			Action Required
	(L/min)	(L/sec)	(m3/day)			Flow Rate (m3/day)	Flow Rate (L/min)	Flow Rate (L/sec)	
15	75.40	1.26	108.6	542.9	107.7	108.57	75.40	1.26	Design Parameters have been exceeded
20	56.55	0.94	81.4	407.2	80.8	81.43	56.55	0.94	
25	45.24	0.75	65.1	325.7	64.6	65.14	45.24	0.75	
30	37.70	0.63	54.3	271.4	53.9	54.29	37.70	0.63	
35	32.31	0.54	46.5	232.7	46.2	46.53	32.31	0.54	
40	28.27	0.47	40.7	203.6	40.4	40.72	28.27	0.47	
45	25.13	0.42	36.2	181.0	35.9	36.19	25.13	0.42	
50	22.62	0.38	32.6	162.9	32.3	32.57	22.62	0.38	
55	20.56	0.34	29.6	148.1	29.4	29.61	20.56	0.34	
60	18.85	0.31	27.1	135.7	26.9	27.14	18.85	0.31	
65	17.40	0.29	25.1	125.3	24.9	25.06	17.40	0.29	
70	16.16	0.27	23.3	116.3	23.1	23.27	16.16	0.27	
75	15.08	0.25	21.7	108.6	21.5	21.71	15.08	0.25	
80	14.14	0.24	20.4	101.8	20.2	20.36	14.14	0.24	Design Parameters will soon be exceeded
85	13.31	0.22	19.2	95.8	19.0	19.16	13.31	0.22	
90	12.57	0.21	18.1	90.5	18.0	18.10	12.57	0.21	
95	11.90	0.20	17.1	85.7	17.0	17.14	11.90	0.20	
100	11.31	0.19	16.3	81.4	16.2	16.29	11.31	0.19	
105	10.77	0.18	15.5	77.6	15.4	15.51	10.77	0.18	
110	10.28	0.17	14.8	74.0	14.7	14.81	10.28	0.17	
115	9.83	0.16	14.2	70.8	14.0	14.16	9.83	0.16	
120	9.42	0.16	13.6	67.9	13.5	13.57	9.42	0.16	
125	9.05	0.15	13.0	65.1	12.9	13.03	9.05	0.15	
130	8.70	0.14	12.5	62.6	12.4	12.53	8.70	0.14	
135	8.38	0.14	12.1	60.3	12.0	12.06	8.38	0.14	
140	8.08	0.13	11.6	58.2	11.5	11.63	8.08	0.13	
145	7.80	0.13	11.2	56.2	11.1	11.23	7.80	0.13	
150	7.54	0.13	10.9	54.3	10.8	10.86	7.54	0.13	
155	7.30	0.12	10.5	52.5	10.4	10.51	7.30	0.12	
160	7.07	0.12	10.2	50.9	10.1	10.18	7.07	0.12	No Action Required
165	6.85	0.11	9.9	49.4	9.8	9.87	6.85	0.11	
170	6.65	0.11	9.6	47.9	9.5	9.58	6.65	0.11	
175	6.46	0.11	9.3	46.5	9.2	9.31	6.46	0.11	
180	6.28	0.10	9.0	45.2	9.0	9.05	6.28	0.10	

Leachate Production Tables 1 L/s

1.13	m3	Pump Station Working Volume
1.00	L/s	Pump Station Output Flow Rate

Leachate PS Working Volume Fill Time (min)	Leachate Production Rate			Required Recirculation Rate (m3/day)	Minimum Leachate Pump Hours	Leachate Flow to Septage Ponds			Action Required
	(L/min)	(L/sec)	(m3/day)			Flow Rate (m3/day)	Flow Rate (L/min)	Flow Rate (L/sec)	
15	75.40	1.26	108.6	542.9	150.8	108.57	75.40	1.26	Design Parameters have been exceeded
20	56.55	0.94	81.4	407.2	113.1	81.43	56.55	0.94	
25	45.24	0.75	65.1	325.7	90.5	65.14	45.24	0.75	
30	37.70	0.63	54.3	271.4	75.4	54.29	37.70	0.63	
35	32.31	0.54	46.5	232.7	64.6	46.53	32.31	0.54	
40	28.27	0.47	40.7	203.6	56.5	40.72	28.27	0.47	
45	25.13	0.42	36.2	181.0	50.3	36.19	25.13	0.42	
50	22.62	0.38	32.6	162.9	45.2	32.57	22.62	0.38	
55	20.56	0.34	29.6	148.1	41.1	29.61	20.56	0.34	
60	18.85	0.31	27.1	135.7	37.7	27.14	18.85	0.31	
65	17.40	0.29	25.1	125.3	34.8	25.06	17.40	0.29	
70	16.16	0.27	23.3	116.3	32.3	23.27	16.16	0.27	
75	15.08	0.25	21.7	108.6	30.2	21.71	15.08	0.25	
80	14.14	0.24	20.4	101.8	28.3	20.36	14.14	0.24	
85	13.31	0.22	19.2	95.8	26.6	19.16	13.31	0.22	
90	12.57	0.21	18.1	90.5	25.1	18.10	12.57	0.21	
95	11.90	0.20	17.1	85.7	23.8	17.14	11.90	0.20	
100	11.31	0.19	16.3	81.4	22.6	16.29	11.31	0.19	
105	10.77	0.18	15.5	77.6	21.5	15.51	10.77	0.18	
110	10.28	0.17	14.8	74.0	20.6	14.81	10.28	0.17	Design Parameters will soon be exceeded
115	9.83	0.16	14.2	70.8	19.7	14.16	9.83	0.16	
120	9.42	0.16	13.6	67.9	18.8	13.57	9.42	0.16	
125	9.05	0.15	13.0	65.1	18.1	13.03	9.05	0.15	
130	8.70	0.14	12.5	62.6	17.4	12.53	8.70	0.14	
135	8.38	0.14	12.1	60.3	16.8	12.06	8.38	0.14	
140	8.08	0.13	11.6	58.2	16.2	11.63	8.08	0.13	
145	7.80	0.13	11.2	56.2	15.6	11.23	7.80	0.13	
150	7.54	0.13	10.9	54.3	15.1	10.86	7.54	0.13	
155	7.30	0.12	10.5	52.5	14.6	10.51	7.30	0.12	
160	7.07	0.12	10.2	50.9	14.1	10.18	7.07	0.12	
165	6.85	0.11	9.9	49.4	13.7	9.87	6.85	0.11	
170	6.65	0.11	9.6	47.9	13.3	9.58	6.65	0.11	
175	6.46	0.11	9.3	46.5	12.9	9.31	6.46	0.11	
180	6.28	0.10	9.0	45.2	12.6	9.05	6.28	0.10	

6.0 Septage Pond Operational Procedures

6.1 Key Principles

The following are the key principles of the procedures for operation of the Septage Ponds.

1. The septage receiving and treatment facility is designed to deliver international standard environmental performance.
2. In order for the septage facility to achieve these environmental performance standards, it must be operated using the recommended procedures.
3. The septage pond system is a biological treatment system and will vary with loading and seasonal factors. Therefore, appropriate management of the system is required for optimum performance.
4. Only septage (liquid waste pumped from septic tanks- Refer Section 4.3.2) will be discharged into the septage ponds, whereas all bulk liquid waste (all other types of liquid waste – Refer Section 4.3.6) will be disposed of in the landfill area.

6.2 Septage Receiving Facility

6.2.1 General

The Septage Receiving Facility is located adjacent to the Primary Septage Pond. The purpose of the facility is to receive septic tank waste from septage tankers. The operation of the facility will be as follows:

1. The septage tanker will enter the site through the main gate and be subjected to the acceptance procedure as per Section 4.3.5.
2. After having the load accepted, the septage tanker will then proceed to the septage receiving station.
3. The septage tanker will enter the septage pond access road adjacent to the primary pond and park in position on the concrete pad, over the receiving manhole grate.
4. The septage tanker will discharge its load into the receiving manhole under the supervision of a member of the Landfill Operations Staff. The Landfill Operations staff member will observe the discharge and take note of any unusual odour, colour or consistency of the septage and ensure the receiving manhole is not overfilled. The discharge will be stopped immediately if any unacceptable substances are suspected – Refer Section 4.3.
5. On completion of discharge, the receiving manhole, surrounding concrete pad and any parts of the septage tanker fouled with septage will be cleaned as per Section 6.2.2.
6. The septage tanker will reverse into the turning area, turn around, then proceed off site. The Landfill Operations Staff member will ensure the gate to the septage pond area is securely CLOSED as the tanker leaves (Refer Section 2.10).

Photos showing the construction of the septage ponds have been provided below

Photo 6-1 First floor panel of Secondary Septage Pond

In this photo the first floor panel in the Secondary Septage Pond has been poured. Note the Geo-Composite Liner (GCL) extending from beneath the concrete. This photo is taken from the sea-ward side of the Secondary Septage Pond looking in the direction of the landfill.

Photo 6-2 Primary Septage Pond Under Construction

The Geo-Composite Liner (GCL) has been laid over the subgrade floor before pouring the two concrete floor panels. The GCL for the intermediate panel is being placed. Note the pit in the centre of the pond where the sludge "bubbles up" from the septage receiving facility. The photo is viewed from the quarry access road in the vicinity of the Waste Acceptance Controller office.

Photo 6-3 Placing Concrete by Shotcrete method to Secondary Pond Side Walls

Placing concrete (by Shotcrete method) to the Secondary Pond side walls after having placed the Geo-Composite Liner (GCL). (Viewed with the Avarua end of the strip of land between the two Ponds).

Photo 6-4 Primary Septage Pond complete

A month prior to completion of the construction contract, the Primary Septage Pond is complete and already holding rain stormwater from the landfill. (Viewed from the vicinity of the Waste Acceptance Controller office).

6.2.2 Cleaning

To ensure a safe and healthy working environment is maintained and to avoid generation of unpleasant odours, the receiving manhole, concrete pad and septage tanker must be thoroughly cleaned after every load discharge.

A high pressure hose and nozzle are supplied adjacent to the septage receiving facility to allow thorough cleaning of the area. All areas fouled with septage must be hosed down in such a manner that all the spilled septage is washed into the receiving manhole. The grate of the receiving manhole must be thoroughly cleaned by removing all materials trapped on the grate and disposing of them in the landfill. Waste material removed from the receiving manhole grate will be treated as Controlled Waste (refer Section 5.6.6) when placed in the landfill (NOTE: No person will enter the septage receiving manhole without following the procedures detailed in Section 2.8). The walls and grate of the receiving manhole must then be hosed down to remove any remaining septage.

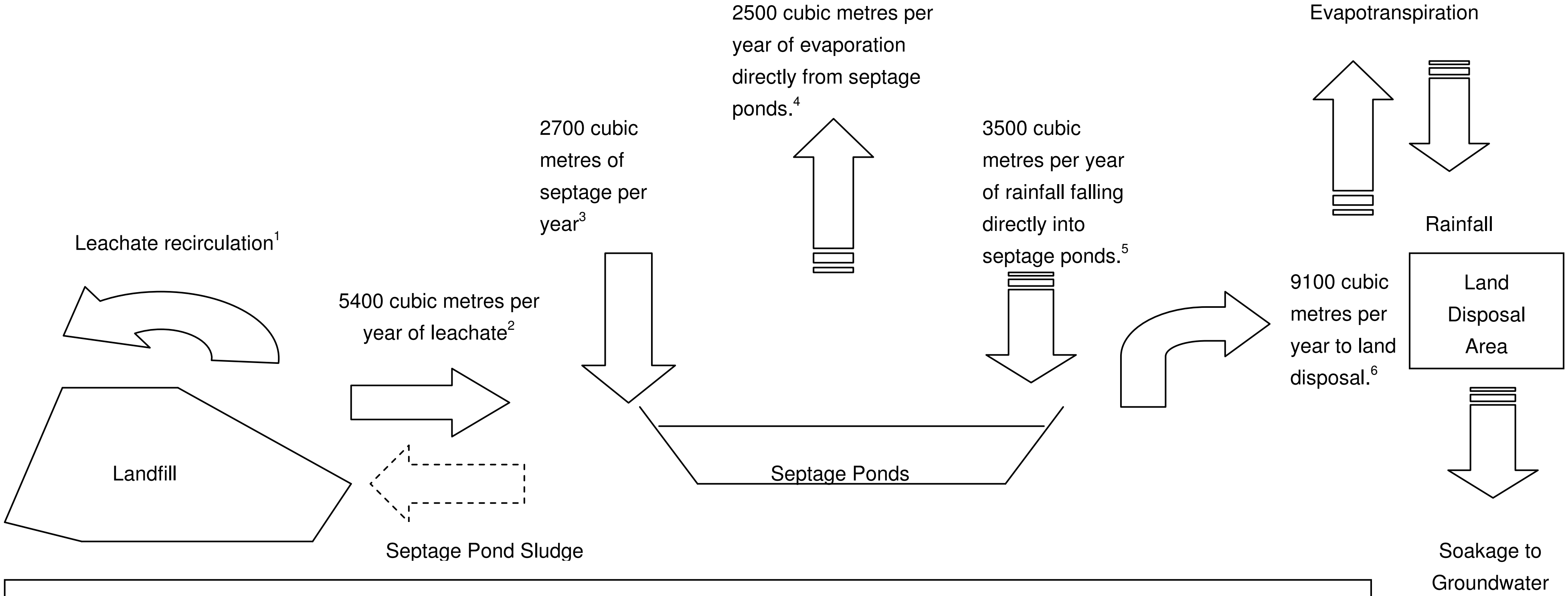
In addition to cleaning the receiving facility, any septage spilled on the septage tanker must be washed off while the tanker is on the concrete pad. This is to ensure septage does not get spread over the main site access roads and cause a public health hazard.

6.3 Septage Pond Operation

6.3.1 Septage and Leachate Inputs

Raw septage discharged from the delivery tanker, into the designated reception facility at the site, will flow directly into the primary pond. The flow from the reception facility will enter the pond at the bottom of its deep central pit. A diagram explaining the various inflows and outflows from septage pond operation is shown below in Figure 6-1.

Figure 6-1 Leachate and Septage Disposal Schematic



Notes
1. Reference: Rarotonga Landfill EIA Report, Meritec Limited, January 2003, Section 4.3, p.29.
2. For Stage 1. Source: Rarotonga Landfill EIA Report Final , Meritec Limited, January 2003, Table 5-1, p.33..
3. Design flow being average projected septage quantity over period 2004 to 2023. Actual septage quantity for 2001 was 1750 cubic metres per year.
4. Source : Rarotonga Landfill Design Options Report – Final, Meritec Limited, January 2003, Sect 4.3, p.5.
5. Septage facility consists of two ponds. Some leachate may be sent directly to the second pond.
6. Flows are for an average year approximately half way through the life of the facility. Actual flows will depend on actual weather conditions and operational factors.
7. This is a simplified schematic and does not attempt to show all flows and discharges associated with the facilities.

The leachate from the landfill can be discharged into either pond, or, if desired, partially into each. For a number of reasons it is considered that delivery of the leachate into the secondary pond, leaving the primary receiving only the tankered septage, should be the most efficient in terms of overall efficiency of the two-pond system. Those reasons include:

- Dedicating the primary pond to treating the septage, which is predominantly organic and readily bio-degradable in character, and excluding the landfill leachate should enhance the ponds facultative performance because leachate typically:
  - Is less strong organically,
  - Is less biodegradable,
  - has an imbalance in the proportions of the principal nutrient elements (C, N, P, etc) that are essential to cell growth in biological processes such as the facultative ones intended for the pond.
  - contains higher proportions of inorganic and bio-inhibitory material leached from the landfill refuse.

- Maximising the hydraulic retention time for the organic waste being treated by the primary pond, which should in turn maximise the benefit of that pond's facultative processes, by excluding the leachate flow (ie. by directing the leachate directly to the secondary pond instead).

- The leachate is already pre-treated by re-circulation within the landfill, thus reducing the pollutant load.

- The influent purification load on the secondary pond, while comprising landfill leachate as a primary fraction, will include only the substantially treated effluent from the primary pond. Together, those two inputs should be comfortably handled by the secondary pond.

Facultative lagoons are particularly suited to purification of readily biodegradable organic wastes like septage. It is therefore considered that the loading arrangement indicated (ie. septage alone into the primary pond, and leachate directly into the secondary) will be optimal utilisation of the two-pond system. However, proof will come only with actual performance, and it might be appropriate at some stage to vary the delivery of leachate, diverting all or some of it into the primary pond.

6.3.2 Pond Level Control

Both the primary and secondary pond water levels must be maintained at 'weir' level (i.e. constantly wetting the overflow weirs). Initially, both ponds will be filled with water that will eventually be displaced through the treatment system by the septage discharged into the primary pond. It is predicted that septage deliveries and leachate discharge will be sufficient to maintain the ponds at the required level. However, should septage deliveries be stopped at any point, the water level in the ponds must be maintained. This can be done by the following methods:

- Pumping in stormwater from the landfill liner (Refer Section 7.4.2)
- Adding extra leachate from the landfill (Refer Section 5.12.1)
- Trucking in water from another source
- Using site supply water

Seawater will NOT be used under any circumstances.

6.3.3 Normal Operational Mode

(i) Background Operation Information

The two ponds are each designed to USEPA guidelines, as passive, facultative lagoons, where algae dominate the main body of the pond, bacteria dominate the layer of sludge that accumulates on the pond floor, and the two function symbiotically with each other and with other micro-organisms (such as protozoa) in the pond. Collectively, those communities of micro-organisms break down the polluting matter in the septage and leachate. That combination of processes, typical of most ponds used to treat urban wastewater lagoons, is termed “facultative”. Such systems are thus called facultative lagoons or, more commonly, oxidation ponds.

Although both ponds at this landfill will function facultatively, because of the different biological and chemical characteristics of their respective septage and leachate inputs, they will probably differ in their appearance and algal/microbial populations. Under the loading regime proposed under 6.3.1above, the primary pond will receive and treat only raw septage (ie. organically strong and biodegradable), whereas the secondary will receive effluent from the primary pond (only the residual/refractory fraction of the original raw septage) plus the leachate direct from the landfill.

(ii) pH Control

By far the widest use of facultative ponds is in the treatment of domestic sewage and, for that duty, they are totally passive and require no operational intervention or attention by operators. Sunlight (photosynthesis of algae) and wind (natural aeration) alone provide all of the energy inputs necessary to sustain the processes. However, the septage and the landfill leachate flow streams being treated in this case both tend to be acidic and it will therefore be prudent to monitor the pH of the pond and to add lime if the pH should fall below about 6.8. The pH should ideally be close to neutral, between a minimum of 6.8 and a maximum of 7.2. Hydrated lime, which is available as a powder in bagged form, is recommended subject to:

- the bags being of plastic (or, if multi-walled, having a plastic liner) and air tight, so as to prevent moisture and carbon dioxide (which will turn the powder solid) from being absorbed from the atmosphere,
- its being stored in a secure dry area, indoors and
- gloves, masks and goggles being used if it is applied by hand.

If the spray recirculation system is operating, application of the lime onto the spray-landing zone on the pond surface should enhance its efficient distribution and mixing.

No tanker load should be accepted if it is known to be of significantly low pH (below 6). Its delivery should be prohibited until its pH is adjusted to an acceptable level. However, if such a load is accepted, it could be dosed with lime as it is discharged from the delivery tanker into the reception chamber.

(iii) Sludge Behaviour

Raw septage discharged by the delivery tanker enters the primary pond in the central, deepened, pit section of the pond floor. It remains nominally in that pit area until displaced up into the main, shallower body of the pond by subsequent tanker deliveries arriving "behind it", although of course there will be a degree of mixing of the successive inputs, and displacement up and out of the pit will not occur in simple plug-flow fashion.

Two phenomena will occur during the septage's residence time in the pit, namely:

- Solids in the septage will tend to settle under gravity, resulting in a density gradient from thicker sludge at the bottom to thinner at the top, and
- The organic content of the septage, will continue to biodegrade and ferment, generating gases. Those gases, on rising through the pit and the main body of pond above it, will tend to stir up the sludge through which they rise, and will tend to attach to and buoy up particles of suspended solids.

In general, the buoying phenomenon is weaker than the settlement, so that there is not normally a problem with significant quantities of solid being buoyed all the way up to the pond surface. The decomposition and fermentation that occur in the pit are anaerobic processes and, as such, any solids that might be buoyed to the surface would be septic and odorous. It is possible that settlement-vs-buoyancy phenomena could get out of balance, in which case odorous clumps of rising sludge can appear on the surface of the pond. If this occurs, the clumps should be broken up with a high pressure hose or other means, whereupon the broken up solid residues will sink back to the bottom.

(iv) Sludge Generation

As it is progressively displaced out of the pit over the months, the sludge will spread out over the surrounding floor of the pond, where it will initially form a relatively thin layer. The same gravity thickening and fermentation process will occur in that spread-out layer but, at least until the layer becomes quite thick, rising sludge and/or odour are unlikely to occur at all, and should be of only minor consequence if they do. If rising sludge and/or odour from that wider area of pond should be any more than minor, then it could be a signal that the pond is overdue for de-sludging (Refer Section 6.3.5).

There should be a relatively distinct interface at the top of the sludge layer, between it and the algae-dominated water column above it. The depth to that sludge/algal-zone interface in the ponds should be checked at least annually, and at six month intervals if there have been an especially high number of tanker deliveries of septage. Subject to overriding conditions that might be experienced with rising sludge or odour, it is suggested that the ponds be de-sludged when the top of the sludge layer has risen to within about 0.6 metre of the pond surface (Refer Section 6.3.5).

Apart from the rising sludge mentioned, it is possible that floating masses of fat or grease (as distinct from sludge) might occur on the pond surface or banks. This can be problematic, odorous and a significant nuisance. To avoid this, grease traps are recommended on appropriate premises and the disposal of grease trap emptyings and similar greasy/oily wastes in these ponds is prohibited (Refer Section 4.3).

The banks of the ponds, around the water's edge, should be kept clear of any accumulations of scum, by high pressure hosing. Otherwise, the material is likely to putrefy and cause foul odours.

6.3.4 Preventing Pond Turnover

(i) Definition of Turnover

Under certain climatic conditions, wastewater ponds can "turn over", bring the bottom sludge to the surface. That sludge is predominantly anaerobic but, under normal facultative operation, odorous gases that it generates are oxidized, metabolized and dispersed by the other facultative processes, and odours given off from the pond surface are effectively zero. However, if the pond overturns, that anaerobic sludge is brought to the pond surface where it releases obnoxious and nauseating odours, usually in such concentrations and quantities as to cause considerable local nuisance in the immediate vicinity of the ponds.

The phenomenon is more common in temperate climates than in the tropics. Its occurrence is best illustrated by a description of the typical circumstances that occur in temperate latitudes where, classically, overturn occurs at the transition from summer to autumn. After a prolonged period of warm weather (eg. in late summer) the body of the pond has been warmed to a uniform temperature throughout its full depth. This differs from the norm, where the temperature is higher at the surface than at the bottom. While the pond is in the "same-temperature-top-to-bottom" state, the first cool snap of autumn suddenly occurs and chills the water at the pond surface. Cold water being denser than warm water, the chilled surface water will be heavier than the water below it, causing the whole pond to "flip". This is the overturn.

(ii) Spray Recirculation System

The pumped pond spray recirculation system should not be needed except during events such as an unseasonal evening chill or cooling rain. It is only during seasons that these may occur when the pond-mixing systems would need to be turned on. Those seasons are best determined from local knowledge, either anecdotal, or from the local meteorological service, or from experience in operating the ponds.

The purpose of the pumped spray recirculation system in each pond is to thoroughly mix the upper algal zone, with the input of just sufficient mixing energy, no more and no less, to ensure continuous interchange of the waters of that algal zone, without disturbing the bottom sludge layer. There is a threshold of energy input, beyond which settled solids in the sludge layer would be disturbed and lifted back into suspension, an undesirable situation in a number of respects. The purpose of the mixing will be to continually:

- Remove surface water from the pond and to
- Recirculate and mix that surface water with the main subsurface body of algae-laden water , down as far as but without disturbing the top of the sludge layer,

On the basis that this circulation will continuously remove and mix surface water before it is chilled by the cooler weather conditions indicated, thereby preventing a layer of colder water from having time to develop on the pond surface.

The pumps provide the energy input to pond mixing in the spray recirculation system. Those pumps have been selected:

- For their ready availability, serviceability and robust self priming functionality. They are models that are commonplace in New Zealand.

- For their size and power rating because, when operated (un-throttled) as a pair in parallel in each pond, their combined power should provide the input of energy for the optimal, upper-zone mixing described above, when the bottom sludge layer is only just (barely) spread across the floor of the main body of the pond.

As the layer of sludge on the pond floor deepens and the upper, algae-laden zone becomes shallower, the outputs of the pumps should be throttled accordingly, as discussed more fully below.

(iii) Septage Pond Curtains

The Primary pond is divided into two halves by a longitudinal curtain. This enables the requisite mixing power to be provided by the relatively inexpensive pumps, and it also improves the efficiency of the mixing process in the broad shallow geometry of the ponds.

The longitudinal curtains are provided to divide the ponds into the two halves mentioned, and they are positioned obliquely so that the return flow of the sprayed discharge back to the pump intake will be strongly convergent, with minimum possible potential for short-circuiting or for there to be dead/eddy zones that do not get mixed. The spray discharge will disperse the liquid to be mixed over the wide end of each partitioned half of the pond, and convergence to the opposite, narrow end at the pump intake will promote the plug flow and minimise any short-circuiting or dead/unmixed zones.

The transverse curtains serve a baffling function, forcing the return flow to pass through the mid-depth zone of the pond and preventing any short-circuiting directly along the water surface, which would otherwise be the path of least hydraulic resistance to flow.

(iv) Recirculation System Intake

The intake rose on each pump's suction hose is suspended at an adjustable depth below its supporting float. The depth of the intake rose should initially be set close to the floor of the pond. It should take numerous deliveries of septage before the sludge fills the central pit and spreads out and fully covers the floor of the pond to a significant depth. When it does so, and the sludge layer on the floor begins to increase, the intake rose should be progressively raised closer to the surface, by shortening its suspension line from the float. This should prevent sludge solids from being drawn into the pump suction, ie. the pump should continue to recirculate only the algae laden waters, and not any sludge solids.

Keeping the intake as deep as possible (but not so deep as to draw in sludge solids) will assist in preventing the surface short-circuiting mentioned, and will promote the plug return mode of flow that is desired (for optimum mixing efficiency).

It will be important for the longitudinal curtain to be in close contact with the floor and with the end slopes of the pond, so that the sprayed discharge from each pump will be prevented from short-circuiting back to the adjacent pump intake. If that short circuiting should be allowed to occur, the mixing energy provided by the pumps will be wasted, because parts of the pond beyond the short circuiting will remain unmixed, while the short circuited zones will be excessively mixed and stirred up. The transverse curtains are not critical in this regard, only the longitudinal curtains.

For the same reason, the fabric of the longitudinal curtain should be checked every 3 years for holes or general deterioration, and all curtains should be replaced when they are worn out. The curtains specified are guaranteed by their supplier, subject to normal usage and wear and tear, for 10 years.

(v) Recirculation Rate

The amount of mixing necessary (and desirable) will reduce as the bottom sludge layer thickens and the depth of pond water above the sludge decreases. If excessive energy is applied to mixing, settled solids will be stirred up from the top of the sludge layer, into the algal zone. This undesirable situation would be likely to be indicated in the water being sprayed, by either or both odour and/or increased turbidity, and by deterioration of the algal population, although these effects would probably be noticed progressively and not necessarily all together.

As mentioned above, in the discussion on pumps, as sludge accumulates and becomes thicker on the floor of the pond, the algal zone will become correspondingly shallower and smaller in volume, and the mixing energy applied should be reduced in proportion to the volume. This should be achieved by throttling the valve on the pump discharge, to reduce the rate of flow/recirculation. Both pumps in each pond should be equally throttled; the pump flow rates can be checked sufficiently accurately by the “stopwatch-and-bucket” method, collecting the discharge (temporarily deflected) from the spray nozzle.

The need for and degree of throttling will be determinable by whether sludge solids are present or absent in the sprayed discharge. The throttling should be as little as possible, and the depth of the intake rose as deep as possible, without sludge solids being evident in the discharge. While such solids might be obvious by odour they give off, it might be difficult to detect any change in smell (especially if any change is gradual) and it is suggested that a sample of the sprayed discharge be collected and visually inspected from time to time. Visual inspection, if done regularly, should indicate any change in turbidity, colour or algal character of the liquor.

6.3.5 De-sludging of Ponds

(i) Timing

If the sludge layer becomes too deep (and the algal zone on top of it becomes too shallow), a threshold stage will be reached when the difference between too much and too little throttle valve adjustment becomes too narrow to manage, with the result that either:

- If under-adjusted, the mixing will be insufficient to prevent sudden cool change(s) in the weather from causing pond turn-over and the accompanying odours, or

- If over-adjusted, the mixing will stir up the sludge layer causing upset of the upper algal zone of the pond, again possibly with attendant odours.

It is uncertain how deep the sludge layer will have grown (or, conversely, how shallow the algal zone will have reduced to) when this state is arrived at. Unless the need is indicated by signs such as these above, or by clumps of rising sludge occurring to an unacceptable extent or frequency, it is suggested that the ponds be de-sludged when the top of the sludge rises to within about 0.6 metres of the pond surface, at which point the sludge would occupy approximately half of the 1.2 metres nominal depth of the pond, leaving the algal zone occupying the remaining, 0.6 metre deep, upper half.

This suggestion of 0.6 metres is provisional and should be subject to findings from actual operating experience. Trial and error over the initial years of operation, coupled with analysis of records of tankered volumes of septage, may well indicate a different depth and/or different criteria for determining the appropriate time for de-sludging. Alternatively, it might indicate that a regular, little-by-little, year-round de-sludging programme will maintain the system in a permanently stable regime.

In facultative ponds, there is usually a relatively distinct interface between the sludge layer and the algal zone and a variety of devices may be used for detecting that interface. While some devices are highly sophisticated and costly, others are very simple and inexpensive and involve such concepts as stoppered glass bottles and long Perspex tubes with pullable bottom plugs. Such devices may be able to be made at low cost using locally available materials. Alternatively, various manufacturers produce proprietary models. One such manufacturer, the Wildlife Supply Company of Buffalo, New York USA, produces the following products that are of the stoppered bottle and Perspex tube types respectively:

- Swing Sampler and accessories (reference codes 165-C10, 165-H30 and 165-H62)

- Sludge Judge and accessories (reference code 168-A10, 168-A25, 168-A30 and 168-A40)

and, in 2004, is represented in New Zealand by The Environmental Collective Ltd of 40 George Street, Mt Eden, Auckland, phone +64 9 623 3386, email info@envco.org.

Because it is the primary pond that will be receiving the septage and accumulating the resulting sludge, it is this pond that will be the first to require de-sludging. Because the secondary pond will be receiving very little solid material in its feed flows, it is expected that the de-sludging interval for the secondary pond will be many times that for the primary.

If possible, deliveries of raw septage from septic tank pump-outs should be discontinued for the duration of the de-sludging operation. Also, if possible, it should be discontinued for as long as possible in advance of the exercise commencing, so that the amount of fresh septage in the pond is the minimum possible.

(ii) Method

The de-sludging methodology that will be most efficient will depend on the type of plant and equipment that is locally available at the time. Options may include:

- a bank-side pump with a float-supported suction hose and intake, with float being progressively pulled around the pond by ropes, or

- a pontoon-mounted pump and dewatering unit (such as has been used in New Zealand), or

- a submersible pump moved around the pond floor by one means or another (eg. slung from a pontoon or lifted by a crane), or

- some other method, or a variation or combination of the above methods.

Whatever method is adopted, an essential criterion for its selection and implementation must be that the method must cause no damage to the lining of the pond. While this ultimately relates to the pond's geosynthetic clay liner (GCL), protecting that GCL will, in the first instance, mean ensuring that no damage is caused to the protective layer that overlies the GCL. Fracturing, subsidence or other such damage caused to the overlay would almost certainly puncture the GCL. It must therefore be a fundamental of any de-sludging operation that no heavy machinery or any other traffic that might fracture or damage the GCL protection shall be permitted on the pond floor or bank slopes, or even be allowed to come close to (approximately 3 metres) the bank edge. Effectively, this should limit activity and loads on the pond floor to foot traffic and plant that is light enough to be manoeuvred by hand.

It will be advantageous for the sludge being removed from the pond to be as thick in consistency as possible (ie. for its solids:water ratio to be as high as possible). As well as reducing the volume of sludge being removed and the length of time that the operation will take, there will also be benefit at the disposal end of the exercise, where the removed sludge has to be buried with refuse in the body of the landfill.

Apart from the stopping of deliveries of septage during (and preferably for some time before) de-sludging, as indicated above, if suitable facilities such as a flexible suction hose and a floating off-take are available, then thickening of the sludge might be enhanced if the water overlying the sludge layer is decanted down to the top of the sludge (eg. by carefully pumping into the adjacent pond). Lowering of the pond below normal operating levels should only be undertaken towards the end of the dry season. At this time groundwater levels will be low and there is less risk of groundwater pressure under the pond floor causing the floor to heave.

(iii) Disposal of Pond Sludge

Sludge removed from the pond should be buried in the landfill, preferably with fresh refuse, according to the procedures described for bulk liquid waste under Sections 5.6.5.

6.3.6 Pond Mixing Pump Maintenance

The maintenance requirements for the pond mixing pumps are summarized in the following table.

Table 6-1 Pond Mixing Pump Maintenance Schedule

Activity Description	Work Day	Fortnightly	Monthly	Annually	Other
Visual inspection of pumps	✓				
During the pump off-duty season (when climate is consistently such that there is no risk of pond overturn, and the pond mixing system is switched off), check that the pump is correctly operating by manual on/off switching		✓			
During the pump on-duty season (when the climate is such that there is the risk of pond overturn, and the pond mixing system is switched on), check that: 1) the pump is correctly operating 2) there is no blockage of flow into the suction of the pump (eg. due to blockage of the suction rose on the inlet hose)	✓				
Read and record pump hours during the on-duty period	✓				
Check operation of telemetry system			✓		
Check bearings and seals on primary and standby pumps				✓	
Thorough in situ inspection of pumps by suitably qualified mechanical/electrical specialist(s)				✓	
Full overhaul or (depending on respective costs) replacement of pumps, at a specialist mechanical/electrical workshop approved by the pump vendor					Every 20,000 hours of operation or every 5 years, whichever occurs the sooner

6.4 Treated Effluent Pump Station

6.4.1 Health and Safety

The Landfill Operational Contractor will be aware of all the health and safety provisions included with this management plan in Section 2.8. In relation to the Treated Effluent Pump Station the following provisions are VERY important:

- NO entry to the pump station without a Permit to Work signed by the Landfill Manager and appropriate Confined Space Entry training
- NO fires within or near the pump station – gas within the pump station is highly flammable

6.4.2 Operation

The main purpose of the Treated Effluent Pump Station (PS) is to discharge treated effluent from the secondary septage pond into the Treated Effluent Disposal System described in Section 6.5.

Treated Effluent PS operation is primarily automated and for normal operations requires little operator intervention beyond daily inspections and recording of pump hours. The programmed control logic is as follows:

- Pump cut-in: Pump station top water level (TWL) or every 6 hours, whichever is sooner.
- Pump cut-out: Pump station low water level (LWL) or 40 minutes after pump cut-in, provided water level is less than TWL
- Duty / Standby: Standby to take over duty on pump fault (overload, trip)
- Pump cut-out: During filter backwash cycle.

The following alarms are transmitted via a text message to a mobile phone nominated by the Landfill Operational Contractor.

- Pump station Low Level alarm
- Pump station High Level alarm
- Pump Faults (overload, failed to start)
- Control Panel Door Opening
- Power Supply Fault greater than four hours.

6.4.3 Monitoring

(i) Work Day Inspections

The Landfill Operational Contractor will make inspections of the following on all work days:

- Visual Inspection of Treated Effluent Pumps
- Check level of effluent within pump station
- Check operation of primary and secondary pump (using manual override)
- Read and record pump hours of both pumps

(ii) Pump Station Drawdown

To monitor the output of the treated effluent PS, the Landfill Operational Contractor will conduct the following test at 6 monthly intervals.

1. Using a stopwatch, measure the time required by the pump to remove the working volume from the treated effluent PS – the time from high level cut-in to low level cut-out (add water to the pump station if treated effluent does not fill the working volume).
   The working volume can be calculated as follows:
   a. The internal diameter of the wet well is taken as 1,500mm (1.5m). Hence, the water surface area is 1.77m^2.
   b. Measure the difference in elevation between the cut-in and cut-out floats. (The design drawings show this as being 2.5m but this may have been constructed differently (refer As-Built drawings), or altered by Landfill Operational Contractor or previous operators).
   c. Multiply the surface area by the difference in levels to find the working volume. If the volume is within +/-10% of 4.5m^3, (ie between 4.0 and 4.9 m^3), then Table 6-2 may be used. (All of the tables in Appendix 6.1 are based on a working volume of 4.5m^3. These tables will need to be revised if the floats have been adjusted to cause the working volume to go outside the range 4.0 and 4.9 m^3.)

2. Find the measured time in Table 6-2 and note the corresponding flow rate.

(iii) Treated Effluent Volumes

The Landfill Operational Contractor will measure the rate at which treated effluent enters the PS once per month using the following method:

1. Using a stopwatch, measure the time required for the working volume within the Treated Effluent PS to be filled with effluent (i.e. measure the time between low level cut-out and the high level cut-in of the pumps).

2. Compare the time measured to the ranges in Table 6-3 and take the appropriate action. (NOTE: Time ranges and recommendations shown in Table 6-3 only apply if the effluent PS output flow rate is 4.3L/s – detailed tables showing lower output flow rates and action recommendations are included in Appendix 6.1)

Table 6-2 Treated Effluent Pump Station Drawdown

Time for PS to remove working volume*		Treated Effluent PS Output (litres/sec)
min	sec	
15	0	5.4
15	30	5.3
16	0	5.1
16	30	5.0
17	0	4.8
17	30	4.7
18	0	4.6
18	30	4.5
19	0	4.4
19	**30**	**4.3****
20	0	4.2
20	30	4.1
21	0	4.0
21	30	3.9
22	0	3.8
22	30	3.8
23	0	3.7
23	30	3.6
24	0	3.6
24	30	3.5
25	0	3.4
25	30	3.4
26	0	3.3
26	30	3.3
27	0	3.2
27	30	3.2
28	0	3.1
28	30	3.1
29	**0**	**3.0*****

Note:

* This time calculation assumes an inflow of leachate from the landfill of $40m^3$/day. During the first months of landfill operation and during dry periods when the septage ponds are not spilling, the time required for the PS to remove the working volume may be less than the minimum time value in this table as effluent inflow from the ponds may be lower than this. (If there is no flow from the landfill, then the time to remove the working volume will be 1 to 2 minutes quicker.)

** This is the design value for the PS, and is based on a 1500mm wet well internal diameter and a vertical distance between the cut-in and cut-out floats of 2.5m (as per the design drawings). Adjustment of the floats will cause a different flow rate for a particular time from cut-in to cut-out.

*** If this value is reached (and the distance between the floats is still 2.5m), the pump requires a full shop service.

Table 6-3 Treated Effluent Disposal Volume Guidelines

Treated Effluent PS Working Volume Fill Time (minutes)	Recommended Action
Over 100	No action required – Volume within disposal field capacity
80 to 100	Review septage and leachate inputs – discharge volume is close to design parameters. Review leachate production rates against Table 5-2. If this rate is not high, then high effluent production is caused by inputs to the septage ponds. High rainfall on the ponds in recent hours can contribute to this. Check for surface water draining into the ponds or septage receiving facility.
Less than 80	Find and eliminate source of excess effluent production. Stop septage and leachate inputs (leachate inputs can not be stopped*) – discharge rate disposal field capacity

Notes:

1. These fill times are based on a 1500mm wet well internal diameter and a vertical distance between the cut-in and cut-out floats of 2.5m (as per the design drawings). Adjustment of the floats will cause a different fill time for a given flow rate.
2. The time ranges and recommendations shown in Table 6-3 only apply if the effluent PS output flow rate is 4.3 L/s – detailed tables showing lower output flow rates and action recommendations are included in Appendix 6.1. The treated effluent PS output flow rate is determined according to Section 6.4.3.

* It is not good practice to stop the leachate pump station removing effluent from the landfill, as this would cause the leachate drainage system in the bottom of the landfill to fill with leachate. When the temporary cover system is still in place over parts of the landfill floor, this may cause the temporary cover to float or billow upwards, dislodge weights and expose the temporary cover to an increased risk of damage from winds. In addition, increased hydraulic pressure on the lining system increases the likelihood of leakage through the lining system.

However, it is possible for short periods of time (less than a week) to close the valve on rising main from the Leachate Pump Station to the Septage Ponds, so that 100% of the leachate is recirculated to the landfill. (This assumes the first cell has been placed over around a quarter of the landfill and to at least 3m above the landfill floor). In this way, leachate inflows can be stopped from entering the septage ponds.

As an alternative means of investigating sources of inflow, the leachate can be temporarily diverted to the secondary pond (bypassing the primary pond). This is done using the control valves to the south (Arorangi side) of the primary septage pond.

(iv) Septage Composition

Refer Section 8.7.1.

6.4.4 Maintenance

All maintenance requirements are detailed in Table 6-4.

6.4.5 Failure Contingency

Refer Section 9.5.3

Table 6-4 Treated Effluent Pump Station Maintenance Schedule

	Frequency					
Activity Description	**Work Day**	**Weekly**	**Monthly**	**6-Monthly**	**12-Monthly**	**Other**
Visual inspection of pumps		✓				
Check level of effluent	✓					
Check operation of primary pump (using manual override)	✓					
Check operation of standby pump (using manual override)	✓					
Read and record pump hours	✓					
Check oil level and consistency in primary and standby pumps				✓ (One week after installation, one month after installation, and 6 monthly thereafter)		(1) If the seals have been replaced, one week after replacement (2) One week after an oil change
Visual inspection of lifting handle and chain			✓			
Check operation of telemetry system			✓			
Visual inspection of valve chamber			✓			
Check bearings and seals on primary and standby pumps				✓		
Perform drawdown test and record pump outputs				✓		
Detailed inspection of complete primary and standby pumps, full service and oil change, by a local mechanic trained by Trimate					✓	
Major overhaul in service shop in Auckland						Once per 3 years

6.5 Treated Effluent Disposal System

6.5.1 Sand Filter

The purpose of the Sand Filter (Hayward Pro Series Plus High Rate Sand Filter) is to provide final treatment to the effluent from the septage ponds before it is discharged into the irrigation system for final disposal. The Sand Filter is designed to be a normal swimming pool filter (Note: Ignore all references to swimming pools in the operating manual included in Appendix 6.2), but can be used equally well in this application of final treatment of septage pond effluent.

As with the pump stations described previously, the sand filter requires very little operator intervention beyond daily inspections and reading of backwash pump hours. Backwash pump controls are automated (with a manual override) as follows:

- Pump cut-in: High differential pressure across filter.
- Pump cut-out: Adjustable backwash period after start.

The following alarm is transmitted via a text message to a mobile phone nominated by the Landfill Operational Contractor.

- Sand Filter high differential pressure after backwash.

The maintenance requirements of the Sand Filter and related equipment are detailed in the Rarotonga Waste Facility Maintenance Schedule included as part of the Executive Summary of this management plan.

6.5.2 Irrigation System

The irrigation system is a series of pipes laid around the area of the septage ponds (Refer to As-Built drawings in Section 12.0 for layout and construction details). The pipes have a series of small holes to allow even distribution of treated effluent over the irrigation area.

The irrigation system is controlled with a series of valves leading off the two primary manifolds. The primary manifolds are located directly to the South of the secondary septage pond and between the secondary and primary septage ponds. It is recommended that the complete irrigation system (both primary manifolds and all branches) be used at all times; however, individual branches can be closed off if necessary. Initial set up of the irrigation system and after any changes (such as individual branches being closed off for maintenance) the following procedure needs to be followed to ensure even distribution of treated effluent:

1. Ensure pump station is operating (i.e. pumping into the irrigation system) (NOTE: Ensure that the valves are open as described in Steps 2 to 4 below. Do not operate pump station when all valves are closed (i.e. no flow)).

2. If both manifolds are to be used, fully open both manifold valves (immediately adjacent to the sand filter). If only one manifold is to be used, only fully open the relevant manifold valve.

3. Fully close off the valves on the branches that are not required or are to be removed from the system for maintenance. Fully open all valves if the entire system is being used.

4. Set valves on branches as follows (refer to As-Built Drawings in Section 12.0):
    a. Pipeline 1 – No Control Valve
    b. Pipeline 2 – 44 Degrees from parallel
    c. Pipeline 3 – No Control Valve
    d. Pipeline 4 – 10 Degrees from parallel
    e. Pipeline 5 – 35 Degrees from parallel
    f. Pipeline 6 – 40 Degrees from parallel
    g. Pipeline 7 – 50 Degrees from parallel
    h. Pipeline 8 – 52 Degrees from parallel
    i. Pipeline 9 – 35 Degrees from parallel

5. Walk around the irrigation field and check that each branch has approximately the same height of water jet coming out of it.

6. If adjustment is required, manually adjust the valve settings on each branch valve until approximately the same water jet height is achieved across the entire system.
    a. To achieve an even distribution off Manifold 1, begin manual valve adjustments at Pipeline 2 or 4 and work back towards the Septage Ponds
    b. To achieve an even distribution off Manifold 2, begin manual valve adjustments at Pipeline 8 or 9 and work back towards the Septage Ponds

The Landfill Operations Contractor will inspect the disposal area on a weekly basis and note any areas of ponding and/or overland flow. If ponding or overland flow consistently occurs, the Landfill Manager will be notified and he will review the rate and distribution of disposal through the irrigation field. If the rate of distribution is changed, follow the procedure outlined above to ensure even distribution is achieved over the entire field.

6.6 Septage Pond Asset Management Review

On or around 30 June each year the Landfill Manager will review the operational procedures of the septage ponds and will check the following;

- The volume of septage being delivered
- The volume of treated effluent being discharged though the irrigation system
- The level of sludge within both septage ponds

- The amount of leachate being discharged into the septage ponds

Appendix 6.1

Treated Effluent PS Operating Ranges

Treated Effluent PS Disposal Volumes 4.30 L/sec

4.47	m3	Pump Station Working Volume
4.30	L/s	Pump Station Output Flow Rate

Treated Effluent PS Working Volume Fill Time (min)	Treated Effluent Inflow Rate			Effluent Pump Operation Time		Action Required
	(L/min)	(L/sec)	(m3/day)	(Hours)	(min)	
15	298.1	5.0	429.2	27.7	1664	Design Parameters have been exceeded
20	223.5	3.7	321.9	20.8	1248	
25	178.8	3.0	257.5	16.6	998	
30	149.0	2.5	214.6	13.9	832	
35	127.7	2.1	183.9	11.9	713	
40	111.8	1.9	161.0	10.4	624	
45	99.4	1.7	143.1	9.2	555	
50	89.4	1.5	128.8	8.3	499	
55	81.3	1.4	117.1	7.6	454	
60	74.5	1.2	107.3	6.9	416	
65	68.8	1.1	99.0	6.4	384	
70	63.9	1.1	92.0	5.9	356	
75	59.6	1.0	85.8	5.5	333	
80	55.9	0.9	80.5	5.2	312	Design Parameters will soon be exceeded
85	52.6	0.9	75.7	4.9	294	
90	49.7	0.8	71.5	4.6	277	
95	47.1	0.8	67.8	4.4	263	
100	44.7	0.7	64.4	4.2	250	
105	42.6	0.7	61.3	4.0	238	No Action Required
110	40.6	0.7	58.5	3.8	227	
115	38.9	0.6	56.0	3.6	217	
120	37.3	0.6	53.7	3.5	208	
125	35.8	0.6	51.5	3.3	200	
130	34.4	0.6	49.5	3.2	192	
135	33.1	0.6	47.7	3.1	185	
140	31.9	0.5	46.0	3.0	178	
145	30.8	0.5	44.4	2.9	172	
150	29.8	0.5	42.9	2.8	166	
155	28.8	0.5	41.5	2.7	161	
160	27.9	0.5	40.2	2.6	156	
165	27.1	0.5	39.0	2.5	151	
170	26.3	0.4	37.9	2.4	147	
175	25.5	0.4	36.8	2.4	143	
180	24.8	0.4	35.8	2.3	139	

Treated Effluent PS Disposal Volumes 4.00 L/sec

4.47	m3	Pump Station Working Volume
4.00	L/s	Pump Station Output Flow Rate

Treated Effluent PS Working Volume Fill Time (min)	Treated Effluent Inflow Rate			Effluent Pump Operation Time		Action Required
	(L/min)	(L/sec)	(m3/day)	(Hours)	(min)	
15	298.1	5.0	429.2	29.8	1788	Design Parameters have been exceeded
20	223.5	3.7	321.9	22.4	1341	
25	178.8	3.0	257.5	17.9	1073	
30	149.0	2.5	214.6	14.9	894	
35	127.7	2.1	183.9	12.8	766	
40	111.8	1.9	161.0	11.2	671	
45	99.4	1.7	143.1	9.9	596	
50	89.4	1.5	128.8	8.9	537	
55	81.3	1.4	117.1	8.1	488	
60	74.5	1.2	107.3	7.5	447	
65	68.8	1.1	99.0	6.9	413	
70	63.9	1.1	92.0	6.4	383	
75	59.6	1.0	85.8	6.0	358	
80	55.9	0.9	80.5	5.6	335	
85	52.6	0.9	75.7	5.3	316	Design Parameters will soon be exceeded
90	49.7	0.8	71.5	5.0	298	
95	47.1	0.8	67.8	4.7	282	
100	44.7	0.7	64.4	4.5	268	
105	42.6	0.7	61.3	4.3	255	
110	40.6	0.7	58.5	4.1	244	
115	38.9	0.6	56.0	3.9	233	
120	37.3	0.6	53.7	3.7	224	
125	35.8	0.6	51.5	3.6	215	
130	34.4	0.6	49.5	3.4	206	No Action Required
135	33.1	0.6	47.7	3.3	199	
140	31.9	0.5	46.0	3.2	192	
145	30.8	0.5	44.4	3.1	185	
150	29.8	0.5	42.9	3.0	179	
155	28.8	0.5	41.5	2.9	173	
160	27.9	0.5	40.2	2.8	168	
165	27.1	0.5	39.0	2.7	163	
170	26.3	0.4	37.9	2.6	158	
175	25.5	0.4	36.8	2.6	153	
180	24.8	0.4	35.8	2.5	149	

Treated Effluent PS Disposal Volumes 3.50 L/sec

4.47	m3	Pump Station Working Volume
3.50	L/s	Pump Station Output Flow Rate

Treated Effluent PS Working Volume Fill Time (min)	Treated Effluent Inflow Rate			Effluent Pump Operation Time		Action Required
	(L/min)	(L/sec)	(m3/day)	(Hours)	(min)	
15	298.1	5.0	429.2	34.1	2044	Design Parameters have been exceeded
20	223.5	3.7	321.9	25.5	1533	
25	178.8	3.0	257.5	20.4	1226	
30	149.0	2.5	214.6	17.0	1022	
35	127.7	2.1	183.9	14.6	876	
40	111.8	1.9	161.0	12.8	766	
45	99.4	1.7	143.1	11.4	681	
50	89.4	1.5	128.8	10.2	613	
55	81.3	1.4	117.1	9.3	557	
60	74.5	1.2	107.3	8.5	511	
65	68.8	1.1	99.0	7.9	472	
70	63.9	1.1	92.0	7.3	438	
75	59.6	1.0	85.8	6.8	409	
80	55.9	0.9	80.5	6.4	383	
85	52.6	0.9	75.7	6.0	361	
90	49.7	0.8	71.5	5.7	341	
95	47.1	0.8	67.8	5.4	323	
100	44.7	0.7	64.4	5.1	307	Design Parameters will soon be exceeded
105	42.6	0.7	61.3	4.9	292	
110	40.6	0.7	58.5	4.6	279	
115	38.9	0.6	56.0	4.4	267	
120	37.3	0.6	53.7	4.3	255	
125	35.8	0.6	51.5	4.1	245	
130	34.4	0.6	49.5	3.9	236	
135	33.1	0.6	47.7	3.8	227	
140	31.9	0.5	46.0	3.6	219	
145	30.8	0.5	44.4	3.5	211	
150	29.8	0.5	42.9	3.4	204	
155	28.8	0.5	41.5	3.3	198	
160	27.9	0.5	40.2	3.2	192	No Action Required
165	27.1	0.5	39.0	3.1	186	
170	26.3	0.4	37.9	3.0	180	
175	25.5	0.4	36.8	2.9	175	
180	24.8	0.4	35.8	2.8	170	

Treated Effluent PS Disposal Volumes 3.00 L/sec

4.47	m3	Pump Station Working Volume
3.00	L/s	Pump Station Output Flow Rate

Treated Effluent PS Working Volume Fill Time (min)	Treated Effluent Inflow Rate			Effluent Pump Operation Time		Action Required
	(L/min)	(L/sec)	(m3/day)	(Hours)	(min)	
15	298.1	5.0	429.2	39.7	2384	Design Parameters have been exceeded
20	223.5	3.7	321.9	29.8	1788	
25	178.8	3.0	257.5	23.8	1431	
30	149.0	2.5	214.6	19.9	1192	
35	127.7	2.1	183.9	17.0	1022	
40	111.8	1.9	161.0	14.9	894	
45	99.4	1.7	143.1	13.2	795	
50	89.4	1.5	128.8	11.9	715	
55	81.3	1.4	117.1	10.8	650	
60	74.5	1.2	107.3	9.9	596	
65	68.8	1.1	99.0	9.2	550	
70	63.9	1.1	92.0	8.5	511	
75	59.6	1.0	85.8	7.9	477	
80	55.9	0.9	80.5	7.5	447	
85	52.6	0.9	75.7	7.0	421	
90	49.7	0.8	71.5	6.6	397	
95	47.1	0.8	67.8	6.3	376	
100	44.7	0.7	64.4	6.0	358	
105	42.6	0.7	61.3	5.7	341	
110	40.6	0.7	58.5	5.4	325	
115	38.9	0.6	56.0	5.2	311	Design Parameters will soon be exceeded
120	37.3	0.6	53.7	5.0	298	
125	35.8	0.6	51.5	4.8	286	
130	34.4	0.6	49.5	4.6	275	
135	33.1	0.6	47.7	4.4	265	
140	31.9	0.5	46.0	4.3	255	
145	30.8	0.5	44.4	4.1	247	
150	29.8	0.5	42.9	4.0	238	
155	28.8	0.5	41.5	3.8	231	
160	27.9	0.5	40.2	3.7	224	
165	27.1	0.5	39.0	3.6	217	
170	26.3	0.4	37.9	3.5	210	
175	25.5	0.4	36.8	3.4	204	
180	24.8	0.4	35.8	3.3	199	

Appendix 6.2

Sand Filter Manual

IS311SX-00A

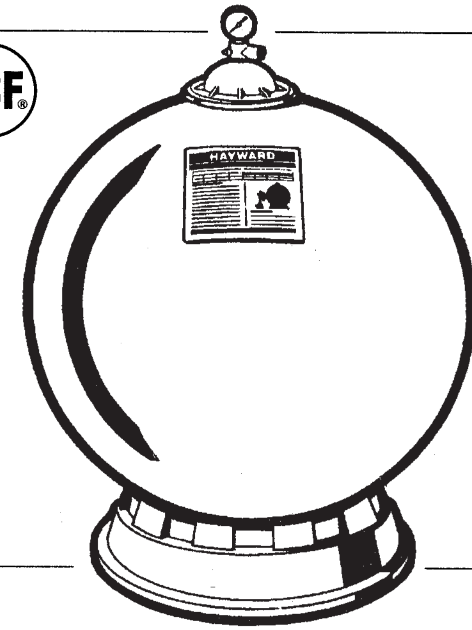
OWNER'S GUIDE

HAYWARD®

PRO™ SERIES PLUS

HIGH-RATE SAND FILTERS

Models S311SX, S311SXV, S360SX



Your Hayward Pro Series high-rate sand filter is a high performance, totally corrosion-proof filter that blends superior flow characteristics and features with ease of operation. It represents the very latest in high-rate sand filter technology. It is virtually foolproof in design and operation and when installed, operated and maintained according to instructions, your filter will produce clear, sparkling water with only the least attention and care.

HOW IT WORKS

Your filter uses special filter sand to remove dirt particles from the water. Filter sand is loaded into the filter tank and functions as the permanent dirt removing media. The pool water, which contains suspended dirt particles, is pumped through your piping system and is automatically directed by the patented filter control valve to the top of the filter tank. As the pool water is pumped through the filter sand, dirt particles are trapped by the sand bed, and filtered out. The cleaned pool water is returned from the bottom of the filter tank, through the control valve and back to the pool through the piping system. This entire sequence is continuous and automatic and provides for total recirculation of pool water through your filter and piping system.

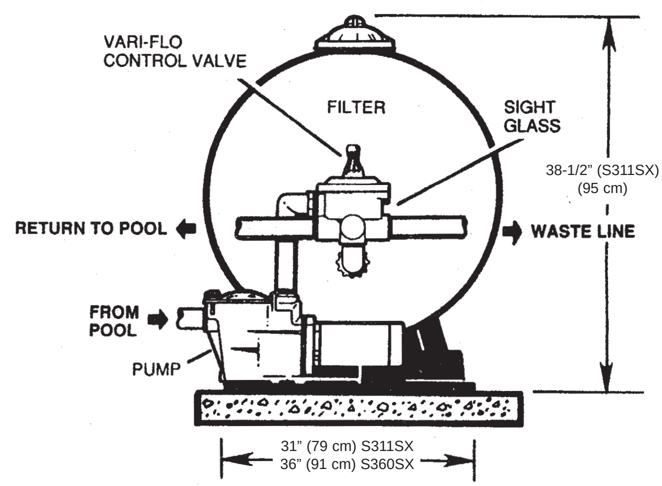
After a period of time, the accumulated dirt in the filter causes a resistance to flow, and the flow diminishes. This means it is time to clean (backwash) your filter. With the control valve in the backwash position, the water flow is automatically reversed through the filter so that it is directed to the bottom of the tank, up through the sand, flushing the previously trapped dirt and debris out the waste line. Once the filter is backwashed (cleaned) of dirt, the control valve is manually resequenced to Rinse (Vari-Flo Control Valve only), and then Filter, to resume normal filtering.

INSTALLATION

Only simple tools (screwdriver and wrenches), plus pipe sealant for plastic adapters, are required to install and/or service the filter.

1. The filter system should be installed, not more than 6 feet above pool water level, on a level concrete slab, very firm ground, or equivalent, as recommended by your pool dealer. Position the filter so that the piping connections, control valve and winter drain are convenient and accessible for operation, service and winterizing.
2. Assemble filter control valve to filter. Align the two (2) valve pipe connections, with O-rings in place, with the two openings in the side of the filter tank and press in firmly. Secure the assembly to the tank connections with the two bulkhead locknuts.
   Do not overtighten.

TYPICAL INSTALLATION



NOTE: If rigid return piping is used, installation of a piping union is recommended for ease of future servicing.

SPECIFICATIONS

MODEL NUMBER	EFFECTIVE FILTRATION AREA		DESIGN FLOW RATE*		PRESSURE LOSS AT DESIGN FLOW RATE		MAXIMUM WORKING PRESSURE		REQUIRED CLEARANCE				MEDIA REQUIRED		
									SIDE		ABOVE		TYPE	AMOUNT	
	FT^2	M^2	GPM	LPM	PSI	BAR	PSI	BAR	INCH	MM	INCH	MM	FILTER SAND**	LBS	KGS
S311SX/SXV	4.95	0.46	99	375	4.8	0.34	50	3.45	18	457	18	457	0.45-0.55	350	159
S360SX	6.68	0.62	133	503	8.6	0.6	50	3.45	18	457	18	457	0.45-0.55	700	318

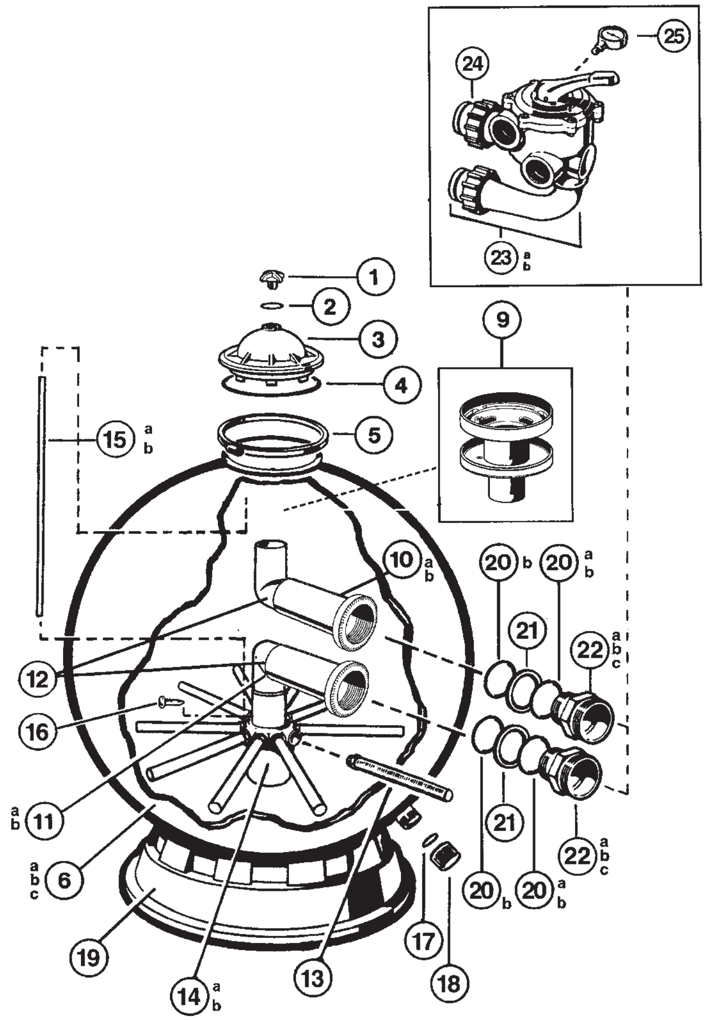
*Based on 20 GPM/ft^2 (maximum allowable NSF rating).

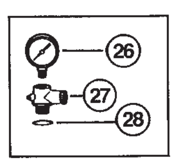
***Also known as No. 20 or No. 1/2 Silica Sand.*

PARTS
Models S311SX, S311SXV, S360SX

REF. NO.	PART NO.	DESCRIPTION	NO. REQ'D.
1	SX200G	Manual Air Relief Cap	1
2	SX200Z5	O-Ring, 3/16" O.D.	1
3	SX244KN	Top Closure Dome, Noryl®	1
4	GMX600F	Valve/Tank O-Ring	1
5	SX310N	Flange Clamp (Valve/Tank)	1
6a	SX311AA2	Filter Tank (S311 - 1995 and Prior)	1
6b	SX311AA2FW	Filter Tank (S311 - After 1996)	1
6c	SX360AA2	Filter Tank (S360 - 1999 and Prior)	1
6d	SX360AA2FW	Filter Tank (S360 - After 1999)	1
7a	SX311G	Label Plate with Label (S311)	1
7b	SX360G	Label Plate with Label (S360)	1
8	SX311Z1	Label Plate Screws	2
9	SX244G	Top Diffuser Assembly	1
10a	SX311CD1	Top Elbow Assembly (S311 - 1995 and Prior)	1
10b	SX311CD1FW	Top Elbow Assembly (S311 - After 1996))	1
11a	SX311CD2	Bottom Elbow Assembly (S311 - 1995 and Prior)	1
11b	SX311CD2FW	Bottom Elbow Assembly (S311 - After 1996)	1
12a	SX360CD	Elbow Assembly, Top & Bottom (S360 - 1999 and Prior)	2
12b	SX360CDFW	Elbow Assembly, Top & Bottom (S360 - After 1999)	2
13	SX310HA	Lateral	10
14a	SX311DA	Folding Umbrella Lateral Holder Assembly (S311 - 1997 -) ***	1
14b	SX242MA3	Folding Umbrella Lateral Holder Assembly (S360) - ***	1
15a	CX1100Z4	Plastic Air Tube (S311)	1
15b	SX360Z2	Air Tube (S360)	1
16	SX200Z2	Air Tube Lock Screw	1
17	SX180G	Gasket	1
18	SX180H	Drain Cap	1
19	SX310J	Filter Support Stand	1
20a	SX220Z3	O-Ring (S311 - 1995 and Prior)	2
20b	SX360Z1	O-Ring (S311, S360 - After 1995)	4
21	SX360E	O-Ring Spacer (S311, S360 - After 1995)	2
22a	DEX360F	Bulkhead Fitting (S311 - 1995 and Prior)	2
22b	SX244P	Bulkhead Fitting (S311 - After 1996, S360 - After 1999)	2
22c	SX311F	Bulkhead Fitting (S360 - 1999 and Prior)	2
23a	SP0710X62	Vari-Flo Valve Assembly —1-1/2" FIP (Optional)	1
23b	SP0715X62	Vari-Flo Valve Assembly —2" FIP (Optional)	1
23c	SP0410X602S	Slide Valve Assembly —2" SKT (Included for S311SXV, Optional for S311SX & S360SX)	1
24	SX200Z4	O-Ring	2
25	ECX270861	Pressure Gauge	1
Optional (Supplied with Model S311SXV Slide Valve Unit Only)			
26	ECX270861	Pressure Gauge	1
27	DEX2400S	Relief Valve/Gauge Adapter Assembly	1
----	DEX2400Z3A	O-Ring for Relief Valve Stem (Set of 3)	1
28	SX200Z5	Relief Valve Assembly O-Ring	1

*** See Diagram A





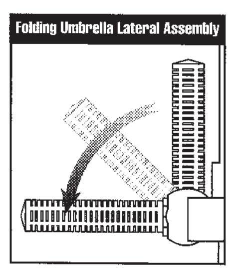
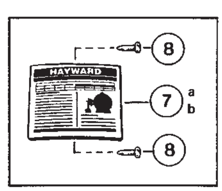
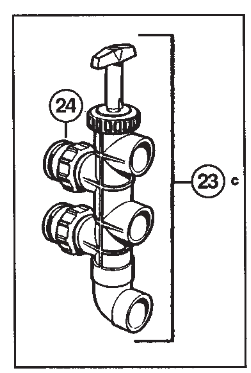


DIAGRAM A





3. Assemble pump and pump mounting base (if supplied) to the filter according to instructions packed with the base.
4. Loading sand media. Filter sand media is loaded through the top opening of the filter.
   a. Remove the top diffuser from the internal diffuser elbow pipe and place flexible automatic air relief tube to the side, out of the way, inside the tank.
   b. Cap the internal diffuser elbow pipe with sand shield provided to prevent sand from entering it. DO NOT MOVE ELBOW PIPE as this can affect the integrity of the bulkhead seal.
   c. It is good practice to fill tank approximately 1/2 way with water to provide a cushioning effect when the filter sand is poured in. This helps protect the underdrain laterals from excessive shock. (Be sure the drain cap is securely in place on drain pipe.) **Note: Check to confirm all laterals are in the down position before loading with sand. (See Figure A on Page 2.)**
   d. Carefully pour in correct amount and grade of filter sand, as specified. Sand surface should be leveled and should come to about the middle of the filter tank. Use no more than the recommended amount of sand.
   e. Remove sand shield from internal diffuser elbow pipe.
   f. Replace diffuser on internal diffuser elbow pipe, positioning automatic air relief tube through the hole provided in the diffuser.
   g. Place stainless steel valve flange clamp around neck of tank. Do not overtighten. Wipe filter flange clean.
   h. Insert Top Closure Dome (with flange O-ring in place) into the tank neck. Place clamp around dome flange and tank flange and tighten with screwdriver, tapping around clamp with screwdriver handle to help seat flange clamp.
5. Connect pump to control valve opening marked PUMP according to instructions. Make return to pool pipe connection to control valve opening marked RETURN and complete other necessary plumbing connections, suction lines to pump, waste, etc.
6. Make electrical connections to pump per pump instructions.
7. To prevent water leakage, be sure drain cap is securely in place and all pipe connections are tight.

INITIAL START-UP OF FILTER

1. Be sure correct amount of filter sand media is in tank and that all connections have been made and are secure.
2. Depress Vari-Flo control valve handle and rotate to BACK WASH* position. (To prevent damage to control valve seat, always depress handle before turning).
3. Prime and start pump according to pump instructions (be sure all suction and return lines are open), allowing the filter tank to fill with water. **CAUTION: All suction and discharge valves must be open when starting the system. Failure to do so could cause severe personal injury and/or property damage.** Once water flow is steady out the waste line, run the pump for at least 2 minutes. This initial backwashing of the filter is recommended to remove any impurities or fine sand particles in the sand media.
4. Turn pump off and set valve to RINSE position (Vari-Flo Control Valve only). Start pump and operate until water in sight glass is clear—about 1/2 to 1 minute. Turn pump off, set valve to FILTER position and restart pump. Your filter is now operating in the normal filter mode, filtering particles from the pool water.
5. Adjust pool suction and return valves to achieve desired flow. Check system and filter for water leaks and tighten connections, bolts, nuts, as required.
6. Note the initial pressure gauge reading when the filter is clean. (It will vary from pool to pool depending upon the pump and general piping system). As the filter removes dirt and impurities from the pool water, the accumulation in the filter will cause the pressure to rise and flow to diminish. When the pressure gauge reading is 6-8 PSI (0.41-0.55 BAR) higher than the initial “clean” pressure you noted, it is time to backwash (clean) the filter (see BACKWASH under Filter Control Valve Functions).

NOTE: During initial clean-up of the pool water it may be necessary to backwash frequently due to the unusually heavy initial dirt load in the water.

IMPORTANT: To prevent unnecessary strain on piping system and valving, always shut off pump before switching Filter Control Valve positions.

To prevent damage to the pump and filter and for proper operation of the system, clean pump strainer and skimmer baskets regularly.

FILTER CONTROL VALVE FUNCTIONS

FILTER—Set valve to FILTER for normal filtering. Also use for regular vacuuming.

BACKWASH—For cleaning filter. When filter pressure gauge rises 6-8 PSI (0.41-0.55 BAR) above start-up (clean pressure): Stop the pump, set valve to BACKWASH. Start pump and backwash approximately 2 minutes or less depending on dirt accumulation, until water in sight glass is clear. Proceed to RINSE.

RINSE—After backwashing, with pump off, set valve to RINSE. Start pump and operate for about 1/2 to 1 minute. This ensures that all dirty water from backwashing is rinsed out to the filter to waste, preventing possible return to the pool. Stop pump, set valve to FILTER, and start pump for normal filtering.

WASTE—To bypass filter for draining or lowering water level and for vacuuming heavy debris directly to waste.

RECIRCULATE—Water is recirculated through the pool system, bypassing the filter.

CLOSED—Shuts off flow from pump to filter.

VACUUMING—Vacuuming can be performed directly into the filter. When vacuuming heavy debris loads, set valve to WASTE position to bypass the filter and vacuum directly out to waste.

FILTER CONTROL SLIDE VALVE -Two positions

FILTER and BACKWASH selections are provided for all necessary operational functions.

FILTER—Set Valve to FILTER for normal filtering. Also use for vacuuming (handle in DOWN position).

BACKWASH—For pressure cleaning filter (handle in UP position).

*NOTE: For new concrete or gunite pools, or where there is a large amount of plaster dust or debris—start filter in FILTER position (not BACKWASH) to prevent clogging of underdrain laterals.

WINTERIZING

1. Completely drain tank by unscrewing drain cap at base of filter tank. Leave cap off during winter.
2. Depress control valve handle (if used) and rotate so as to set pointer on valve top between any two positions. This will allow water to drain from the valve. Leave valve in this "inactive" position.
3. Drain and winterize pump according to pump instructions.

SERVICE & REPAIRS

Consult your local authorized *Hayward* dealer or service center. No returns may be made directly to the factory without the expressed written authorization of Hayward Pool Products, Inc.

PLEASE REALIZE . . .

Pure, clear swimming pool water is a combination of two factors—adequate filtration and proper water chemistry balance. One without the other will not give the clean water you desire.

Your filter system is designed for continuous operation. However, this is not necessary for most swimming pools. You can determine your filter operation scheduled based on your pool size and usage. Be sure to operate your filtration system long enough each day to obtain at least one complete turnover of your pool water.

To properly sanitize your pool, maintain a free chlorine level of 1 to 3 ppm and a pH range of 7.2 to 7.6. Insufficient chlorine or an out of balance pH level will permit algae and bacteria to grow in your pool and make it difficult for your filter to properly clean the pool water.

PROBLEM SOLVING LIST

	LOW WATER FLOW	SHORT FILTER CYCLES	POOL WATER WON'T CLEAR UP
REMEDY	1. Check skimmer and pump strainer baskets for debris. 2. Check for restrictions in intake and discharge lines. 3. Check for air leak in intake line (indicated by bubbles returning to pool). 4. Backwash filter.	1. Check for algae in pool and superchlorinate as required. 2. Be sure chlorine and pH levels are in proper range (adjust as required). 3. Check surface of filter sand for crusting or caking (remove 1" of sand if necessary).	1. Check chlorine, pH and total alkalinity levels and adjust as required. 2. Be sure flow rate through filter is sufficient. 3. Operate filter for longer periods. 4. Be sure Vari-Flo valve is set on "Filter" position.

POOL CHEMISTRY GUIDELINES

SUGGESTED POOL CHEMISTRY LEVELS		ACTION REQUIRED TO CORRECT POOL CHEMISTRY	
		TO RAISE	TO LOWER
pH	7.2 to 7.6	Add Soda Ash	Add Muriatic Acid or Sodium Bisulphate
TOTAL ALKALINITY	100 to 130 ppm	Add Sodium Bicarbonate	Add Muriatic Acid
CHLORINE (UNSTABILIZED)	0.3 to 1.0 ppm	Add Chlorine Chemical	No action - chlorine will naturally dissipate
CHLORINE (STABILIZED)	1.0 to 3.0 ppm	Add Chlorine Chemical	No action - chlorine will naturally dissipate
CHLORINE STABILIZER (Cyanuric Acid)	40 to 70 ppm	Add Stabilizer	Dilution - partially drain & refill pool with water that has not been treated with Cyanuric Acid.

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ZA del'Observatoire
2, Avenue des Chaumes
78182 St. Quentin en Yvelines Cedex
France

Rev. 1/00 B

7.0 General Operational Procedures

7.1 Key Principles

The following are the key principles of the procedures for general operation of the Rarotonga Waste Facility,

1. General public and regulating authority perception of landfill performance is primarily based upon the level of adverse effects on the wider community.

7.2 Recycling Centre

(REFER SECTION 1.5)

The operation of the Recycling Centre is the responsibility of the recycling contractors. The method of operation shall be determined by the recycling contractor to efficiently and safely carry out the recycling tasks.

No wastes may be accepted at the Recycling Centre except those which the Recycling Contractor is contracted to accept. At the end of the term of the Recycling Contract the Recycling Contractor will be obliged to remove all waste machinery or debris not owned by the Government of the Cook Islands and to dispose of these in an environmentally sound matter and at commercial rates if disposed of in the landfill.

7.3 Disposal Charges

The Waste Acceptance Controller will collect disposal charges from all users of the landfill and septage ponds as they enter the site. The only parties who will be not required to pay disposal charges are those contractors who have set up an account with the Landfill Manager. In this case, the Waste Acceptance Controller will simply record the volume of waste being delivered.

The disposal charges will be set by the Landfill Manager and reviewed annually in consultation with the CIIC based on the principles of full cost recovery and user pays charges will be proportional to refuse volume.

To encourage the source separation of recyclable/recoverable waste materials, the Landfill Manager will implement a differential pricing strategy for loads of waste bought directly to the landfill facility. Mixed solid waste will attract the highest charge for disposal. Loads of recyclable/recoverable waste materials that are separated by the generator will attract a lower disposal charge.

Initially it is proposed that reduced charges or nil charges be applied to the following three types of source separated loads:

- Earth, rocks, broken concrete and other materials that can all be used as cover material in the land filling operation.

- Separated garden and wood waste
- Separated recyclable materials

The Landfill Manager will continually monitor conditions and as markets evolve, differential pricing may be applied to encourage source separation and recovery of other selected waste materials.

7.4 Surface Water Management

7.4.1 Types of Surface Water

Surface water can be divided into three categories:

- Refuse Contaminated Water
- Stormwater
- Septage Contaminated Water

(i) Refuse Contaminated Water

Surface runoff that comes into contact with refuse will be treated as leachate and directed to the leachate collection and treatment system. Such areas include:

- Active working area
- Cover material area
- Truck turn around and drop off area

(ii) Stormwater

Stormwater is clean runoff from:

- Intermediate cover areas
- Temporary cover areas
- Final cover areas
- Borrow areas which have not been vegetated
- Upper quarry site
- Spoil and cover stockpiles

- Any other surface not in contact with refuse

Stormwater will be diverted to the stream diversion channel or to areas where the runoff will infiltrate quickly into the ground and not create any potential erosion problems.

(iii) Septage Contaminated Water

Septage contaminated washdown and rain water from the truck drop-off pad will be discharged into the septage pond.

7.4.2 Surface Water Control

(i) General

The following general surface water control has been constructed:

- Stream diversion channel along the northern edge of the site to direct any surface runoff from the upper valley away from the landfill and septage pond facility.
- Within the septage pond facility, the ponds are sized with a freeboard of 500mm and are double bunded. Stormwater runoff from within the double bunded area will be disposed of by soakage.
- The access road has been sloped away from the landfill and septage ponds to redirect any water spilling out of the stream diversion channel back into the channel.

(ii) Stream Diversion Channel

A stream diversion channel has been constructed along the eastern end of the landfill and between the access road and the northern highwall to divert the intermittent stream flow that ran through the landfill site prior to development.

The road alongside the stream channel has been designed with a crossfall back into the stream channel. This will help to ensure that, should any flows leave the stream channel for any reason (eg excessive flow, blockage due to slip or rockfall), the flow will be redirected back into the channel.

The channel longitudinal gradient has been set so as to encourage any deposit of sediments to occur in the flatter reach upstream of the culvert so that the culvert is less likely to be blocked by sediment. The grade through the culvert has been locally steepened to further reduce the likelihood of blockage due to sediment drop out.

Inspection of the stream channel will be required after large storm events to remove accumulated sediments and to ensure the culverts are not blocked. The stream channel and all culverts will also be inspected on an annual basis and repaired as required. The following photos show both an acceptable amount of debris in the stream channel and an unacceptable amount of debris that requires immediate removal.

Photo 7-1 Acceptable Debris in Stream Channel

Photo 7-2 Unacceptable Debris in Stream Channel

(iii) Septage Pond Area

In the vicinity of the septage ponds an effective double bunding system has been provided through the arrangement and relative levels of the access roads. Apart from the rainfall which falls directly into the ponds, the area enclosed by the double bunding system drains by soakage through a soakage trench system.

(iv) Rainfall Falling Directly on Liner System

During the initial stages of landfilling there will be a relatively large area of liner system exposed. The volume of stormwater falling on the liner system could create additional hydraulic loading on the leachate collection system, septage ponds and treated effluent disposal system. For this reason a Temporary Protection Cover has been installed over the leachate collection system to collect rainwater (refer Section 5.5.1). Stormwater collecting on the liner will be clean and will be pumped to the stream diversion via a culvert placed under the access road at the north-western corner of the landfill. As refuse is placed the temporary cover will be gradually rolled back and removed from the landfill.

The Temporary Protection Cover also serves to protect the leachate drainage system from being clogged by dust and debris during the period between initial landfill construction and refuse placement in those areas.

(v) Runoff from Southern Highwall onto Landfill Area

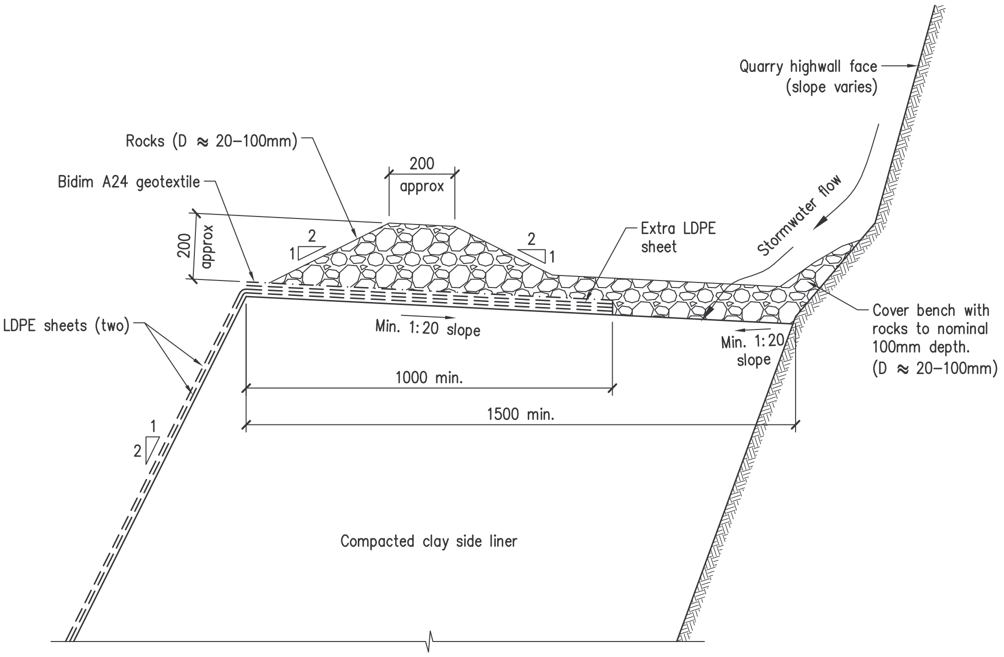
As part of the side liner construction (Refer Section 5.15), each lift of the side liner will be installed with a stormwater drain along the top edge. Any stormwater that bypasses the drain will be treated as per part (iv) of this section.

Where significant runoff occurs from the Southern Highwall onto the side liner, it may be necessary to install temporary protection structures to capture the runoff to protect the side liner and to redirect the flow towards the drain. The design of the temporary protection will need to be determined on site. One possible design is illustrated in Figure 7-1.

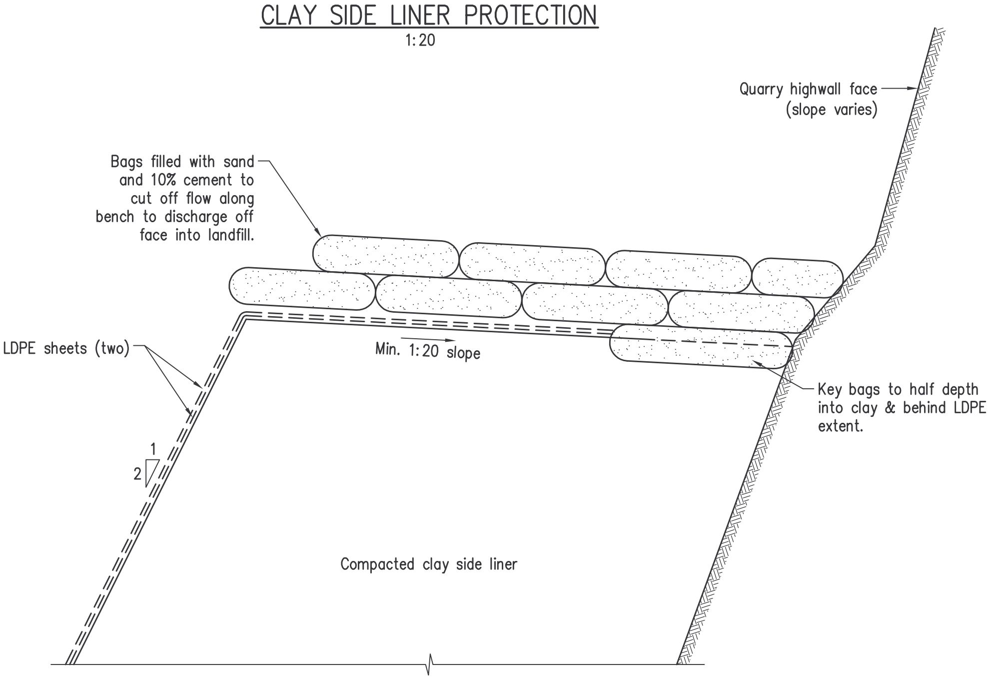
(vi) Recycling Area

The recycling area has been graded so that all stormwater runs into the existing channel to the South West of the Recycling Facility.

Figure 7-1 Clay Sideliner Protection



TYPICAL SECTION
CLAY SIDE LINER PROTECTION
1:20



SECTION AT 20m INTERVALS
1:20

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maunsell

RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
ISSUE 2 – FACILITY OPERATION

Figure 7–1:
CLAY SIDE LINER PROTECTION

7.5 Nuisance Control

7.5.1 General Measures

The Landfill Operator will liaise with neighbours and affected parties if any nuisance complaint occurs (Refer Section 7.6).

A record is to be kept in the site log of all nuisance control measures implemented on a day-by-day basis, this is to include but not be limited to:

- Odour control
- Litter
- Dust control
- Noise control
- Bird control
- Insect control
- Rodent control
- Vegetation

The record is to include the reason for the measures to be implemented, the area affected, the duration that the measures were implemented for and the degree of success in removing the nuisance.

7.5.2 Odour

The objective is that there will be no odour or particulate matter that causes objectionable effect beyond the boundary of the site. Good site management can significantly reduce the risk of objectionable odours from landfills. The following procedures will be adopted at the landfill site:

- Avoiding depositing waste into standing water.
- Good compaction and suitable gradients to minimise water ingress, together with the provision of adequate cover.
- Ensuring immediate deposition of waste on delivery.
- Malodorous waste will be closely controlled and immediately covered.
- Minimising excavations into old refuse.
- Minimising size of working face

If required, odour suppressants may be used on the landfill surface. Odour suppressants will be reviewed and acceptable products identified based on the nature of the suppressant, the duration of usage and success or failure to mitigate the odour. Refer to Section 6.3.4 for procedures to minimise odour generated by the Septage Ponds.

7.5.3 Litter

Measures to encourage the covering of loads are discussed in Section 4.2.1. All loads arriving at the site must be either sheeted or netted to reduce the risk of litter being deposited on the approaches to the site. Non-compliance will result in the vehicle being refused future entry to the landfill.

During operational periods of the landfill, weekly inspection of the approaches to the site will be undertaken by the WAC. The inspections will include the whole of the landfill access road, from the Back Road to the site, the Back Road past the prison entrance and the connecting road from the prison to the main road at the MOW office. Should litter be discovered within the inspection areas this will be collected by the WAC and disposed of in the landfill operators expense.

Where possible, the landfill operator will obtain advance permission to access adjacent private properties to clear windblown litter at any time. Any dispute as to the likely source of the litter on privately owned land will be resolved by the MOW whose decision shall be final.

Vehicles delivering refuse to the site will not be permitted to remove their sheets or nets before arriving at the landfill face.

Mobile litter screens will be placed in an arc immediately down wind of the operational area. Vehicles exiting the working face will first be checked for light material left in the body and around the tailgate. (Extra care must be taken when clearing the tailgate area). On days of extremely high winds, the landfill will be closed.

Regular patrols of the site and its environs will be carried out to identify and collect litter outside the operational phase of the landfill; these patrols will automatically follow periods of high winds.

7.5.4 Dust

The main sources of dust on site are from earthworks and unsealed access roads – especially during periods of dry and/or windy weather. Unsealed roads, exposed earthwork areas and cover operations will be damped down to control dust during operational hours (eg water truck). Dusty waste consignments will be damped as it they are deposited (Refer Section 5.6.6).

Stockpiles are to be managed to minimise the emissions of particulate. One or a combination of the following may achieve this:

- Damping down.
- Locating stockpiles so that they are sheltered from prevailing winds.
- Covering or sheeting of stockpiles.
- Grassing stockpiles.

7.5.5 Noise

All vehicles, machinery and equipment in use on the site are to be maintained in good condition and when necessary repaired promptly. All equipment used on the landfill site for landfill operations must be fitted with effective silencers or mufflers to reduce noise levels created on site to a reasonable level.

7.5.6 Birds

Birds can be attracted to landfill sites in large numbers. It is necessary to prevent the establishment of seagulls, mynah birds and wild fouls or chickens at the early stages, as once established eradication can be difficult.

Litter control, limiting the operational area/size of landfill face, good compaction and adequate use of cover is expected to remove any potential problem with birds, however the following additional methods may also be employed:

- Distress calls - these discourage birds from visiting the site and can be used in conjunction with bird scarers and falcons. The calls must be regularly changed, as birds tend to learn to ignore them.
- Kites - a bird-scaring kite known as a helikit that produces an outline similar to a bird of prey can be used successfully in conjunction with distress calls and bird scarers.
- Shooting - blanks or live ammunition can be used. If live ammunition is used only species unprotected by law can be shot.

Bird control will be the responsibility of the landfill operator. The operator will be licensed to operate a firearm and will store the firearm in a secure location when not in use. Shooting will only be undertaken Monday to Friday during daylight, outside of normal operating hours.

7.5.7 Insects

With the implementation of good landfill management, good compaction and the use of twice-weekly cover the likelihood of infestations of flies and other insects are greatly reduced. However, flies may still be a problem in the summer months. If non-soil cover is being used and insects become a nuisance then consideration should be given to reverting to soil cover at least once and possibly twice per week until the insects are bought under control. Fly traps set near the active area will be used as a secondary method to control flies.

To reduce the volume and depth of water ponded on the rain cover, the pond should be checked after rain, and the SW pump should be turned on manually until pump starts sucking in air. Do NOT leave the pump unattended as it will burn out if it runs dry. The remaining shallow depth of water on the liner may heat up enough in the sun to kill mosquito larvae. At times of inadequate sunshine it may be necessary for the Public Health Dept to spray small doses of oil onto the ponded water to create a thin film.

It is proposed that fish be introduced into the septage ponds to eat mosquito larvae. The Public Health Dept has introduced small black Cambusia fish from Atiu into a number of water bodies on Aitutaki and these have proved effective in controlling mosquitoes. The fish grow to approx 2cm long and are not attractive for eating. If these fish are already present in Rarotonga then they should also be released into the Rarotonga septage ponds.

Cislin 10 (pyrethriod deltamethrin) insecticide or another insecticide approved by the ES and the MOH may need to be applied to refuse and/or the septage ponds. A Materials Data Safety sheet for *Cislin 10* is included in Appendix 7.2. When applying insecticides, site staff will take special care, will have undergone full training in its application and will wear protective clothing provided by the Landfill Operational Contractor.

7.5.8 Rodents and Feral Animals

The most satisfactory way of avoiding rodent infestation and feral animals is effective site management.

Adequate compaction of the waste and effective use of cover removes the rodent access to food and nesting places. As part of the landfilling operating regime rodent presence is to be closely monitored and any necessary control carried out. Poison may be administered in manner so as to target rodents and not endanger other wildlife or domestic animals.

7.5.9 Vegetation

Weed and pest plant species are to be comprehensively controlled. All areas are to be regularly monitored including stockpiles, capped areas, amenity areas and restored areas for pest plant species. If pest species are discovered they will be dealt with by the appropriate method, if this is spraying with herbicide, it is to be carried out by personnel trained and qualified in the use of herbicide. Sprayed areas are to be grassed.

7.6 Complaints Procedure

7.6.1 Receiving Complaints

If a complaint is received by post or fax, it is to be brought to the attention of the Landfill Manager as soon as possible and within 4 hours of receipt during operational hours or the next day if outside operation hours.

If a complaint is received by telephone, the call will be directed to the Landfill Manager and the following details of the complaint will be taken and recorded in the site log:

- Name, address and telephone number.
- Nature of complaint.
- Time and date of occurrence that gave rise to the complaint.
- Location of the source of the complaint.
- Weather, wind direction and rainfall at the time of complaint.
- Response made and likely cause of complaint.
- Action taken or proposed.

If the Landfill Manager is to be out of contact for more than 4 hours, either a designated person or the landfill supervisor will respond to the complaint. The Environment Service and MOH will be informed of any complaints received and the action taken in response as soon as practicable and no longer than one working day after the complaint was reported.

At the end of each day, any complaints received will be transferred to the complaint register. The environmental log will be immediately available to the Environment Service on request.

7.6.2 Response to complaints

The Landfill Manager is to contact the complainant by telephone immediately, or if this is not possible, by sending a letter on the same day as the complaint is received.

If the cause of the complaint is identifiable, measures will be put in place to avoid a recurrence (if practical). If there is uncertainty as to the nature or cause of the complaint, the Landfill Manager must seek clarification. A meeting may be required to discuss the complaint and if possible should be arranged as soon as is practicable.

All complaints must be responded to in writing, in some cases this may be after clarification.

Copies of the written responses are to be filed with the complaints register.

All complaints must be reported to the MOW within 24 hours of their receipt.

7.6.3 On Going Complaints

If a complainant is dissatisfied with a response to a complaint, every reasonable attempt is to be made to find a satisfactory solution. If all reasonable measures are rejected, the complainant should be referred to the ES. Details of the remedial measures offered are to be sent by the Landfill Manager to the ES.

7.6.4 Access to complaints register

The complaints register and responses to the complainants will be available for inspection by the Environment Service and MOH at all reasonable times.

7.7 Record Keeping

All records will be legible and stored either as paper copy in an appropriate file and/or as a computer file as required. Paper copies will back up computer files and data will be regularly downloaded to a computer storage medium. The site logs will be archived. Monitoring information will be compared to compliance requirements and trigger levels. Trends will be monitored and explanations provided where possible.

7.7.1 On Site Documentation

The following information will be recorded in respect of all wastes accepted at the landfill or septage ponds. If not directly entered into a computer at the site it shall be batch entered at least once a week.

Table 7-1 Waste Acceptance Records

Information	Credit Customers	Cash Customers Commercial	Cash Customers Domestic
Date and Time	✓	✓	✓
Vehicle. Type (Std List)	✓	✓	✓
Registration No.	✓	✓	Not necessary
Waste Type (Std List)	✓	✓	✓
Waste Volume	✓	✓	✓
Source of Waste	Only if special waste or septage		
Fees Charged	✓	✓	✓
Invoice/Receipt No.	✓	✓	✓

In the event that a consignment of waste is considered unacceptable for disposal at the landfill due to a hazardous waste content, procedures will be followed as per Section 4.2.2. Information recorded as per

Section 4.2.2 will be documented on a Waste Inspection Sheet, and a copy delivered to the Environment Service within 24 hours. The original sheet is to be passed to the Landfill Manager.

The results of random inspections will be recorded on the Waste Inspection Sheets, if during these random inspections hazardous waste is discovered copies of the Inspection Sheets will be sent to the Environment Service along with a description of the action taken.

7.7.2 Environmental Log

A site environmental log will be maintained. This will include the times and dates of monitoring activities undertaken, daily rainfall gauge readings, flow statistics and all public complaints. This log will also reference ground and surface water quality.

7.7.3 Nuisance Control Measures

A record will be kept in the site log of all nuisance control measures implemented on a day-by-day basis, this will include but not be limited to measures listed in Section 7.5.

The record will include the reason for the measures to be implemented, the area affected, the duration that the measures were implemented for and the degree of success in removing the nuisance.

7.7.4 Topographic Surveys

A topographic survey of the landfill surface will be undertaken annually. This topographic data will then be used to calculate current amount of volume used, the remaining volume and the life remaining at the current rate of usage.

7.7.5 Reporting

An Annual Report will be prepared by the Landfill Manager for the year to 30 June. A summary of the content required in the Annual Report is included in Appendix 7.1. This report will be forwarded to the Environment Service and the Ministry of Health by 1st August each year.

7.8 Electrical Control Cabinets

The electrical control cabinets are to be kept locked at all times except when staff are present and have a need to control the equipment. The termination boxes have exposed live terminals and should only be opened by a suitably qualified electrician.

Each cabinet has a heater, thermostat, and fan. The Heater is controlled by thermostat, set at 20 degrees.
The Fan is on manual operation - run continuously during the hottest months.

Appendix 7.1

Annual Report Content

Rarotonga Waste Facility Annual Report

The Landfill Manager will prepare an annual report with the following content as a minimum:

- The status of landfilling and septage pond operations on the site
- Quantities of each type of waste received
- Register of Special Wastes received
- Locations of refuse placement during the year
- Compacted refuse density
- Volume of landfill consumed in the year
- Estimation of remaining landfill life
- Quantities of septage received
- Treated Effluent disposal quantities
- Quantity and type of materials handled in recycling centre
- Review of recycling operations
- Major maintenance undertaken during the year
- Construction undertaken during the year
- Budget required for construction and major maintenance over the next 3 years.
- Budget required for operations in compliance with Landfill Management Plan for future years
- Actual operating costs for year
- Income received by waste type and source
- All groundwater analyses
- Leachate quality analyses
- Interpretation of monitoring results including any trends or exceedences
- Compliance with ES Project Permit conditions
- Complaints received and actions taken
- Activities undertaken to implement peer review recommendations
- Minutes of Community Liaison Meetings and actions taken
- Health and Safety including a summary of incidents and accidents with the related time lost
- Training undertaken
- Key activities planned for the next year
- Identification of timeline for any approvals or inputs required by regulating authorities
- Emergency actions required

Appendix 7.2

Cislin 10 Information

CISLIN®

Aventis

MATERIAL SAFETY DATA SHEET

STATEMENT OF HAZARDOUS NATURE

Not classified as hazardous according to the criteria of New Zealand Legislation.

COMPANY DETAILS

AVENTIS CROPSCIENCE PTY LTD, NEW ZEALAND	24 HOUR EMERGENCY RESPONSE NUMBER 0800 734 607	
PO Box 31341	NATIONAL POISONS INFORMATION CENTRE (03) 474 7000	
20 Pretoria Street	BUSINESS NUMBER	FAX NUMBER
Lower Hutt	(04) 570 2180	(04) 570 2181

IDENTIFICATION

COMMERCIAL PRODUCT NAME	CISLIN® Residual Insecticide
OTHER NAMES	K-OTEK®
PROPER SHIPPING NAME	None known
MANUFACTURER PRODUCT CODE	AE F032640 00 SC01 B1
U.N. NUMBER	Not applicable
DANGEROUS GOODS CLASS	Not applicable
HAZCHEM CODE	Not applicable
TOXIC SUBSTANCES SCHEDULE	Not classified
PACK SIZE AND CONTAINER TYPE	2.5 L HDPE bottle
USES	A liquid insecticide concentrate for spray application.
PHYSICAL DESCRIPTION/PROPERTIES	
APPEARANCE	White liquid with practically no odour
BOILING POINT/MELTING POINT	100°C
VAPOUR PRESSURE	As for water
SPECIFIC GRAVITY	1.01 @ 20°C
FLASH POINT	Not applicable
FLAMMABILITY LIMITS	Not applicable

SOLUBILITY

- **IN WATER** — Forms a suspension

STABILITY AND REACTIVITY — Stable under normal conditions of use and transport

pH — Not known

EXPLOSION HAZARD — Not combustible

CORROSIVE HAZARD — Non corrosive

INGREDIENTS

CHEMICAL NAME	CAS NUMBER	PROPORTION
• Deltamethrin	52918-63-5	10 g/L
• Propylene glycol	57-55-6	60 g/L
• Ingredients determined not to be hazardous		12 g/L
• Water	7732-18-5	928 g/L

HEALTH HAZARDS INFORMATION

HEALTH EFFECTS

ACUTE

- **SWALLOWED**
  - LD50 Oral (product): Rat >10 000 mg/kg
  - LD50 Oral (Deltamethrin): Rat 130 mg/kg
  - Product is harmful if swallowed causing headache, dizziness, drowsiness, diarrhea, nausea and vomiting.
- **EYE CONTACT**
  - Deltamethrin causes slight eye irritation in rabbits.
  - Causes eye irritation.
- **SKIN CONTACT**
  - LD50 Dermal (product): Rat >10 000 mg/kg
  - LD50 Dermal (Deltamethrin): Rabbit >2000 mg/kg
  - Causes irritation to the skin. Contact with the skin, especially the face, may cause initial stinging or burning sensations followed by numbing that may persist for a few hours.
- **INHALATION**
  - LC50 (4 hour): Rat 2.2 mg/l
  - Avoid breathing spray as this may cause transient irritation (up to 24 hours) of the mucous membranes of nose, throat and respiratory tract.

CHRONIC — No evidence of carcinogenic, mutagenic or reproductive toxicity hazards.

FIRST AID

IF POISONING OCCURS: contact a doctor or the National Poisons Information Centre.

DO NOT ATTEMPT TO GIVE ANYTHING TO A SEMICONSCIOUS OR UNCONSCIOUS PERSON.

SWALLOWED If patient is conscious rinse mouth with water. Induce vomiting if more than 15 minutes away from a hospital, preferably by using Ipecac Syrup APF. If breathing stops apply artificial respiration. Seek medical advice. Show this MSDS to a medical practitioner.

EYE CONTACT Immediately irrigate open eye with copious quantities of water for at least 15 minutes. Seek medical advice. Show this MSDS to a medical practitioner.

SKIN CONTACT Remove contaminated clothing. Wash affected areas with plenty of soap and water.

INHALATION Move patient into fresh air away from contaminated area. If breathing stops apply artificial respiration. Seek medical advice. Show this MSDS to a medical practitioner.

FIRST AID FACILITIES Ensure washing facilities are available.
Secure a supply of Ipecac Syrup APF.

ADVICE TO DOCTOR Treat symptomatically. Skin contacted with Deltamethrin must be carefully cleaned using cleansing milk. Symptoms can be partially alleviated by the application of a moisturizing cream or anesthetic ointment.

PRECAUTIONS FOR USE

EXPOSURE STANDARDS No occupational exposure standards have been established for the product.
Deltamethrin: Aventis recommends OES of 0.28 mg/m^3
Propylene glycol: manufacturer recommends TWA of 10 m/m^3 mist (400ppm vapour)

ENGINEERING CONTROLS Use in a well-ventilated area only.

PERSONAL PROTECTION Protective clothing: full-length overalls, waterproof protective gloves, boots, goggles or face shield and a suitable respiratory mask for prolonged or repeated handling.
Wash facilities should be available.
Wash hands, arms and face thoroughly with soap and water after use and before eating, drinking or smoking.
Wash protective clothing and equipment at the end of each day.

FLAMMABILITY Not flammable.

OTHER PRECAUTIONS To be used strictly in accordance with label instructions.

SAFE HANDLING INFORMATION

STORAGE AND TRANSPORT

<u>STORAGE</u>

- **LOCATION** Store in a cool, dry, well-ventilated area away from direct sunlight.
- **SECURITY** Secure storage required to keep product away from children, animals,

food, feedstuffs, seed and fertilisers.

- **VENTILATION** — Storage area to be well ventilated.
- **TEMPERATURE CONDITIONS** — Cool but frost free.
- **WEATHER/SUNLIGHT** — Avoid direct sunlight.
- **FLAMMABILITY** — Not flammable.
- **STORAGE INCOMPATIBILITIES**
  - Avoid iron and alloys.
  - Avoid oxidising agents, strong acids and alkalis.
- **CONTAINER/PACKAGE** — Store in tightly sealed original container.

TRANSPORT

LAND TRANSPORT — Not classified

MARITIME TRANSPORT — Not classified

AIR TRANSPORT — Not classified

SPILLS AND DISPOSAL

PERSONAL PROTECTION — Avoid contact with eyes, skin and clothing or inhalation of product. Personal protective clothing: full length overalls, waterproof protective gloves, boots, goggles or face shield and a suitable respiratory mask should be worn when dealing with spills and disposals to minimise the potential for increased personal exposure.

SPILL CONTAINMENT — Deal with spillage immediately.

Keep people away and upwind of the spillage.

Contain the spill by damming, recover spilt product by absorbing with sawdust or an inert absorbent material then transfer the recovered spilt material to a properly labeled drum. Seal the drum and arrange for use or disposal.

Wash down the affected area with water. Absorb washing water with inert material and place in a properly labeled sealable container for subsequent disposal.

Warn the local water authority if contamination of drains, streams, watercourses etc is unavoidable.

Avoid contamination of ponds and waterways.

DISPOSAL — Disposal of contaminated product, waste or packaging should be by

- Burial in an approved landfill away from steams or watercourses.
- Incineration at an authorised installation OR
- As dictated by relevant Local Body regulations.

Contaminated packaging must not be used to store other products.

FIRE/EXPLOSION HAZARD

HAZARDS OF USE/STORAGE — Not flammable.

DANGEROUS DECOMPOSITION OR COMBUSTION PRODUCTS

Stable at normal temperatures but generates carbon and nitrogen oxides and other irritant and toxic fumes when heated or combusted.

FIRE-FIGHTING RECOMMENDATIONS

See below. Do not use a water jet from a fire hose. Contain run-off.

TYPES OF EXTINGUISHER/FIRE FIGHTING AGENTS

- Carbon dioxide
- Foam
- Dry powders
- Water spray or fog

PRECAUTIONS	Avoid skin contact and inhalation of product.
PROTECTIVE CLOTHING	Full protective clothing and self-contained breathing apparatus
REACTIVITY	Stable under normal conditions of use and transport.
HAZCHEM CODE	Not applicable

OTHER INFORMATION

TOXICITY AND ECOTOXICITY

Deltamethrin is not persistent in the environment and does not build up in the food chain. It is destroyed by soil microorganisms and leaves no residues in the environment.

- LD50: Duck >5000 mg/kg
- LD50: Quail >10 000 mg/kg

Deltamethrin is highly toxic to fish and aquatic organisms. Avoid contamination of ponds, streams and waterways.

- LC50 (96 hours): Fish 0.001-0.01 mg/L

CONTACT POINT

EMERGENCY CONTACTS

POLICE, AMBULANCE OR FIRE BRIGADE	111
EMERGENCY RESPONSE SERVICE (24 hours)	0800 734 607
NATIONAL POISONS INFORMATION CENTRE	03 474 7000

DISCLAIMER

The information contained in this Safety Data Sheet, as of the issue date, is believed to be true and correct. However, the accuracy or completeness of this information and any recommendations or suggestions are made without warranty or guarantee.

Since the conditions of use are beyond the control of our company, it is the responsibility of the user to determine the conditions of safe use of this product. The information in this sheet does not represent analytical specifications, for which please refer to our technical data sheet.

8.0 Process Control and Environmental Monitoring

8.1 Key Principles

The following are the key principles of process control monitoring and environmental monitoring.

1. It is important to undertake regular environmental monitoring for indicators of pollution caused by the operation of the landfill and septage ponds (training will be provided in these areas)
2. Should any pollution be discovered, it is of the utmost importance that the source be identified and mitigation measures be instigated as soon as possible to prevent further environmental damage.
3. The Landfill Manager is responsible for ensuring that Process Control and Environmental Monitoring is undertaken in accordance with this management plan.

8.2 General Procedures

Process Control and Environmental monitoring will be carried out by adequately qualified and trained personnel. Specialist training will be provided to ensure appropriate operation of all monitoring equipment and its maintenance. When equipment is replaced or updated, training will be given to those staff operating the equipment.

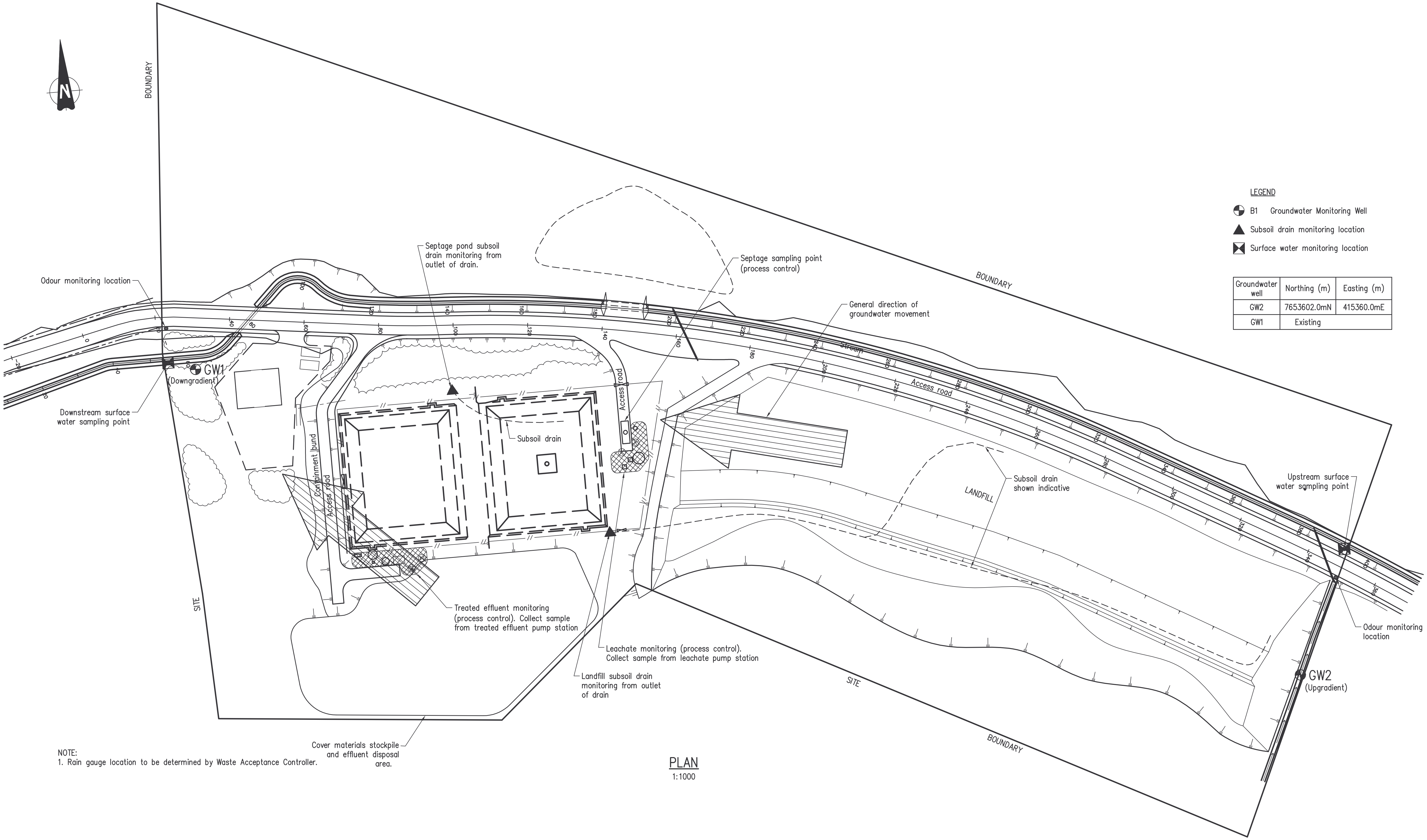
All sampling and monitoring equipment will be kept in good repair and checked or recalibrated at the appropriate intervals. Recalibration records will be documented.

Monitoring will continue post closure according to the aftercare plan (Refer Section 10.0).

All water quality sample analyses required will be undertaken using standard methods as detailed in the "Standard Methods For The Examination Of Water and Waste Water, 1995" 19th edition by A.P.H.A and A.W.W.A and W.E.F. and any other subsequent updates. For all field measurements, the methods employed are to be in accordance with the monitoring equipment instructions and are to be agreed to in advance with the Environment Service and Ministry of Health.

All monitoring locations are shown in Figure 8-1. A summary schedule of required monitoring is presented in the Executive Summary.

Figure 8-1 Monitoring Locations



Groundwater well	Northing (m)	Easting (m)
GW2	7653602.0mN	415360.0mE
GW1	Existing	

Last saved: Wed, 22 Dec 2004 02:46 pm

CAD Ref: K:\Dept_49\Projects\4964312 - COO Waste Management Project\CAD\Working\Rarotonga Management Plan\Issued\04.12.22\ Figure8-1_rev2.dwg

RAROTONGA WASTE FACILITY MANAGEMENT PLAN
COOK ISLANDS WASTE MANAGEMENT PROJECT
ISSUE 2 – FACILITY OPERATION

Figure 8–1:
MONITORING LOCATIONS

8.3 Atmospheric Monitoring

A rain gauge will be installed at the landfill and measurements taken at approximately the same time each day. Weekend and holiday measurements will be recorded as cumulative.

- Rainfall quantities will be read using a rain gauge, and be recorded at 9am each working day by the Waste Acceptance Controller.
- Visual observation of rainfall, wind direction and speed will be recorded at 9am each working day by the Waste Acceptance Controller.

8.4 Odour Monitoring

An odour assessment will be made by the Landfill Manager (MOW) on a twice yearly basis.

The Landfill Manager is selected for this role to enable an objective odour assessment to be made rather than a person who works frequently at the site who may be accustomed to any odours at the site.

Odours are to be recorded at the gates at the upstream and downstream boundary of the site, and at the designated location near the treated effluent pump station (Refer Figure 8-1)

Records of wind direction, wind speed and types of wastes received during the day of the odour assessment should be noted to assess any correlation with these aspects. Any indications of excessive odour at the boundaries of the site are to be investigated further.

8.5 Landfill Gas Monitoring

Once Passive Gas Wells (Refer Section 5.13.1) have been installed near the end of the landfill life, gas composition should be tested by the Landfill Manager. Table 8-1 lists an ideal range of parameters to be tested for, but the actual test range will depend on the equipment available in the Cook Islands at the time testing commences.

Table 8-1 Landfill Gas Testing Parameters

Parameter	**Unit**
Methane	%
Carbon Dioxide	%
Oxygen	%
Nitrogen	%
Carbon Monoxide	ppm
Hydrogen Sulphide	ppm
Barometric Pressure (day before and day of reading)	hPa
Gas Flow	m^3/hr

Landfill Gas sampling procedures and acceptable levels for each of the listed test parameters will be determined by the Landfill Manager when the Passive Gas wells are installed. Care should be taken to calibrate any monitoring equipment. Do not use methane meters with probes that can become contaminated by hydrogen sulphide.

8.6 Environmental Monitoring

The Landfill Manager will be responsible for undertaking all Environmental Monitoring. Appendix 8.1 contains information relating to the procedures required for sending samples to NZ for analysis at Hill Laboratories in Hamilton, New Zealand.

8.6.1 Surface Water and Groundwater Monitoring

The stream that exists directly north of the landfill site does not flow all year around and therefore surface water samples will have to be taken when practicable. Figure 8-1 shows the location of the two surface water sampling sites.

Figure 8-1 shows the location of the two groundwater monitoring wells: Borehole 1 (BH1, Upgradient) and Borehole 2 (BH2, Downgradient). In the event of a groundwater monitoring well being destroyed, it will be replaced with a new well in the same general location.

Subsoil drains have been installed under the landfill and under the primary septage pond for the purpose of relieving groundwater uplift pressure on these lining systems. It is proposed to take advantage of the subsoil drains by monitoring them when they flow so as to provide early warning of leakage from the landfill and primary septage pond. Note- these drains are only likely to pick up leakage in their immediate vicinity.

Figure 8-1 shows the marine monitoring locations. These monitoring sites are intended to detect evidence of bacterial contamination of the marine environment. Also shown on Figure 8-1 are the locations of the two subsoil drainage outlets where monitoring shall also occur. One subsoil drain extends under the invert of the landfill, while the other extends under the northern part of the Primary Pond. Accordingly, adverse water quality in these drains is the first indication of leakage from either containment facility. Much like the stream, these drains will operate intermittently. However, it is likely that the drains will be operating when the stream is flowing. Samples will have to be taken from the outlets of these drains when practicable. The parameters to be tested in these samples from the subsoil drains are the same as for groundwater sampling.

Table 8-3 lists the analytical parameters that samples of surface water, sub-soil drainage and groundwater are to be tested for.

8.6.2 Groundwater Quality Baseline Data Collection and Monitoring Frequency

The proposed programme for monitoring is set out in Table 8-2. The programme shows a reducing frequency of sampling with time, once a reasonable baseline of background data has been established.

Baseline water quality data is required in order to set trigger levels and determine the effects the landfill may be having on the surrounding environment. These trigger levels will be based on the upstream and upgradient water quality results.

The data will be initially gathered during the landfill construction. Following construction, additional surface and groundwater quality data collected from the upgradient borehole and upstream sampling locations will be used to extend the baseline water quality data set.

Trigger levels are to be established for each parameter. The trigger level shall be set at a value equal to the mean plus two standard deviations except for pH which shall be set at the mean plus or minus two standard deviations. The trigger levels are to be reset using additional monitoring results at a frequency outlined in the following table. The trigger levels will initially be set using data collected from the site during the construction phase (a minimum of 6 sampling rounds). Following the first full year of operation, the trigger levels can be reset with new available data, as per Table 8-2. The purpose of the trigger levels is to help identify whether down-gradient and downstream samples are being adversely affected by the landfill operation and to ‘trigger’ the need for further investigations to take place (refer Section 8.6.3 below).

The first trigger levels set for the down-gradient borehole should be based on the up-gradient borehole data but must also take account of the pre-landfill pollution of the site due to informal tipping in the old quarry. For this reason, the first trigger levels set for the downstream borehole shall be the lower of:

- the calculated trigger level based on the up-gradient borehole; or
- the calculated trigger level based on the down-gradient borehole.

All subsequent re-setting of the trigger levels shall not include data from the down-gradient sampling location.

Table 8-2 Surface Water and Groundwater Monitoring Programme

Period	Indicator Suite*	Extended Suite*
Construction Phase (6 months)	None	Monthly (6 samples)
Set Trigger Levels		
Year 1	Monthly	Quarterly (4 samples per year) + Extra depending on results of Indicator Suite
Reset Trigger Levels		
Year 2 + Year 3	Every 3 Months	Twice Yearly (2 samples per year) + Extra depending on results of Indicator Suite
Reset Trigger Levels		
Year 4 onwards	Every 3 Months	Annually (1 sample per year) + Extra depending on results of Indicator Suite
Review monitoring frequency and parameters		

* Refer Table 8-3. Marine water samples tested for microbiological parameters only.

8.6.3 Monitoring Parameters

Table 8-3 lists the water quality analyses required for groundwater and surface water monitoring. The parameters in the Indicator Suite will be analysed more frequently than those in the Extended Suite.

Should the Indicator Suite results (for the downstream surface water sample or downgradient borehole) show levels elevated above the set trigger levels, then an additional set of samples is to be taken within 2 weeks and is to be analysed for the Extended Suite.

Should these results continue to be above trigger levels, then the Landfill Manager will consider and take appropriate action having regard to the contingency plans set out in this management plan. The Landfill Manager will notify NES if trigger levels are exceeded and the actions to be taken.

Table 8-3 Surface Water and Groundwater Monitoring Parameters

Parameter	Units	Surface Water (Upstream, Downstream, and Subsoil Drains)		Groundwater (Upgradient and Downgradient		Sampling Requirements	
	Suite	Indicator	Extended	Indicator	Extended	Bottle Type	Container Used
Flow (estimated)	L/s	✳	✳				
Water Level	m			✳	✳	-	-
Temperature	°C	✳	✳	✳	✳	-	-
pH	pH units	✳	✳	✳	✳	Polyethylene	Unpreserved
Electrical Conductivity	mS/m	✳	✳	✳	✳	Polyethylene	Unpreserved
Suspended Solids	g/m^3	✳	✳	✳	✳	Polyethylene	1 Litre unpreserved
Iron	g/m^3	✳	✳	✳	✳	Polyethylene	100mL acid preserved
Zinc	g/m^3	✳	✳	✳	✳	Polyethylene	100mL acid preserved
Alkalinity	g/m^3		✳		✳	Polyethylene	Unpreserved
Aluminium	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Ammoniacal-Nitrogen	g/m^3		✳		✳	Polyethylene	Unpreserved
Arsenic	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Biological Oxygen Demand (BOD)	g/m^3		✳		✳	Polyethylene	500mL unpreserved
Boron	g/m^3		✳		✳	Polyethylene	Unpreserved
Cadmium	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Calcium	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Chemical Oxygen Demand	g/m^3		✳		✳	Polyethylene	250mL unpreserved
Chloride	g/m^3		✳		✳	Polyethylene	Unpreserved
Chromium	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Copper	g/m^3		✳		✳	Polyethylene	100mL acid preserved

Parameter	Units	Surface Water (Upstream, Downstream, and Subsoil Drains)		Groundwater (Upgradient and Downgradient		Sampling Requirements	
	Suite	Indicator	Extended	Indicator	Extended	Bottle Type	Container Used
Cobolt	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Dissolved Reactive Phosphorus	g/m^3		✳		✳	Polyethylene	Unpreserved
Lead	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Magnesium	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Manganese	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Mercury	g/m^3		✳		✳	Glass	100ml preserved
Nickel	g/m^3		✳		✳	Polyethylene	100mL acid preserved
Nitrate Nitrogen	g/m^3		✳		✳	Polyethylene	Unpreserved
Potassium	g/m^3		✳		✳	Polyethylene	Unpreserved
Semi-Volatile Organic	g/m^3		✳		✳	Glass	1 Litre glass
Sodium	g/m^3		✳		✳	Polyethylene	Unpreserved
Sulphate	g/m^3		✳		✳	Polyethylene	Unpreserved
Total Hardness	g/m^3		✳		✳	Polyethylene	Unpreserved
Total Organic Carbon	g/m^3		✳		✳	Glass	100ml unprserved
Total Kjeldahl Nitrogen	g/m^3		✳		✳	Polyethylene	250mL acid preserved
Turbidity	NTU		✳		✳	Polyethylene	1 Litre Unpreserved
Volatile Organic Compounds	g/m^3		✳		✳	Glass	120mL VOC Vial

8.6.4 Groundwater Sampling Procedure

The borehole shall be purged by removal of at least three bore volumes of water from each bore to remove any stagnant water or water which is not representative of the aquifer, before retaining any samples for analysis. During the purging process, checks on temperature, pH and electrical conductivity shall be carried out and pumping continued until these parameters stabilise. Records of these measurements shall be maintained.

Samples shall be collected using a dedicated downhole bailer or sampling pump (such that disturbance of suspended solids is minimised). No transfer of sampling equipment between the two boreholes shall be permitted.

At the time of sampling, all samples collected shall be stored at 4°C. Transfer to the analytical laboratory will be completed within 48 hours of sample collection.

In addition to the previously discussed procedures, the following requirements shall also be followed:

- The bailer or sampling pump shall be constructed of material compatible with the suspected contaminants.
- If a bailer is used, the bailer shall be lowered gently to avoid disturbance of any sediment that may still be in the bore and to avoid damage to the bailer or rope. Samples should be recovered from beside the slotted section of the standpipe.
- Prior to commencement of sampling, a clean piece of plastic shall be placed on the ground beside the well. All equipment shall be placed on this sheet when not in use and all cleaning shall be carried out on the plastic sheet. As the bailer is removed from the well, care shall be taken to place the rope on the plastic sheet.
- Water samples shall be placed in screw capped containers which shall be supplied by the laboratory. Containers are to be screw capped and must be made of polythene for samples to be analysed for metals and inorganics, and glass for samples to be analysed for organics.

Water samples to be analysed for heavy metals may require filtration on site to remove particles that could affect the concentration of metals. Filtering shall take place before the water sample is added to the container with the preservative. Care shall be exercised to minimise aeration of the sample during filtration. Alternatively, if relatively clear and low turbidity samples can be collected, provided the sample may be recovered without aeration, then the sample may be recovered without filtration.

A sample collection record form shall be completed for each sample collected.

(i) Water level determination

The standing water level shall be measured and recorded as part of every monitoring round. Sufficient time shall be allowed for stabilisation of the water levels following development or other disturbance of the bore. The time required for stabilisation will depend on the aquifer characteristics and may range from minutes to days.

A cleaned dipper shall be lowered down the well to ascertain the water level. Water levels shall be referenced to ground surface and recorded to the nearest centimetre.

8.6.5 Surface Water Sampling Procedure

Representative samples from the stream and the landfill shall be collected from two locations. The Upstream Sampling Location where the stream enters the landfill and the Downstream Sampling Location where the stream exits the Waste Facility Site.

Standing in the stream shall be avoided where possible as this disturbs the bottom sediments and could be dangerous in high flows. If this cannot be achieved then stand downstream of the sampling collection point. Clean gloves should be worn for the sample collection.

Surface water samples shall be collected using containers supplied by an accredited laboratory. Containers are to be screw capped and must be made of polythene for samples to be analysed for metals and inorganics, and glass for samples to be analysed for organics.

It is important to use the large 1L unpreserved bottle to collect and pour stream water into the bottles that have a preservative in them. The preservative bottles should not be used to collect samples as the preservative may get flushed out when submerging the bottle.

Samples are to be collected from a 2cm depth below surface. Avoid collecting floating pieces of debris in the sampling container by immersing the bottle upside down, tilting neck and slowly moving into the flow while bottle fills.

If there is no preservative in the bottle, ensure that there is no air left when the lid is sealed. Squeezing the bottle slightly to make the water rise to the top and slightly overflow and then putting the lid on can achieve this. If the bottle contains a preservative then fill to neck of bottle but do not allow any sample water to overflow out of the bottle (as the preservative may also get released).

At the time of sampling, all samples collected shall be stored at 4°C. Transfer to the analytical laboratory will be completed within 48 hours of sample collection.

(i) Flow Estimation

Estimation of the flow in the stream is to be carried out as part of every monitoring round. Flow is to be estimated using the stream velocity, as measured in the field, multiplied by the estimated cross-sectional area of the stream.

Velocity of the stream shall be determined in the field by measuring the time for a floatable object (e.g. an orange or semi-weighted plastic container) to travel an arbitrary (but measured) distance along the stream.

8.6.6 Marine Water Sampling Procedure

There are three marine water sampling sites for the Rarotonga Waste Facility as shown below in Figure 8-2,

(i) Edgewater Resort Site,
(ii) MOW Site, and
(iii) Seventh Day Adventist (SDA) Church Site.

Figure 8-2 Marine Water Sampling Sites

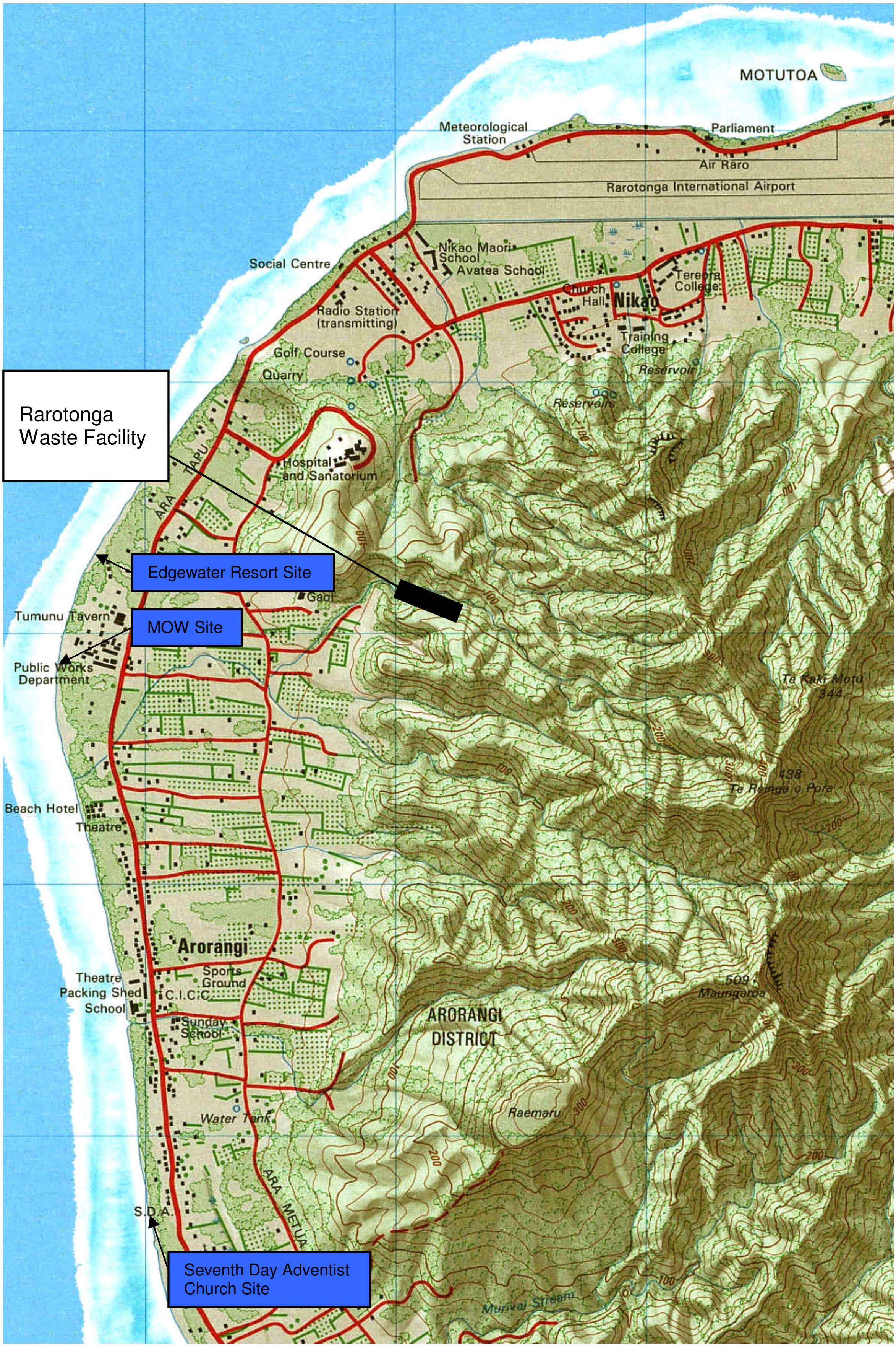


Figure 8-2
Rarotonga Waste Facility
Marine Water Sampling Sites

(i) Marine sampling site at Edgewater Resort

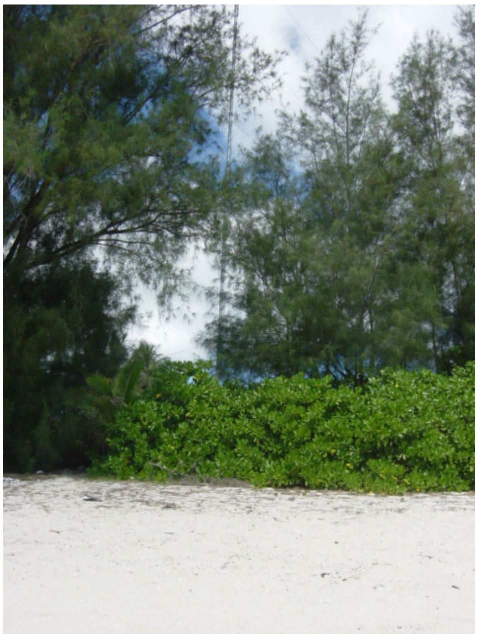
Photo 8-1 Edgewater Resort Marine Sampling Site - Photo showing approach through Edgewater Resort to the right of Block 100

Photo 8-2 Edgewater Resort Marina Sampling Site - Photo showing location from sampling site back through access through Edgewater Resort – the sampling site lines up with the face of the wall at the right hand end of the new block.

(ii) MOW sampling site, and

Photo 8-3 MOW Marine Sampling Site - Photo showing access to the beach to the left of the TV mast

Photo 8-4 MOW Marine Sampling Site - Photo showing view from beach to TV mast. Sampling point is located where stay wires are directly behind and hidden by mast.



(iii) Arorangi SDA Church sampling site

Photo 8-5 SDA Marine Sampling Site - Photo showing view from Main Road to access beside Arorangi SDA church.

Photo 8-6 SDA Marine Sampling Site - Photo showing view from beach back towards SDA church and road. Sampling point lines up with hedge row to the left of SDA church.

The following outlines the techniques for taking and analysing marine water samples.

At the time of sampling enter in a logbook (for later transcription to a sample sheet) details of weather conditions at the time of sampling (estimated wind speed and direction, rainfall), comment on weather conditions in preceding 24 hours, water temperature, salinity, and observations of conditions such as wave disturbance of seabed, turbidity or discoloration and any unusual circumstances affecting the site (e.g. seaweed, jellyfish).

The marine sampling procedure is as follows;

(i) Ensure that the bottle is clearly labelled for later sample identification.

(ii) Quickly plunge the sample bottle upside down approximately 15-20cm below the surface at a point where the depth of water is 0.5m.

(iii) Tilt the bottle until the neck points slightly upwards with the mouth directed towards the current. The bottle can be moved forward horizontally until filled if necessary. Completely fill the bottle.

(iv) Rapidly bring the bottle to the surface and pour out a small portion (leave a space of 2-3cm) to permit proper mixing for analysis. Quickly fit the cap and secure tightly.

(v) Record the time of sample collection and check sample identification labelling.

(vi) Place in a chilly bin containing frozen slicker pads.

Samples of marine water are to be analysed at the Ministry of Health's Laboratory in Rarotonga for the following microbiological parameters only: total coliform, total faecal coliform and enterococcus.

8.7 Process Control Monitoring

8.7.1 Leachate and Treated Effluent Monitoring

Raw leachate and treated effluent are to be visually assessed for odour, clarity and colour on a weekly basis by the Landfill Operations Contractor. These observations are to be recorded.

Table 8-4 lists the parameters that are to be tested 3-monthly and annually. Samples of raw leachate are to be collected from the designated location illustrated in Figure 8-1 using containers supplied by an accredited laboratory.

Samples of treated effluent are to be collected from the designated location illustrated in Figure 8-1 using containers supplied by an accredited laboratory.

At the time of sampling, all samples collected shall be stored at 4°C. Transfer to the analytical laboratory will be completed within 48 hours of sample collection.

Results of the analysis will be sent to the Landfill Manager within one month of the samples being taken, unless otherwise agreed in writing.

Table 8-4 Leachate and Treated Effluent Monitoring Parameters

Parameter	Units	Raw Leachate		Treated Effluent	
		3- Monthly	Annually	3- Monthly	Annually
Odour, clarity, colour (Visual)	-	✳	✳	✳	✳
pH	pH units	✳	✳	✳	✳
Electrical Conductivity	mS/m	✳	✳	✳	✳
Suspended Solids	g/m^3	✳	✳	✳	✳
Iron	g/m^3	✳	✳	✳	✳
Zinc	g/m^3	✳	✳	✳	✳
Alkalinity	g/m^3		✳		✳
Aluminium	g/m^3		✳		✳
Ammoniacal-Nitrogen	g/m^3		✳		✳
Arsenic	g/m^3		✳		✳
Biological Oxygen Demand	g/m^3		✳		✳
Boron	g/m^3		✳		✳
Cadmium	g/m^3		✳		✳
Calcium	g/m^3		✳		✳
Chemical Oxygen Demand	g/m^3		✳		✳
Chloride	g/m^3		✳		✳
Chromium	g/m^3		✳		✳
Copper	g/m^3		✳		✳
Cobolt	g/m^3		✳		✳
Dissolved Reactive	g/m^3		✳		✳
Lead	g/m^3		✳		✳
Magnesium	g/m^3		✳		✳
Manganese	g/m^3		✳		✳
Mercury	g/m^3		✳		✳
Nitrate-Nitrogen	g/m^3		✳		✳
Nickel	g/m^3		✳		✳
Potassium	g/m^3		✳		✳
Sodium	g/m^3		✳		✳
Sulphate	g/m^3		✳		✳
Total Hardness	g/m^3		✳		✳
Total Kjeldahl Nitrogen	g/m^3		✳		✳
Total Organic Carbon	g/m^3		✳		✳
Turbidity	NTU		✳		✳
Volatile Organic Compounds	g/m^3		✳		✳
Semi-Volatile Organic Compounds	g/m^3		✳		✳

8.7.2 Septage Monitoring

In addition to the operational requirements for septage quantity and waste acceptance monitoring (as outlined in Section 4.3.2) samples of septage are to be collected by the Landfill Operations Contractor and tested periodically to provide baseline data for septage composition. This data will also be used to help assess the quality of the treated effluent.

The septage ponds will receive septage from both residential and commercial sources.

Random grab samples of septage are to be taken and analysed for the Surface Water Indicator Suite of parameters as listed in Table 8-3. In addition to this suite, an ‘Oil and Grease’ test is also to be made (Refer Section 4.3).

- Four samples of residential septage are to be collected in the first year of the landfills operation and twice annually thereafter. The residential septage tanker load from which a sample is to be taken shall be randomly chosen. The samples can be collected at the same time during the year (provided they are taken from different tankers) in order to coincide with other environmental monitoring.
- Four samples of commercial septage will be collected in the first year of the landfall’s operation and twice yearly thereafter. The commercial septage tanker from which a sample is to be taken shall be randomly chosen. The samples can be collected at the same time during the year (provided they are taken from different tankers) in order to coincide with other environmental monitoring.

Samples are to be taken as the tanker is discharging into the ponds. Septage samples shall be collected using containers supplied by an accredited laboratory. Containers are to be screw capped and must be made of polythene for samples to be analysed for metals and inorganics and glass for samples to be analysed for organics.

At the time of sampling, all samples collected shall be stored at 4°C. Transfer to the analytical laboratory will be completed within 48 hours of sample collection.

8.8 Record Keeping and Reporting

All environmental monitoring records will be compared against trigger levels/compliance levels and baseline monitoring results. Trends will be plotted graphically and electronic records of monitoring data will be backed up at a minimum frequency of every six months. If and when trigger levels are exceeded, the Landfill Manager will notify Environmental Services and inform ES of the actions to be taken.

The Landfill Manager will produce a report on environmental monitoring work in April of each year. The report should outline the following, but not be limited to:

- Monitoring results for groundwater, surface water, raw leachate, treated effluent and septage;
- Trends identified and resultant actions undertaken;
- Any difficulties that arose during the year and measures taken/to be taken to address them;
- Proposed changes to sampling programme regarding parameters and frequency; and
- Proposed changes to the methods used for sample collection and analysis.

8.9 Site Inspections

8.9.1 Ministry of Health Inspections

The MOH will undertake regular monthly inspections of the entire landfill, septage ponds and recycling facilities to assess the condition of the facilities and the performance of measures undertaken by the Landfill Operational Contractor and the Recycling Operational Contractor to prevent public health impacts. This will include checking the following:

- The presence of litter on approach roads, around the boundary of the site, on adjacent land and within the site.
- The presence of vermin, insects and pests at the site. Particularly around the landfill working face and in the septage ponds.
- The effectiveness of waste deposition, compaction and covering practices at the land filling operation, at maintaining sanitary conditions and minimising odour and litter.
- The presence of any standing water that may provide a breeding ground for vectors i.e. mosquitoes
- The presence of any foul odours at the site.
- The operation and maintenance of the leachate recirculation system, the septage ponds and the treated effluent disposal system.
- Existing work practices and compliance with Health and Safety standards.
- Any other potential public health risks or nuisances.

The results of the public health inspections will be reported to the Landfill Manager, initially on a 3 monthly basis. After 12 months of operation of the facility, regularity of inspections and reporting will be reviewed and may be extended.

8.9.2 Environment Service Inspections

The ES will initially undertake inspections of the entire facility on a monthly basis to inspect and assess the performance of the environmental management measures implemented at the facility. The inspection will generally encompass the following:

- A visual inspection and assessment of the landfilling operations;
- An inspection and assessment of the leachate collection system, leachate recirculation system, septage ponds and treated effluent treatment system;
- An inspection and assessment of surface water management measures at the site;
- An assessment of dust control measures;
- An assessment of noise generation;
- An assessment of odour control measures;
- An assessment of litter control measures;
- Checking of the complaints record.

After 12 months of operation of the facility, the regularity of the environmental inspections will be reviewed and may be extended to a 3 monthly basis depending on the performance of the environmental management measures.

Appendix 8.1

Sampling Procedures

General instructions for ordering sample bottles, sampling equipment and sample analyses from NZ

In addition to the sampling procedures described in Section 8 of the RWF and AWF Management Plans (Section 8), the following steps should also be taken when arranging for sample analysis by Hill Laboratories and/or ordering sampling equipment from Environmental Collective in New Zealand.

1. The attached Hill Laboratories' Quote No. 15316 lists all the bottles and analyses required for **one** round of sampling for all the sample types, for both islands (i.e. groundwater, surface water, marine water, sub-soil drainage, septage, raw leachate and treated effluent). It is recommended that the Landfill Manager order all the sample bottles that will be required for a **full** year of sampling at the start of each year, so that Hill Laboratories can arrange for these to be freighted to the Cook Islands. The goods could be sea freighted to reduce cost. The sample bottles can be stored for up to one year in the Cook Islands before the preservatives contained in some of the bottles will start to degrade. Hill Laboratories contact details are listed below. The first point of contact at Hill Laboratories is Ms. Jean Connick (Client Services Manager):

Hill Laboratories	Hill Laboratories 1 Clyde Street Private Bag 3205 Hamilton, New Zealand Tel + 64 7 858 2821 Fax + 64 7 858 2001	 **Contact Person:** Jean Connick, Client Service Manager Jean.Connick@hill-labs.co.nz

2. Additional bottles will also need to be ordered at the start of the year for those groundwater, surface water and marine water samples that need to be regularly tested for the indicator parameters. These samples will be tested in the Cook Islands and therefore the bottles will not be returned to NZ for analysis.

3. Additional sampling equipment (e.g. groundwater bailers, tubing, footvalues and filters) can be ordered from The Environmental Collective Ltd. Contact details are provided below.

The Environmental Collective	The Environmental Collective Ltd 40 George Street Mt. Eden Auckland, New Zealand Tel + 64 9 623 3368 Fax + 64 9 623 3369 **Contact Person: Murphy O'Neil, murphy@envco.org**

4. It is expected that at least four sets of samples will need to sent back to Hill Laboratories in the first year and two sets per year thereafter. These samples will need to be freighted back to NZ in the least possible time to reduce any degradation of the samples. Sampling dates and times will need to be coordinated with DHL (or equivalent) flight timetables (DHL Rarotonga, ph + 68 228 110). Where

possible, it will be most efficient to send all samples back to NZ on the same flight, however, due to difficulties associated with coordinating inter-island flights between Aitutaki and Rarotonga, it may eventuate that the Aitutaki samples need to be sent separately from the Rarotonga samples.

5. Attached are also copies of the following documents that will need to accompany any package containing samples that are to be returned to Hill Laboratories for analysis (either as hand-luggage with a traveller or as unaccompanied cargo):
    - A detailed description of samples (included on **Chain of Custody Form**).
    - Copy of **Hill Laboratories Sample Import Permit**. The permit should be folded such that the blue label is displayed on the outside. Note that this Permit expires in June 2005.
    - Copy of **Hill Laboratories MAF Letter**: Procedure for Sending Samples via Air Main or Air Cargo OR Procedure for Bringing in Overseas Samples in Person.

    If, the samples are to be sent unaccompanied, all of these documents are to be sealed in a sturdy, clear plastic bag or self-adhesive clear document sleeve and attached to the OUTSIDE of the parcel.

    If samples are to be accompanied to NZ as hand-luggage, the same documentation as listed above is required, however upon arrival in the NZ International Terminal Building, the documentation needs to be presented to MAF Quarantine Officers for inspection.

    In addition, a 'Senders Declaration Notice' label needs to be affixed to the OUTSIDE of package. This is typically a small green adhesive label which provides a brief description of the contents (i.e. "water samples") and their value (i.e. "$0").

    Each chilly bin/package should also have a notice displayed on the outside of the container stating "KEEP CHILLED – PLEASE REFRIDGERATE. DO NOT FREEZE".

6. All packages must be addressed to:

    Hill Laboratories
    1 Clyde Street
    Private Bag 3205
    Hamilton
    NEW ZEALAND

7. Upon arrival in NZ, Hill Laboratories arranges for a courier to pick the samples up from the airport. If samples are sent to NZ unaccompanied, then Hill Laboratories will need to be advised (via phone, fax or email) of the flight details and any other necessary tracking reference numbers for the package(s) (e.g. 'MAF Number', 'BACC Number' or 'Airways Bill Number'). If samples are brought to NZ as hand-luggage, then Hill Laboratories should be contacted upon arrival so that samples can be collected by courier as soon as possible. Containers should be refrigerated by MAF while waiting for the courier to arrive.

Hill Laboratories

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton
New Zealand

Telephone: +64 (7) 858-2000
Facsimile: +64 (7) 858-2001

Quote No - 15316

Client Name: Maunsell Limited, AUCKLAND
Contact Name: N Wakim
Charge To: Maunsell Limited
Fax No: 09 336 0121

Date: 27/11/2003
From: Mrs J Connick
Client Ref: Cook Islands

We are pleased to be able to quote for your analyses as follows:

Detail Line	Quote Price	Qty	Line Total	Bottles Reqd
1 **Amended 19/11/04 - 8 Septage names and samples added to SW - JC**				
2 **Amended 18/11/04 - Septage x 2 removed from GW added to SW - JC**				
3 **[Amended 16/11/04 to add extra Septage, leachate and effluent samples, PGR]**				
4 **[Amended 12/11/04 to add Septage, Raw leachate and treated effluent, PGR]**				
5 **[Amended 24/6/04 to alter sample/bottle numbers, PGR]**				
6 **Amended 25/5/04 - 2 x Surface Waters added - Re NW - JC**				
7 **Amended 26/8/04 - All tests removed from Marine Waters (Ster. containers still required), 2 Sub-soil drain samples added - analyses the same as the surface water samples - JC**				
8				
9 MAF Inspection Fee / Disposal of overseas samples (Ad.MAFClear)	$100.00	0	$0.00	
10 **Duplicate UP1L Samples to be analysed in the Cook Islands**				
11				
12 **Groundwater (5 sites - BH1, BH2GW2, GWA1, GWA2, GWA3**				
13 Container - Unpreserved (1L), (One bottle to be used for testing in Cook Islands for each site) (UP1L, Desc)	$0.00	10	$0.00	
14 Container - Filtered Unpreserved (100 mL), (for field filtered nutrients) (UPF100, Desc)	$0.00	5	$0.00	
15 Container - Sulphuric Preserved (250 mL) (S250)	$0.00	5	$0.00	
16 Container - Unpreserved (BOD) (500 mL) (BOD)	$0.00	5	$0.00	
17 Container - Glass for TOC (100 mL) (TOC100)	$0.00	5	$0.00	
18 Container - Filtered, Nitric preserved (100 mL) (FN100)	$0.00	5	$0.00	
19 Container - Glass Mercury Sulphuric/Dichromate Pres (250 mL) (Hg100)	$0.00	5	$0.00	
20 Container - Brown glass for VOC (40 mL) (VOC40)	$0.00	10	$0.00	
21 Container - Glass, unpreserved for Organics (500 or 1,000 mL) (Org)	$0.00	5	$0.00	
22 Container - PET, microbial testing, leave 1cm air gap (400 mL), (Microbiology is beiing done locally in Cook Islands) (Ster, Desc)	$0.00	5	$0.00	
23				
24 Shorthaul courier for chillybin with bottles (Ad.BSHC)	$0.00	1	$0.00	
25				

	Details	Quote Price	Qty	Line Total	Bottles Reqd
26	pH, Electrical Conductivity (EC), Turbidity, Total Alkalinity, Total Suspended Solids (W.pH, W.EC, W.Turb, W.Alk, W.SS)	$40.80	9	$367.20	See line 13
27	Total Ammoniacal-N, Dissolved reactive phosphorus (DRP), Nitrate-N + Nitrite-N (TON), Nitrate-N, Nitrite-N (W.NH4N, W.DRP, W.NOxN, W.NO3N, W.NO2N)	$30.18	9	$271.58	See line 14
28	Chloride, Sulphate (W.Clic, W.SO4ic)	$14.45	9	$130.05	See line 14
29	Chemical oxygen demand (COD), low level, Total Kjeldahl digestion, Total Kjeldahl Nitrogen (TKN) (W.CODL, W.TKDig, W.TKNfia)	$30.60	9	$275.40	See line 15
30	Carbonaceous Biochemical Oxygen Demand (CBOD~5^) (W.CBOD5)	$30.60	9	$275.40	See line 16
31	Total Organic Carbon (TOC) (W.TOC)	$25.50	9	$229.50	See line 17
32	Leachate metals suite, dissolved, trace, (includes Al As B Cd Co Cr Cu Fe Mn Ni Pb Zn) (W.MWLdt, Desc)	$76.50	9	$688.50	See line 18
33	Dissolved Calcium, Dissolved Magnesium, Dissolved Sodium, Dissolved Potassium, Total Hardness (W.CaSI, W.MgSI, W.NaSI, W.KSI, W.HardSI)	$28.90	9	$260.10	See line 18
34	Total Mercury profile (W.HgTC)	$29.75	9	$267.75	See line 19
35	Volatile organic compounds (VOC), Screen level (W.VOCs)	$102.00	9	$918.00	See line 20
36	Semivolatile Organic Compounds, screen level (W.SVOCs)	$153.00	9	$1,377.00	See line 21
37	Total			$5,060.48	
38					
39	**Surface Water and Sub-soil drain waters**				
40	**SeptRWF(ResA),SeptRWF(ResB), SeptRWF(CommA), SeptRWF(CommB), SeptAWF(ResA), SeptAWF(ResB), SeptAWF(CommA),SeptAWF(CommB)**				
41					
42					
43	Container - Unpreserved (1L), (One bottle to be used for testing in Cook Islands for each site) (UP1L, Desc)	$0.00	28	$0.00	
44	Container - Sulphuric Preserved (250 mL) (S250)	$0.00	14	$0.00	
45	Container - Unpreserved (BOD) (500 mL) (BOD)	$0.00	14	$0.00	
46	Container - Glass for TOC (100 mL) (TOC100)	$0.00	14	$0.00	
47	Container - Nitric Preserved (100 mL) (N100)	$0.00	14	$0.00	
48	Container - Glass Mercury Sulphuric/Dichromate Pres (250 mL) (Hg100)	$0.00	14	$0.00	
49	Container - Brown glass for VOC (40 mL) (VOC40)	$0.00	28	$0.00	
50	Container - Glass, unpreserved for Organics (500 or 1,000 mL) (Org)	$0.00	14	$0.00	
51	Container - Glass oil & grease (500 mL), (For 8 Septage samples) (OAG, Desc)	$0.00	8	$0.00	
52					
53	pH, Electrical Conductivity (EC), Turbidity, Total Alkalinity, Total Suspended	$40.80	14	$571.20	See line 43

	Details	Quote Price	Qty	Line Total	Bottles Reqd
	Solids (W.pH, W.EC, W.Turb, W.Alk, W.SS)				
54	Sample filtration for general testing, Total Ammoniacal-N, Dissolved reactive phosphorus (DRP), Nitrate-N + Nitrite-N (TON), Nitrate-N, Nitrite-N (W.Filtmg, W.NH4N, W.DRP, W.NOxN, W.NO3N, W.NO2N)	$34.42	14	$481.95	See line 44
55	Chloride, Sulphate, Sulphate (W.Clic, W.SO4ic, W.SO4ic)	$21.68	14	$303.45	See line 44
56	Chemical oxygen demand (COD), low level, Total Kjeldahl digestion, Total Kjeldahl Nitrogen (TKN) (W.CODL, W.TKDig, W.TKNfia)	$30.60	14	$428.40	See line 44
57	Carbonaceous Biochemical Oxygen Demand (CBOD~5^) (W.CBOD5)	$30.60	14	$428.40	See line 45
58	Total Organic Carbon (TOC) (W.TOC)	$25.50	14	$357.00	See line 46
59	Sample filtration for metals analyses, Dissolved Calcium, Dissolved Magnesium, Dissolved Sodium, Dissolved Potassium, Total Hardness (W.Filtm, W.CaSI, W.MgSI, W.NaSI, W.KSI, W.HardSI)	$34.00	14	$476.00	See line 47
60	Total (nitric) acid digest for low level metals, Leachate metals suite, totals, trace, (includes Al As B Cd Co Cr Cu Fe Mn Ni Pb Zn) (W.MDig, W.MWLtt, Desc)	$85.00	14	$1,190.00	See line 47
61	Total Mercury profile (W.HgTC)	$29.75	14	$416.50	See line 48
62	Volatile organic compounds (VOC), Screen level (W.VOCs)	$102.00	14	$1,428.00	See line 49
63	Semivolatile Organic Compounds, screen level (W.SVOCs)	$153.00	14	$2,142.00	See line 50
64					
65	**Extra tests for Septage samples (Res and Com**				
66	Oil & Grease (W.O&G)	$51.00	8	$408.00	See line 51
67	Total			$8,630.90	
68	**Raw leachate and Treated effluent [Leachate RWF and AWT, TreatedEff RWF and AWT]**				
69	Container - Unpreserved (1L) (UP1L)	$0.00	4	$0.00	
70	Container - Sulphuric Preserved (250 mL) (S250)	$0.00	4	$0.00	
71	Container - Unpreserved (BOD) (500 mL) (BOD)	$0.00	4	$0.00	
72	Container - Nitric Preserved (250 mL) (N250)	$4.25	4	$17.00	
73	Container - Glass Mercury Sulphuric/Dichromate Pres (250 mL) (Hg100)	$0.00	4	$0.00	
74	Container - Glass for TOC (100 mL) (TOC100)	$0.00	4	$0.00	
75	Container - Glass, unpreserved for Organics (500 or 1,000 mL) (Org)	$0.00	4	$0.00	
76	Container - Brown glass for VOC (40 mL), (Needs 2/site) (VOC40, Desc)	$0.00	8	$0.00	
77	pH, Electrical Conductivity (EC), Total Alkalinity (W.pH, W.EC, W.Alk)	$21.68	4	$86.70	See line 69
78	Total Suspended Solids (W.SS)	$11.90	4	$47.60	See line 69
79	Turbidity (W.Turb)	$7.22	4	$28.90	See line 69
80	Sample filtration for general testing, Total Ammoniacal-N, Nitrate-N + Nitrite-N (TON), Nitrite-N, Nitrate-N, Dissolved reactive phosphorus (DRP),	$48.88	4	$195.50	See line 69

	Details	Quote Price	Qty	Line Total	Bottles Reqd
	Chloride, Sulphate (W.Filtmg, W.NH4N, W.NOxN, W.NO2N, W.NO3N, W.DRP, W.Clic, W.SO4ic)				
81	Sample filtration for metals analyses, Dissolved Calcium, Dissolved Magnesium, Dissolved Sodium, Dissolved Potassium (W.Filtm, W.CaSI, W.MgSI, W.NaSI, W.KSI)	$34.00	4	$136.00	See line 69
82	Total Hardness (W.HardSI)	$0.00	4	$0.00	See line 81
83	Chemical oxygen demand (COD), high level (W.CODH)	$15.30	4	$61.20	See line 70
84	Total Kjeldahl digestion, Total Kjeldahl Nitrogen (TKN) (W.TKDig, W.TKNfia)	$15.30	4	$61.20	See line 70
85	Carbonaceous Biochemical Oxygen Demand (CBOD~5^) (W.CBOD5)	$30.60	4	$122.40	See line 71
86	Acid soluble extraction, Heavy metals, acid sol, trace As,Cd,Cr,Cu,Ni,Pb,Zn, Acid Soluble Aluminium, Acid Soluble Iron, Acid Soluble Manganese, Acid Soluble Boron, Acid Soluble Cobalt (W.ASol, W.MWHMat, W.AlAI, W.FeAI, W.MnAI, W.BAI, W.CoAI)	$106.25	4	$425.00	See line 72
87	Total Mercury profile (W.HgTC)	$29.75	4	$119.00	See line 73
88	Total Organic Carbon (TOC) (W.TOC)	$25.50	4	$102.00	See line 74
89	Semivolatile Organic Compounds, screen level (W.SVOCs)	$153.00	4	$612.00	See line 75
90	Volatile organic compounds (VOC), Screen level (W.VOCs)	$102.00	4	$408.00	See line 38
91	Total			$2,422.50	
92					
93	**Marine Waters**				
94	Container - PET, microbial testing, leave 1cm air gap (400 mL), Microbiology is beiing done locally in Cook Islands) (Ster, Desc)	$0.00	3	$0.00	

Notes:

Quoted prices do not include GST, and are valid until the 30/06/2004.

This quote is subject to our usual terms and conditions, a copy of which is available on request.

Hill Laboratories is an IANZ Accredited Laboratory. We are Accredited for a very wide range of tests on waters, effluents, soils, sediments, plants and biota. Copies of our Accreditation are available on request.

Please refer to our quote number on the chain of custody, submission form or documentation sent in with the samples. This will ensure that agreed conditions (such as turnaround time, detection limits, analytical methods and prices) will be followed in our laboratory. If you fail to refer to our quote number when submitting samples, and we are required to alter the invoice , then you may be charged an additional $25 Re-Invoicing Fee.

Chain of Custody Form

maunsell

to:	Jean Connick, Hill Laboratories, Hamilton, New Zealand	date:	INSERT DATE HERE
copy to:		file/ref no:	
from:		page **1** of **2**	
subject:	Cook Islands Government - Waste Management Project – Water Quality Monitoring		

Please find enclosed the following samples collected from The Cook Islands. All samples have been labelled according to the labels listed below. Please refer Hill Laboratories Quote No. 15316 for analysis requirements.

Strike out those samples which are not supplied to Hill Laboratories

Groundwater Samples:

- Rarotonga site: BH1 BH2
- Aitutaki site: GWA1 GWA2 GWA3

Sub-Soil Drain Samples:

- Rarotonga site: SSD1 SSD2

Surface Water Samples:

- Rarotonga site: SW1 SW2

Septage Samples:

- Rarotonga site: SeptRWF(ResA), SeptRWF(ResB), SeptRWF(CommA), SeptRWF(CommB)
- Aitutaki site: SeptAWF(ResA), SeptAWF(ResB), SeptAWF(CommA), SeptAWF(CommB)

Raw Leachate Samples:

- Rarotonga site: LeachateRWF
- Aitutaki site: LeachateAWF

Treated Effluent Samples:

- Rarotonga site: TreatedEffRWF
- Aitutaki site: TreatedEffAWF

Please forward test results by e-mail, mail and fax to:
Insert Cook Islands contact details here

Sender:
These samples have been imported as passenger-accompanied/unaccompanied **(circle as appropriate)** luggage by the undersigned, and left at MAF AKL Airport for direct courier to Hill Laboratories.

If accompanied:

Signature:

Print Name:

Airways Bill Number or Tracking Number:

Left with MAF on Date: **Time:**

Flight No:

Comments:

<u>Hill Laboratories:</u>

Please sign below to confirm receipt of samples and date/time and **immediately** fax to:

Insert Cook Islands contact details here

Received at Hill Laboratories by:

Signature:

Print Name:

Date:

Time:

Preparation and Submission of Overseas Samples to Hill Laboratories, NZ

The following notes have been prepared to assist in the preparation and dispatch of samples to New Zealand.

Sample Dispatch

Samples sent to Hill Laboratories **MUST** be accompanied by complete documentation recording the name and address of the client who is to be invoiced, a schedule of sample names and details of the analysis required.

Packaging, Dispatch & Notification:

Packaging should be strong and robust and able to withstand handling in transit. Samples should be packaged to prevent them moving around inside the main package.

Samples should be preferably sent by **airmail**. Samples sent by air-freight have an approx. $50 charge per consignment charged to Hill Laboratories. This is then passed on to the client upon invoicing. Additional fees are not incurred with airmail.

It is recommended that you advise us of dispatch by fax or email. This enables early discovery of any packages delayed in transit. Notification by mail is also useful, however the samples occasionally arrive before the letter. Include any information you have such as airway bill numbers, date of posting etc.

Address & Customs Clearance:

- Address samples to **Hill Laboratories,** NOT MAF Quarantine Services
- Pack relevant **Permit** (copy attached) in an envelope on the OUTSIDE of the parcel
- Attach a **Declaration** to the outside of parcel giving details of the type of product and that it is “for chemical analysis”

All packages must be addressed to:

Hill Laboratories
1 Clyde Street
Private Bag 3205
Hamilton
NEW ZEALAND

MAF Permit to Import Plant, Soil & Water
See attached Permit
Copy MUST come with samples

Agricultural and Horticultural samples

Sample collection

We stress the importance of sending us a representative sample, selected according to the guidelines provided by your advisors. In the absence of specific advice on how to select samples, Hill Laboratories is able to help. It is important to use standard techniques, as proper interpretation of results depends upon the quality of sample sent.

While we indicate the amount of sample we require for analysis, this is always less than the amount you should initially collect. The amount collected must give you and your advisors the confidence that it is an average of the area as a whole. If necessary, after drying it may then be subsampled in a careful and representative manner.

Sample preparation

The following guidelines ensure the samples do not deteriorate in transit and assist in reducing sample volume and freight costs.

Note that samples to be analysed for **pesticides** may need special treatment - please contact our laboratory for advice.

At all stages take care to avoid contamination of soil and plant samples. Plant tissue contaminated with soil leads to erroneous results and the presence of fertiliser as a contaminant creates serious problems in interpretation of analytical results.

Soil Samples

Soils should be dried prior to packaging. This may be achieved in the open air in a clean and dust free area, or in a forced air dryer at ambient temperature or at about 30 degrees Celsius. Place the soil in an aluminium tray or paper bag. Drying will typically take three or four days.

To minimise freight costs, the volume of the sample may be reduced in the following manner.

1. Spread the sample over a clean sheet of paper and break up particles by gentle crushing.

2. Thoroughly mix the sample and then divide into quarters. Discard two diagonally opposite quarters and combine the two remaining quarters and repeat the quartering until the desired amount of soil is left.

Place the sample in a plastic bag and clearly label the outside of the bag. About 200 grams of dry soil are required to complete the standard Basic test and a further 20 grams for each additional test.

Plant Tissue Samples:

It is essential to dry plant tissue prior to submission; field fresh material deteriorates easily in transit. Dry in a clean dust free environment until leaves are crisp. If using a dryer set the thermostat at no more than 60 degrees Celsius.

Place the dried material in paper or plastic bags, seal and label the outside of the bag clearly. About 100 grams of dry material are required for the basic plant test and a further 10 grams for each additional test.

Environmental Samples

Many environmental samples require special storage and transport conditions, depending on the tests to be carried out. Some of the major tests are summarised below, please contact our laboratory staff to discuss anything not covered.

Soils

Metals, nutrients, cyanide, other inorganic testing

These can generally be treated as for Agricultural Soils as described on the previous page. Minimum amount of sample is usually about 50-100 g, depending on the tests required.

Organics - hydrocarbons, PAH, pesticides

Samples should be collected into glass jars (jam jars are suitable), preferably with metal lids.

Samples should, ideally, be transported chilled, but this is sometimes not practical because of locations and air transport constraints. As a minimum, samples should be chilled after collection.

Samples for BTEX or VOC **MUST** be transported chilled to produce valid results.

Waters

Microbiological Tests

It is NOT appropriate to carry out microbiological tests on water samples from overseas, unless arrangements can be made for the samples to be delivered to a laboratory in NZ within 24 hours of the sample being taken. Samples MUST be transported chilled. Local hospital laboratories may be able to assist with microbiological testing of water samples.

General chemical tests

These can usually be done on samples provided samples are chilled after collection and containers are filled to the top. Time delays and variable ambient temperatures may have an affect on results which may need careful interpretation because of this.

Metals

There is usually no problem with testing for metals. An exception is hexavalent chromium which needs to be analysed as soon as possible after sample collection.

Organics

Samples MUST be collected into glass containers and, preferably, transported chilled.

Samples for BTEX or VOC **MUST** be transported chilled to produce valid results.

Hill Laboratories

R J Hill Laboratories Limited – accredited by International Accreditation NZ

1 Clyde Street,
Private Bag 3205,
Hamilton, New Zealand

Telephone: +64 (7) 858-2000
Facsimile: +64 (7) 858-2001
Email: mail@hill-labs.co.nz

Dear

Procedure for Bringing in Overseas Samples in Person

This letter is to inform all Hill Laboratories' clients who intend to bring in samples from overseas via an International Airport. It will assist MAF Quarantine Officers to clear the consignment and allow prompt delivery via NZ Courier's to Hill Laboratories.

Upon arrival at the International Terminal Building, produce the following items for MAF Quarantine Officers to inspect:

1. **The samples that require chemical analysis**
2. **A detailed description of the samples**
3. **A current copy of Hill Laboratories' Sample Import Permit**
4. **A copy of this letter**

Hill Laboratories' MAF Account Number:	**QE 6339**
NZ Courier Number:	**1945876**
Hill Laboratories' delivery address:	**Hill Laboratories** **1 Clyde Street** **Hamilton East** **Hamilton**
Facility Operator's Name:	**Gillian Lees**
FO's Contact Phone Number:	**07 858 2818**
FO's email address:	**Gillian.Lees@hill-labs.co.nz**
Main Office Fax Number:	**07 858 2001**
Sample Reception Phone Number:	**07 858 2869**
Sample Reception Fax Number:	**07 858 2805**

In the event of any queries, please do not hesitate to contact myself weekdays or Sample Reception on Saturdays.

Regards

Gillian Lees
Facility Operator

Hill Laboratories

R J Hill Laboratories Limited – accredited by International Accreditation NZ

1 Clyde Street,
Private Bag 3205,
Hamilton, New Zealand

Telephone: +64 (7) 858-2000
Facsimile: +64 (7) 858-2001
Email: mail@hill-labs.co.nz

Dear

Procedure for Sending Samples via Air Mail or Air Cargo

This letter is to inform all Hill Laboratories' clients who intend to send us samples from outside of New Zealand, via Air Mail or Air Cargo. It will assist New Zealand Customs and MAF Quarantine Officers to clear the consignment and allow prompt delivery to Hill Laboratories.

When sending samples to us either by **Air Mail or Air Cargo** please include the following with your consignment:

1. **The samples that require chemical analysis**
2. **A Senders Declaration Notice (green label attached to OUTSIDE of package)**
3. **A detailed description of the samples**
4. **A current copy of Hill Laboratories' Sample Import Permit (Recommend printing in colour)**
5. **A copy of this letter**

Items **3, 4 & 5** should be enclosed in a self-adhesive clear document sleeve attached to the OUTSIDE of the Parcel. Note: our Sample Import Permit is designed to be folded, so that the reverse side with address details are visible through the document sleeve.

Hill Laboratories' MAF Account Number: **QE 6339**

Hill Laboratories' delivery address:

Hill Laboratories
1 Clyde Street
Hamilton East
Hamilton

Facility Operator's Name:	**Gillian Lees**
FO's Contact Phone Number:	**07 858 2818**
FO's email address:	**Gillian.Lees@hill-labs.co.nz**
Main Office Fax Number:	**07 858 2001**
Sample Reception Phone Number:	**07 858 2869**
Sample Reception Fax Number:	**07 858 2805**

In the event of any queries, please do not hesitate to contact myself weekdays or Sample Reception on Saturdays.

Regards

Gillian Lees
Facility Operator

GJE

PERMIT TO IMPORT LABORATORY SPECIMENS

This permit is issued under The Biosecurity Act, 1993. Any queries, please contact Import Management Plants, MAF Biosecurity Authority, PO Box 2526, Wellington, (Phone 04 498 9631, Facsimile 04 474 4257)

Authorising Officer : Gerard Clover on 31 May 2004

for Chief Technical Officer, Ministry of Agriculture and Forestry, New Zealand, acting under delegated authority.

NOTE: Total number of pages for this permit is 4.
Please ensure all pages (front pages, any appendices and attachments) are included with copies.

Permit for : R J Hill Laboratories Ltd
Private Bag 3205
Hamilton
New Zealand
Attention : Gillian Lees
Phone: 07-858-2000
Fax: 07-858-2001

Permit No : 2004022614
Replaces Permit No : N/A
Expiry Date : 06 Jun 2005
No of Consignments : Multiple
Import Purpose : Laboratory Use

Establishment No :
Client Refs : 101089

Exporter Name : Various (immature apple fruitlets only from Australia).

Country of Origin : All Countries

Type of Material	Commodity Description	Quantity	Measure
Fresh Fruit	Immature apple 'fruitlets' for chemical/nutrient analysis, average weight 30 - 60 grams.	30	Units
Plant Material	Plant tissue samples for chemical/nutrient analysis	Unlimited	Units
Plant Material	Other food and crop samples for chemical/nutrient analysis	Unlimited	Units
Seeds	Seed and grain samples for chemical/nutrient analysis (only species listed in the MAF Biosecurity Authority Biosecurity Index).	10	Kilograms
Soil	Soil samples for chemical/nutrient analysis.	Unlimited	Units

Type of Material	Commodity Description	Quantity	Measure
Water	Water samples for chemical/nutrient analysis	Unlimited	Units

Post Entry Type : Laboratory - aprvd
Standard Reference : 154.02.17 (Standard - Transitional Facilities for Biological Products)
Transitional Facility : R J Hill Laboratories Ltd
Private Bag 3205
Hamilton
1 Clyde St, Hamilton East
Ref : 494

Operator : Gillian Lees
Inspector : Biosecurity Officer - North
Min Period : N/A

Special Conditions :

NOTE: Number of pages in this permit is 4, comprising: 3 front pages, 1 appendix 1.

1. For General Conditions see Appendix 1.

2. On arrival all seeds, plant tissue samples and any immature apple fruitlets are to be inspected for any obvious symptoms of pests and disease by MAF Quarantine Service. (Note: plant tissue samples may be showing mild symptoms of nutrient deficiencies.)

3. Any fresh material considered to be a fruit fly host (this does not included immature apple fruitlets) by the Inspecting Officer is to be frozen until the core temperature has been held at (or below) minus 18 degrees celsius for a minimum of 7 days before being transhipped to the listed transitional facility.

4. The consignment is to be transhipped from the port of entry to the listed transitional facility under secure arrangements to the satisfaction of the Inspector.

5. The quantity of each grain or seed sample is not to exceed 10Kg.

6. The quantity of each consignment of immature apple fruitlets is not to exceed 30 fruitlets.

IMPORTANT INFORMATION FOR PERMIT HOLDERS AND AGENTS

1 You need to ensure that the goods you import comply with the provisions of the specific import health standard(s) and/or entry conditions. The import health standard may be amended during the course of your permit. Import Management will notify you of any significant changes to the import health standard and will re-issue the permit to accommodate these changes.

2 This permit, and compliance with the provisions of the specific import health standard(s) and/or entry conditions, does not guarantee that the goods you import will be given a biosecurity clearance. There are other restrictions in the Biosecurity Act 1993 which apply to the giving of biosecurity clearance.

3 There are a number of other provisions in the Biosecurity Act 1993 which may affect you. If you commit an offence against the Biosecurity Act 1993, heavy penalties under section 157 of the Act might apply.

4 Apart from the Biosecurity Act 1993, there are other laws relating to or prohibiting the importation of goods. This permit, and compliance with the provisions of the specific import health standard(s) and/or entry conditions, does not absolve you of the need to comply with these laws.

IMPORTANT INFORMATION FOR PERMIT HOLDERS AND AGENTS

5 Unless specifically identified in 'Description of Items' or 'Special Conditions' of the permit, NO new organisms, including genetically modified organisms, are permitted entry under this permit.

Appendix 1: Permit to Import Number : 2004022614 **Page 1 of 1**

GENERAL CONDITIONS FOR THE IMPORTATION OF LABORATORY SAMPLES FOR ANALYSIS

Special Conditions :

1. On arrival in New Zealand all documents associated with the consignment will be inspected by an Officer of the New Zealand Ministry of Agriculture and Forestry (MAF) to ensure compliance with the entry conditions.

2. Documentation must include a complete list of scientific names (genus and species) of all viable (propagable) sample types contained in the consignment (e.g. seed). Only plant species listed as approved for entry in the MAF Biosecurity Authority Plants Biosecurity Index shall be allowed entry under this permit to import.

   Note: **For new or genetically modified organisms under the Hazardous Substances and New Organisms Act 1996, approval from Environmental Risk Management Authority New Zealand is required.**

3. If any conditions of this permit to import cannot be or are not complied with the importer may be required by an Inspector to reship or destroy the plant material.

4. The samples are to be:

   (i) consigned in leak proof packaging;

   (ii) transported under the direction of an inspector (following arrival in New Zealand) to the MAF Biosecurity Authority registered Operator of the MAF Biosecurity Authority registered Transitional Facility;

   (iii) stored and treated at the registered Transitional facility in accordance with a Quality System approved by an Officer of the MAF Quarantine Service.

5. The samples (or material generated from the seed) are not to be removed or distributed to any person in NZ or used for other purposes without further authorisation from MAF Biosecurity Authority.

6. Any material remaining after analysis is to be incinerated/autoclaved for disposal.

7. A record is to be kept by the importer of all samples introduced under this permit (including scientific name/description, country of origin, date of arrival) and the current status of the material generated from any viable seed/sample (i.e. disposal/storage). This record is to be made available to an Officer of the MAF Quarantine Service at all reasonable times.

8. If an import health standard is approved by a Chief Technical Officer prior to the expiry date indicated on this Permit to Import, the conditions on the import health standard, if different, would override the conditions on this Permit to Import.

Hill Laboratories
Private Bag 3205
1 Clyde Street
Hamilton
NEW ZEALAND
Fax (+64) 7 858 2001

MAF Permit to import Laboratory specimens
PERMIT NO. 2004022614
Expiry Date: 06 June 2005

9.0 Contingency Plans

9.1 Key Principles

The following are the key principles for ensuring contingencies are in place in the event of an incident.

1. To identify that there are practical measures that can be used to deal with a variety of contingencies
2. These contingency plans are only indicative and each individual response will depend on the equipment and/or personnel available on Rarotonga at the time of the incident.

9.2 Emergency List

A list of all emergency contacts will be made available to all site personnel, and this list will be posted in an obvious location in the site office. This list will include, but not be limited to:

- Fire Service – Ph 996
- Ambulance – Ph 998
- Police – Ph 999
- Landfill Manager Landline – Ph 24 030
- Landfill Manager Cellphone – Ph 54 011

9.3 Cyclone

In the event of a cyclone prediction for the Island of Rarotonga, the following procedures will be followed:

- Check all drains are free of debris.
- Ensure weighting systems are in place for any exposed temporary cover sheets.
- Ensure all loose debris and sheet materials are firmly tied down.
- Draw down septage ponds to minimum operating levels by disposing of treated effluent through the treated effluent disposal system.
- Check that all covers are in place on all electrical equipment.
- Ensure that adequate dense landfill cover is in place.
- Close the landfill to all customers

9.4 Stormwater Contamination

In the event stormwater runoff becomes contaminated by coming into contact with refuse, then the contaminated runoff will be pumped back into the operating cell. This contaminated runoff will enter the leachate system after being filtered through the refuse to avoid heavy sediment loads from entering the leachate system.

9.5 Septage System

9.5.1 Structural Failure of Pond

The ponds are double bunded. If one bund fails, the pond will be decommissioned by pumping directly from the remaining pond to the treated effluent disposal system. Septage captured in the double bunded area could be pumped into the landfill using a portable pump for temporary holding until the septage ponds are restored.

Septic tank pump outs would be halted until the septage ponds are restored, except for emergency situations. In these instances the septage would be disposed of directly into the landfill area as a bulk liquid waste.

9.5.2 Pipe Blockage

Pipes have been sized to allow cleaning by jetting and to allow Closed Circuit Television (CCTV) inspection. Therefore, in the event of pipe blockage, the pipe should be jetted and then inspected with CCTV to identify the cause of the blockage.

9.5.3 Pump Station Failure

The pump station has a duty and standby pump to reduce risk of failure. A spare pump has also been provided. If a pump fails, it is to be replaced by the spare. The failed pump shall then be fixed.

9.5.4 Septage Spillage

(i) On Site Spillage

A concrete pad has been provided at the septage receiving facility together with a washdown hose. Any spill in this area will be washed into the septage receiving manhole which discharges into the septage ponds.

(ii) Off Site Spillage

All efforts will be made to contain minor spills and arrangements will be made for a vacuum tanker or appropriate device to remove it. Once removed the area shall be washed down with clean water to dilute the residue.

Efforts will be made to contain major spills within the local drainage system by bunding off the outlet of any drain. A vacuum tanker can then take the majority of the septage to the septage ponds. The area will then be washed down with clean water to dilute any remaining septage.

9.5.5 Septage Pond Liner Failure

A septage pond liner failure may be indicated by failure of the septage pond to hold septage. If this occurs, the septage pond will be decommissioned and inspected. Any obvious faults will be repaired and the pond retested with water. If the pond still leaks a silty clay will be introduced to the pond and then the mixture agitated. The silty clay will be carried by the water flow to the leak and will reduce the leakage.

9.5.6 Septage Pond Overflow

In case of a septage pond overflow, the spill will be contained by the second bund. Any liquid ponded on the ground between the bunds is to be pumped into the landfill using a portable pump.

9.5.7 Pond Turnover / Odour

The mixing/recirculation system described in Section 6.3.4 is designed to minimise the risk of pond turnover. However, there is always the possibility of extreme adverse weather conditions occurring. Such an event could stir up sludge from the bottom of the pond(s), resulting in offensive odour.

Algal populations in ponds do fluctuate with the seasons and there are times of the year, such as autumn in temperate climates, when the algae may be in a decline phase. During such times, even mild climatic changes, if sudden, can precipitate an odour nuisance.

If the pond turnover should occur in spite of preventive measures attempted, then there is little that human effort can do to retrieve the situation. The system will recover, but only at the rate that Mother Nature dictates. Until the pond does recover, its algal community will not be producing the oxygen that is essential to its facultative operation. It might be possible to mitigate the problem by providing the oxygen artificially, by:

- mechanically aerating to the pond, or by
- dosing the pond with a chemical such as sodium nitrate ($NaNO_3$).

These measures are often adopted in such circumstances and are sometimes, but not always, successful.

It is unlikely to be worthwhile to maintain a stock of sodium nitrate, in case it might be needed, because the likelihood of its actually being required is quite low. Rather, it is suggested that a liaison be maintained with regular importers and/or users (eg. in agriculture), so that potential local sources are known if an emergency should arise.

It is stressed that these measures would only augment Mother Nature's natural processes of recovery, and that neither they nor any other human intervention should be expected to provide a "quick-fix" solution to a pond odour situation.

Mechanical aeration to "fix" an odorous pond is ***not*** recommended for this particular system, especially for the primary pond. This is because of the particular (substantial sludge accumulating) function of the primary pond, and the fact that any artificial turbulence beyond the gentle mixing provided by the spray/recirculation system might actually exacerbate an odour problem, by stirring up and driving off gases from the sludge.

Odour will, of course, also result if the pond(s) are not managed properly with respect to de-sludging when they become full, if scum on the surface is allowed to accumulate excessively, if industrial waste that is toxic to algae is allowed into the pond, or if fatty wastes such as from grease traps are accepted, etc.

If a severe odour event should occur, advice on remedial measures should be obtained from expert wastewater professionals.

In an extreme emergency, lime might be able to be used to raise pH to 12 or above but, although giving virtual immediate odour-killing results, this would be only an interim relief measure and the offensive material would need to be disposed of before the pH re-stabilised and putrefaction resumed.

9.6 Landfill Liner Damage

9.6.1 Damage Prior to Refuse Placement

The landfill liner damage may have a number of causes including, but not limited to:

- Vehicle damage
- Flying debris in cyclone
- Stream diversion channel overtopping banks and flowing into landfill
- Groundwater uplift

The procedure to be followed is:

1. Remove the source of the damage (eg. remove vehicle, debris, redirect stream, relieve groundwater pressure).
2. Contract specialist liner suppliers to repair liner.
3. Investigate cause of damage and review site procedures to prevent a re-occurrence of the problem.

9.6.2 Damage to Liner after Refuse Placement

Damage to the liner below the refuse level would become apparent by elevated levels of pollutants observed in groundwater monitoring wells.

If elevated levels of pollutants are observed, the following sequence of measures will be put in place if each preceding step still indicates a problem:

1. Retest groundwater monitoring well to check the initial test was not a one-off 'spike' or mis-reading.
2. Test the groundwater monitoring well for Extended Suite (Refer Table 8-3) of parameters that are indicative of landfill leachate.
3. Install additional groundwater monitoring wells closer to the landfill (down gradient from the landfill).
4. Install groundwater pumps to intercept leachate contaminated groundwater and pump to septage ponds.

9.7 Leachate System

9.7.1 Pump Station Failure

The pump station has one duty and one standby pump to reduce the likelihood of failure. A spare pump has also been provided. If a pump fails, it is to be replaced by the spare. The failed pump shall then be fixed.

If leachate needs to be discharged into the septage ponds during a total pump station failure, a manually opened gate has been installed in the leachate pump station. When this gate is opened using the supplied chain, leachate can flow directly into the primary septage pond via a gravity main.

9.7.2 Rising Main Failure

Stop leachate recirculation pumping. Fix rising main.

9.7.3 Leachate Spillage

All staff and contractors involved in this operation will undergo comprehensive training in emergency response procedures (Refer Section 2.7). Regular inspections of pumps and associated equipment will be conducted by qualified personnel over and above daily inspections. Spillage procedures will be as per Section 9.5.4.

9.7.4 Collection Pipe Blockage

Pipes have been sized to allow cleaning by jetting and to allow Closed Circuit Television (CCTV) inspection. Therefore, in the event of pipe blockage, the pipe should be jetted and then inspected with CCTV to identify the cause of the blockage.

9.8 Hazardous Waste Contingency

In the event of any hazardous waste acceptance that cannot be returned to source for whatever reason, the waste will be temporarily stored within the footprint of the landfill (non working area), bunded and temporarily covered as directed by the Landfill Manager. Arrangements will be made for subsequent removal.

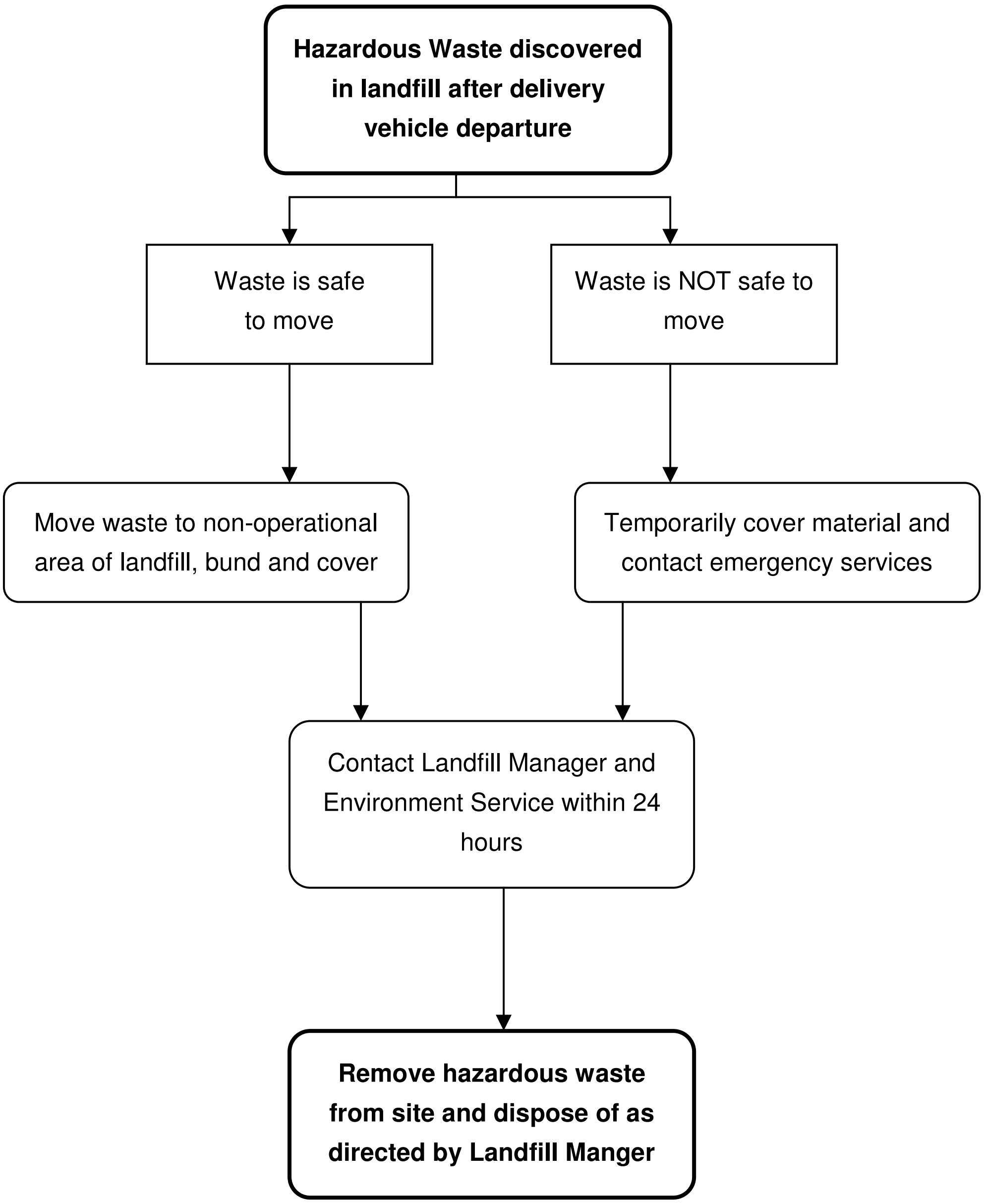
In the unlikely event of the acceptance of incompatible wastes (Refer Section 4.2.6), they will be segregated, temporarily stockpiled, bunded and temporarily covered before arrangements are made for their removal.

If wastes are undergoing a reaction, releasing toxic gasses or are on fire, the relevant emergency services will be called.

The Environment Service will be notified of any hazardous waste acceptance, and informed of procedures implemented, within 24 hours of the event.

A summary of the Hazardous Waste Contingency procedure is shown in Figure 9-1.

Figure 9-1 Hazardous Waste Contingency Procedure



9.9 Fire fighting

Although the risk of fire on the landfill is greatly reduced through sound management and the exclusion of flames and smoking within the landfill area, a risk still exists. In-house training will be given to site staff to reduce this risk as far as practicably possible.

The most likely sources are:

- Paper and other flammable material building up within the engine bays of mobile plant used on the landfill. Daily inspections must be carried out of all plant used on or near the landfill and any build up of material removed.
- Oil, electrical and fuel fires on mobile plant and machinery. Regular maintenance as stipulated by the manufacturer will mitigate this risk and must be undertaken. Should an oil or fuel leak become obvious to the operator or any member of staff the machine must be taken out of use with immediate effect and remain out of use until the problem is fully rectified.

All mobile plant are to carry fire extinguishers, which must be recharged immediately after use and be maintained on a contract with annual inspections.

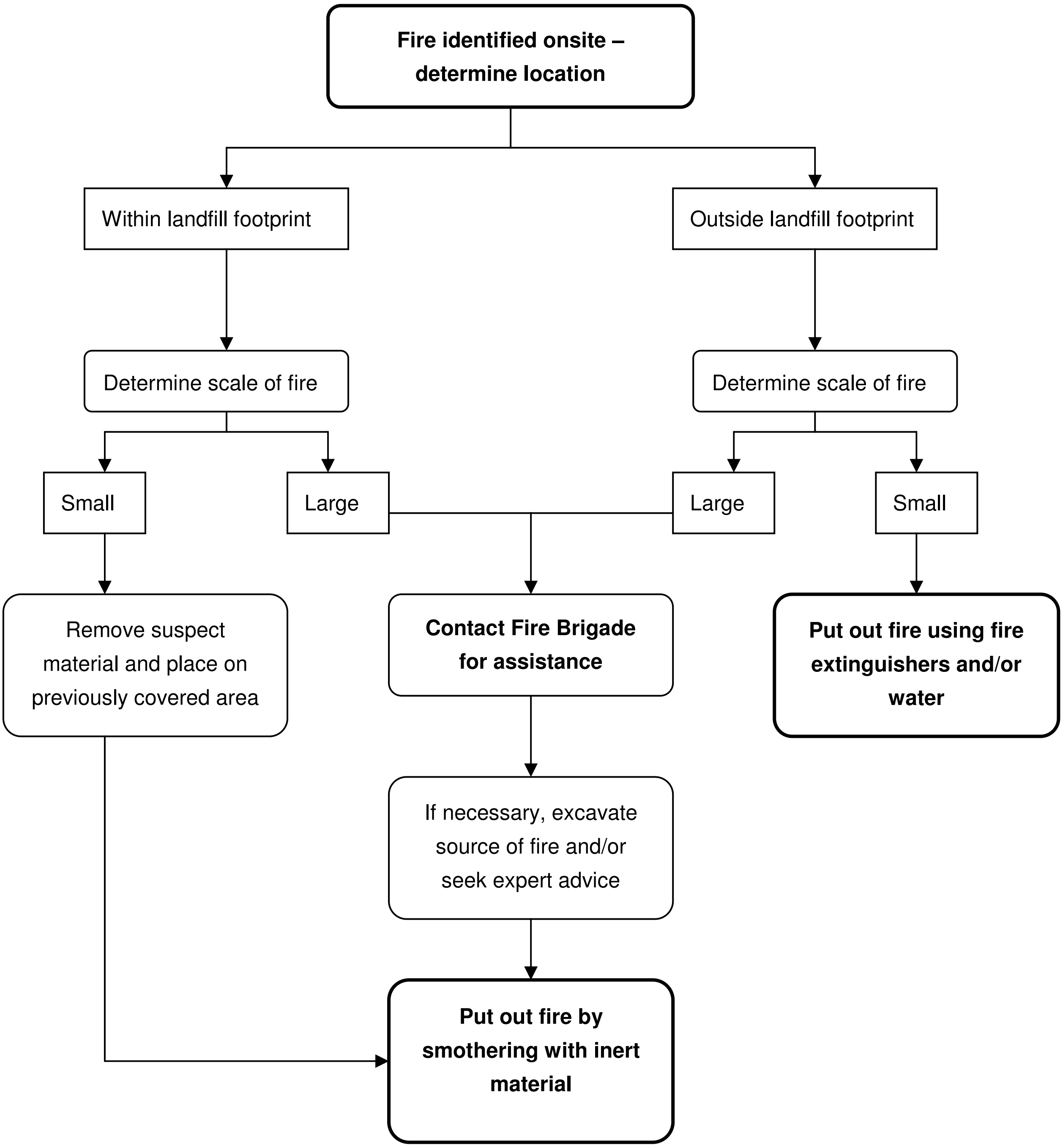
Potential problems due to hot or burning material being delivered with waste should be avoided through inspections of waste prior to and during compaction. If suspect material is identified it must be removed from the operational area and immediately placed on a previously covered area. Unless a chemical reaction is identified, water will be applied and it will be smothered with inert material, clay or soil. The area should then be left undisturbed until the end of the days operations. If still hot at this stage, water should be applied to the covering material to prevent it drying and allowing oxygen to reach the hot material. If a chemical reaction is identified the fire department will be contacted immediately for advice.

Should a fire be discovered on or near the landfill the nominated fire fighter should be informed. In the case of a serious fire, call the Fire Brigade. Expert advice is usually required in extinguishing landfill fires and great care should be taken when tackling them.

Landfill fires do not normally respond to water as a means of extinguishing them. Smothering is usually the preferred option. Usually it is necessary to excavate the affected areas and smother it as it is excavated.

Response to fire procedures will be simulated with and without the emergency services on a half yearly basis. A summary of the fire fighting procedure is shown in Figure 9-2.

Figure 9-2 Fire Fighting Procedure



9.10 Odour

9.10.1 Landfill

If required, odour suppressants (Refer Section 7.5.2) may be used on the landfill. If odour suppressants are used, the nature of the suppressant, duration of usage and success or failure to mitigate the odour problem will be recorded and reported in the annual report.

9.10.2 Septage Ponds

Refer Section 9.5.7.

9.11 Litter

Regular patrols of the site and its environs shall be carried out to identify and collect litter outside the operational phase of the landfill; these patrols will automatically follow periods of high winds.

Should a litter problem arise enroute to the site, due to litter falling or being blown from vehicles delivering refuse to the site, weekly monitoring and clean up of the traffic routes will be undertaken.

9.12 Fuel Spillage

In the event of a fuel spillage every effort will be made to contain it. In a small spill, oil absorbent granules or mats will be used. If a larger spill occurs fuel or oil will be bailed or pumped into a container before soaking up the residue with granules or oil absorbent mats.

9.13 Electricity Failure

In the event of extended electricity supply failure (more than 24 hours), the Landfill Manager will arrange an alternative electricity supply source (eg a mobile diesel/petrol generator) to run the leachate pump station and the septage pump station.

Once electricity supply has been restored, all electrical equipment will be checked for damage and/or proper operation.

9.14 Highwall Failure

If the Southern highwall fails and deposits debris on the landfill liner, the debris will be removed as soon as it is safe to do so. Following this, the liner will then be inspected for damage and repaired according to Section 9.6 if required.

If the Northern highwall fails and deposits debris into the stream diversion channel (or any other drainage channels), the procedure to be followed outlined in Section 9.15).

9.15 Stream Diversion

9.15.1 Channel Blockage

Any blockage (or potential blockage) will be removed and the channel repaired if required.

9.15.2 Culvert Blockage

Any blockage (or potential blockage) will be removed. The culvert has been sized to enable access to remove blockages.

10.0 Closure and Aftercare

10.1 Key Principles

The following are the key principles for the closure and aftercare of the landfill.

1. The landfill must be closed in a manner so as to minimise its impact on future generations.
2. The landfill will need to be looked after for some time post closure until the waste stabilises and its ongoing environmental impact is minimal.

10.2 Capping

As each section of the landfill is completed, the surface will be capped. The area will then be seeded. Once vegetation is established, a program of weed control will be introduced. The final cap (Refer Section 5.10.3) will be installed within one year of final refuse placement.

Final cover on all stages will as a minimum have:

- 300mm intermediate cover layer
- 600mm compacted clay cap with permeability no greater than $1x10^{-7}$ m/s
- 200mm topsoil

The profile of the capped area will generally be 1V: 3.5H slopes (eventually settling to approximately 1V:4H slopes) to maximise landfill volume. The minimum slope will not be less than 1V:20H so as to avoid local ponding of surface water following settlement of the landfill.

Low permeability clay to be used for lining and capping will be laboratory tested to establish its suitability. The frequency of testing will be a minimum of one test per $500m^3$ of material. The in-situ sampling will test index properties and particulate size distribution. A detailed restoration plan will be produced and submitted to the Environment Service at least twelve months prior to cessation of landfilling operations at the site.

10.3 Planting

A detailed planting plan will be agreed with the ES within the rehabilitation and aftercare plan that will be submitted at least twelve months prior to the landfill operations ceasing.

The vegetation cover for the duration of the aftercare period will be either grass or low scrub (generally less than 1m high). Trees or plants with deep penetrating roots are not suitable during the aftercare period as they may change the compacted clay cap.

For three years following seeding the site cap will receive horticultural attention, this will include removing plants around the site that have failed, and weed control.

10.4 Final Land Use

The final land use of the site will be determined by the Government of the Cook Islands. Details of the after use will be incorporated in the rehabilitation and aftercare plan (Refer Section 10.6). The landfill will continue to settle over the long term and will therefore not be suitable for construction of buildings.

10.5 Landfill Gas

Landfill gas production will reduce with time and is expected to be mostly completed within 10 years of landfill closure. Small quantities of landfill gas may be produced beyond this time and appropriate care should be taken.

Landfill Gas monitoring (Refer Section 8.5) will continue annually for a period determined by the ES after the completion of the final cap (Refer Section 10.6).

10.6 Aftercare

Aftercare refers to the maintenance and operation of environmental systems at a facility so as to manage and minimise the effects on the environment. The period of aftercare will be determined by the time it takes for the strength of leachate from the landfill to reduce to levels at which it can be discharged untreated into the environment. This is typically assumed to be 35 years in temperate climates. However, leachate strength may remain high for greater or less time than this in a tropical climate. Nevertheless, a period of 35 years is recommended for planning purposes.

A rehabilitation and aftercare plan is to be submitted to the Environment Service for acceptance in writing at least twelve months before landfilling operations cease on the site. Consultation is to be carried out with interested parties prior to finalisation of the plan.

The plan will address the following issues:

- Land ownership and liability for contamination.
- Capping and revegetation.
- Operation and maintenance of leachate management systems.
- Operation and maintenance of landfill gas management systems.
- Operation and maintenance of stormwater management systems.

- Ongoing monitoring, including groundwater, surface water, treated leachate, landfill gas and landfill capping.
- Annual inspection of the whole site and review of aftercare operations.
- Funding of aftercare.

Following closure, the vegetative cover established on all areas previously affected by the landfilling operations will be maintained to minimise run-off of suspended solids and weed growth will be controlled.

Monitoring of groundwater and leachate will continue along with maintenance of leachate recirculation systems, gas extraction and, if any, flaring/utilisation infrastructure. The intensity of monitoring required will reduce significantly once the landfill is closed. At this stage the Landfill Operations Supervisor will consult with the ES and MOH with a view to reducing the monitoring frequency to a level appropriate to the degree of risk.

11.0 References and Equipment Supply Details

11.1 References

Auckland Regional Council (ARC) (1991) Trade Wastes Bylaw. ARC, Auckland.

Centre for Advanced Engineering, University of Canterbury (2000). Landfill Guidelines, Christchurch, New Zealand.

Heiss, U. and Strauss, M. (1999). Co-treatment of Faecal Sludge and Wastewater in Tropical Climates. Swiss Federal Institute for Environmental Science and Technology (EAWAG) and Department for Waste and Sanitation in Developing Countries (SANDEC).

Meritec Ltd (2001) Tirohia Landfill Management Plan – Version 1, Prepared for HG Leach & Co. Ltd, Auckland, New Zealand.

U.S. Environmental Protection Agency (USEPA) (1984) *Septage Treatment and Disposal Handbook.* USEPA, Ohio.

United States Environmental Protection Agency (1984) Handbook of Septage Treatment and Disposal, Municipal Environmental Research Laboratory, Cincinnati, Ohio, USA.

Worley Consultants Ltd (1994) Kay Road Balefill Management Plan – Final, Prepared for Waitakere City Council, Auckland, New Zealand

11.2 Product Supply and Installation Overview

The following sections summarise the suppliers and installation sub-contractors for the following products and items of plant:

- Leachate, Treated Effluent and Stormwater Pumps
- Electrical controls and alarm systems
- Sand Filter
- Synthetic Liners
- Septage Pond Mixing pumps
- Septage Pond baffle curtains

Head contractor for overall construction of the entire facility was Vuksich and Borich Ltd of New Zealand. Contact details for Vuksich and Borich are included in the following table. Installation of specific plant items was undertaken by various sub-contractors under the supervision of the head contractor.

Table 11-1 Head Contractor Contact Details

Contractor Name	Vuksich and Borich Limited
Origin Country	New Zealand
Fax Number	+64 9 828 8397
Telephone Number	+64 9 828 4182
E-Mail Address	office@vandb.pl.net
Website	http://www.vuksichandborich.co.nz/

11.3 Leachate, Treated Effluent and Stormwater Pumps

The leachate, treated effluent and stormwater pumps were supplied and installed by the company and sub-contractor detailed in the following tables.

Table 11-2 Leachate, Treated Effluent and Stormwater Pump Supply

Supplier Name	Trimate Industries Ltd
Origin Country	New Zealand
Fax Number	+64 9 415 8679
Telephone Number	+64 9 415 8687
E-Mail Address	trimate@fluids.ittind.com
Website	http://www.trimate.co.nz/

Table 11-3 Leachate, Treated Effluent and Stormwater Pump Installation

Sub-Contractor Name	CAB Electrical
Origin Country	New Zealand
Fax Number	+64 9 276 7837
Telephone Number	+64 9 276 8323
E-Mail Address	cab.ele@xtra.co.nz
Website	N/A

11.4 Electrical Controls and Alarm Systems

All electrical controls and alarm systems were supplied and installed by the sub-contractor listed in Table 11-3 – CAB Electrical.

11.5 Sand Filter Unit

The sand filter unit was supplied by the company detailed in Table 11-4. The sand filter was installed by CAB Electrical and Vuksich and Borich Limited – refer Table 11-1 and Table 11-3.

Table 11-4 Sand Filter Unit Supply

Supplier Name	Hayward Australia
Origin Country	Australia
Fax Number	+61 2 997-4111
Telephone Number	+61 2 997-4555
E-Mail Address	N/A
Website	http://www.haywardnet.com

11.6 Synthetic Liners

11.6.1 Geosynthetic Clay Liner Supply

Geosynthetic liners (GCL's) were supplied and installed by Bisleys Environmental of New Zealand (refer Section 11.6.3). However, the GCL was manufactured by Cetco Korea. Queries related to product quality and performance should be directed to Cetco Korea, whereas queries related to supply of more GCL related product should be directed to Bisleys Environmental of New Zealand.

Table 11-5 GCL Supply

Supplier Name	Cetco Korea
Origin Country	South Korea
Fax Number	+82 2 333-4398
Telephone Number	+82 2 336-8646
E-Mail Address	cetco@cetcokorea.co.kr
Website	http://www.cetco.com

11.6.2 HDPE and LLDPE Liner Supply

Both the HDPE and LLDPE liners were supplied and installed by Bisleys Environmental of New Zealand (refer Section 11.6.3). However, the HDPE and LLDPE were manufactured by SL Limitada (Chile). Queries related to product quality and performance should be directed to SL Limitada, whereas queries related to supply of more HDPE or LLDPE related product should be directed to Bisleys Environmental of New Zealand.

Table 11-6 HDPE and LLDPE Supply

Supplier Name	SL Limitada
Origin Country	Chile
Fax Number	+56 2 601-0159
Telephone Number	+56 2 601-9675
E-Mail Address	contact@slchile.com
Website	http://www.slchile.com

11.6.3 Product Installation

All synthetic liners were installed by Bisleys Environmental of New Zealand. During product installation, the Bisleys Environmental brand was purchased by Skellerup New Zealand. Bisleys Environmental has now changed its name to Skellerup Containment Systems. However, all installation warranty liabilities have been retained by McConnell International Limited (the former owner of Bisleys Environmental). Therefore, all product warranty queries and claims should be directed to McConnell International (refer Table 11-8) and all other product installation queries should be directed to Skellerup Containment Systems.

Table 11-7 Skellerup Containment Systems (Formerly Bisleys Environmental)

Installer Name	Skellerup Containment Systems
Origin Country	New Zealand
Fax Number	+64 7 843-8283
Telephone Number	+64 7 843-8008
E-Mail Address	containment@skellerup.co.nz
Website	http://www.bisleys.net http://www.skellerup.co.nz

Table 11-8 McConnell International Limited

Company Name	McConnell International Limited
Origin Country	New Zealand
Fax Number	+64 9 374 3319
Telephone Number	+64 9 374 3300
E-Mail Address	office@mil.co.nz
Website	N/A

11.7 Septage Pond Mixing Pumps and Baffle Curtains

11.7.1 Mixing Pumps and Related Items Supply

Mixing pumps are Lowara brand pumps supplied by EcoStream Irrigation. All other pond mixing items (intake manifolds and spray units) were also manufactured and supplied by EcoStream Irrigation. All queries related to these items should be directed to EcoStream Irrigation.

Table 11-9 Mixing Pump, Intake and Spray Unit Supply

Supplier Name	EcoStream Irrigation
Origin Country	New Zealand
Fax Number	+64 7 849-6247
Telephone Number	+64 7 849-7225
E-Mail Address	ecostream@clear.net.nz
Website	N/A

11.7.2 Baffle Curtain Supply

Baffle curtains were manufactured and supplied by Skellerup and Bisleys Environmental. Refer to Table 11-7 for contact details for these companies.

11.7.3 Product Installation

All Septage Pond Mixing Pumps and Baffle Curtains were installed by Vuksich and Borich Limited with CAB Electrical completing the control and electrical systems. Refer to Table 11-1 and Table 11-3 for these companies contact details.

12.0 As Built Drawings

This section contains the 'As Built' Drawings of the Rarotonga Waste Facility. At the time of writing Issue 4 of this Management Plan, As Built drawings were not available. Therefore, a set of 'Construction Issue' drawings is included with Issue 4 of this Management Plan.

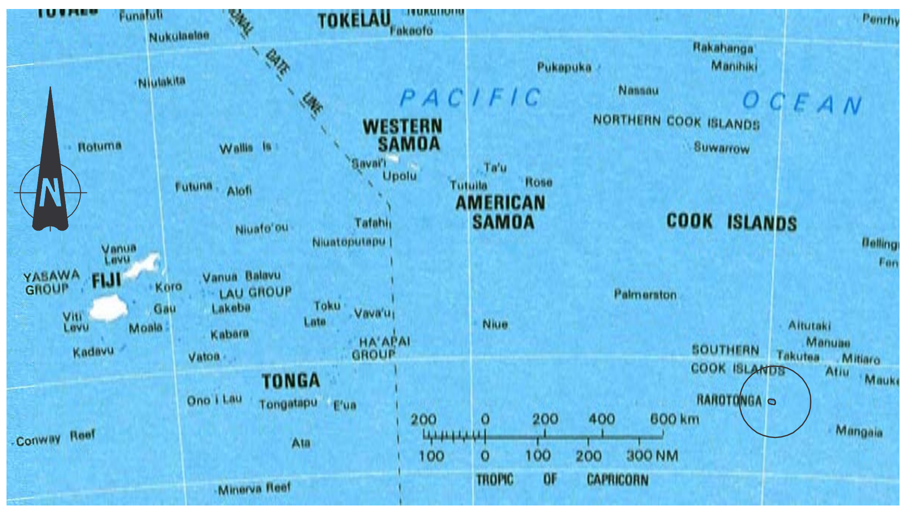
Table 12-1 List of Drawings

Number	Name
101	Cover Plan - Overall locality and List of Drawings
102	General Layout and Survey Control
103	Refuse Filling Sequence Plan
104	Refuse Filling Sequence Details
105	Bulk Earthworks Target Excavation Plan
106	Liner Cross-section and Details
107	Leachate Collection System Layout
108	Leachate Pipelines, Long Sections
109	Leachate and Septage Pumping Station and Header Tank
110	Leachate Pipe and Liner Details. FML Penetration Details
111	Leachate Pipe and Liner Details
112	Septage Receiving Facility
112A	Septage Ponds, Cross Sections
113	Septage Pond Effluent Disposal Details
114	Effluent Disposal System Details
115	Access Road and Stream Diversion Layout Plan
116	Access Road and Stream Diversion Longitudinal Section
117	Stream Diversion Details – Sheet 1
118	Stream Diversion Details – Sheet 2
119-122	*Not Used*
123	Landfill Gas Layout and Details
124	Recycling Area Layout, Fencing and Gate Details
125	Monitoring Well Layout and Sections
126	Pond Mixing System Plan and Details
127	Pond Mixing System Pump Pipework Details
128	Access Road Cross Sections – Sheet 1
129	Access Road Cross Sections – Sheet 2
130	Access Road Cross Sections – Sheet 3
131	Access Road Cross Sections – Sheet 4
132	Access Road Cross Sections – Sheet 5
133	Access Road Cross Sections – Sheet 6
134	Access Road Cross Sections – Sheet 7

GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

DRAWINGS FOR RAROTONGA LANDFILL AND SEPTAGE PONDS



LOCALITY DIAGRAM

DRAWING INDEX

101	COVER PLAN – OVERALL LOCALITY AND LIST OF DRAWINGS
102	GENERAL LAYOUT AND SURVEY CONTROL
103	REFUSE FILLING SEQUENCE PLAN
104	REFUSE FILLING SEQUENCE DETAILS
105	BULK EARTHWORKS TARGET EXCAVATION PLAN
106	LINER CROSS–SECTION AND DETAILS
107	LEACHATE COLLECTION SYSTEM LAYOUT
108	LEACHATE PIPELINES, LONG SECTION
109	LEACHATE AND SEPTAGE PUMPING STATION
110	LEACHATE PIPE & LINER DETAILS. FML PENETRATION DETAIL
111	LEACHATE PIPE & LINER DETAILS
112	SEPTAGE RECEIVING FACILITY
112A	SEPTAGE PONDS, CROSS–SECTIONS
113	SEPTAGE POND EFFLUENT DISPOSAL DETAILS
114	EFFLUENT DISPOSAL SYSTEM DETAILS
115	ACCESS ROAD AND STREAM DIVERSION LAYOUT PLAN
116	ACCESS ROAD AND STREAM DIVERSION LONGITUDINAL SECTIONS
117	STREAM DIVERSION DETAILS – SHEET 1
118	STREAM DIVERSION DETAILS – SHEET 2
119–122	NOT USED
123	LANDFILL GAS LAYOUT AND DETAILS
124	RECYCLING AREA LAYOUT, FENCING AND GATE DETAILS
125	MONITORING WELL LAYOUT AND SECTIONS
126	POND MIXING SYSTEM PLAN AND DETAILS
127	POND MIXING SYSTEM PUMP PIPEWORK DETAILS
128	ACCESS ROAD CROSS SECTIONS – SHEET 1
129	ACCESS ROAD CROSS SECTIONS – SHEET 2
130	ACCESS ROAD CROSS SECTIONS – SHEET 3
131	ACCESS ROAD CROSS SECTIONS – SHEET 4
132	ACCESS ROAD CROSS SECTIONS – SHEET 5
133	ACCESS ROAD CROSS SECTIONS – SHEET 6
134	ACCESS ROAD CROSS SECTIONS – SHEET 7

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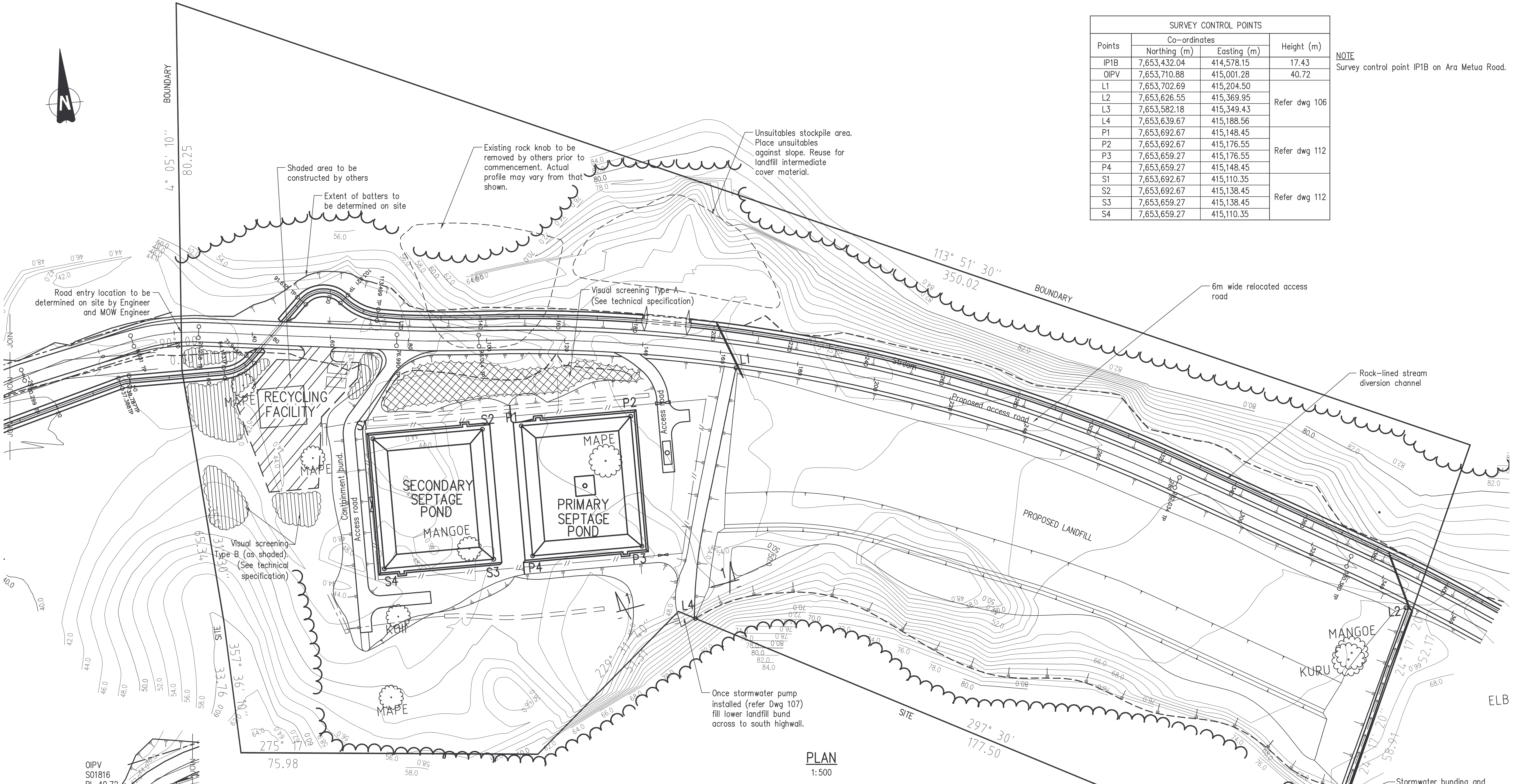
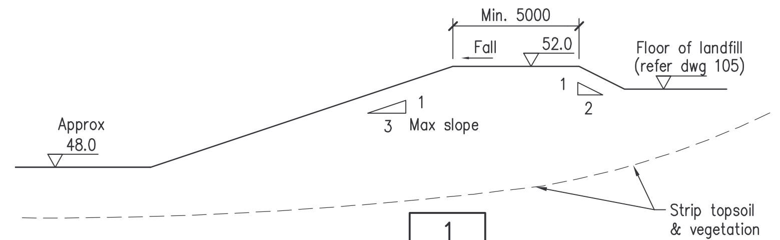
COVER PLAN - OVERALL LOCALITY AND LIST OF DRAWINGS

Drawing No. 101
Issue A



SURVEY CONTROL POINTS			
Points	Co-ordinates Northing (m)	Co-ordinates Easting (m)	Height (m)
IP1B	7,653,432.04	414,578.15	17.43
OIPV	7,653,710.88	415,001.28	40.72
L1	7,653,702.69	415,204.50	Refer dwg 106
L2	7,653,626.55	415,369.95	
L3	7,653,582.18	415,349.43	
L4	7,653,639.67	415,188.56	
P1	7,653,692.67	415,148.45	Refer dwg 112
P2	7,653,692.67	415,176.55	
P3	7,653,659.27	415,176.55	
P4	7,653,659.27	415,148.45	
S1	7,653,692.67	415,110.35	Refer dwg 112
S2	7,653,692.67	415,138.45	
S3	7,653,659.27	415,138.45	
S4	7,653,659.27	415,110.35	

NOTE
Survey control point IP1B on Ara Metua Road.



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107
112
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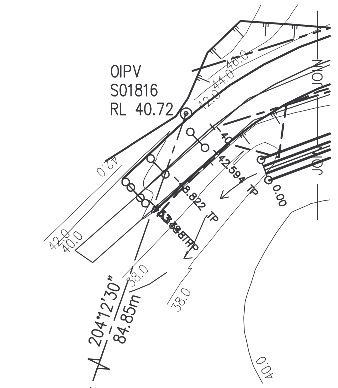

ORIGIN DIAGRAM
N.T.S.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	H Yeo	KO	Apr 03
Drawn	MNL	HY	
Approved	K Oldham	Status	Construction

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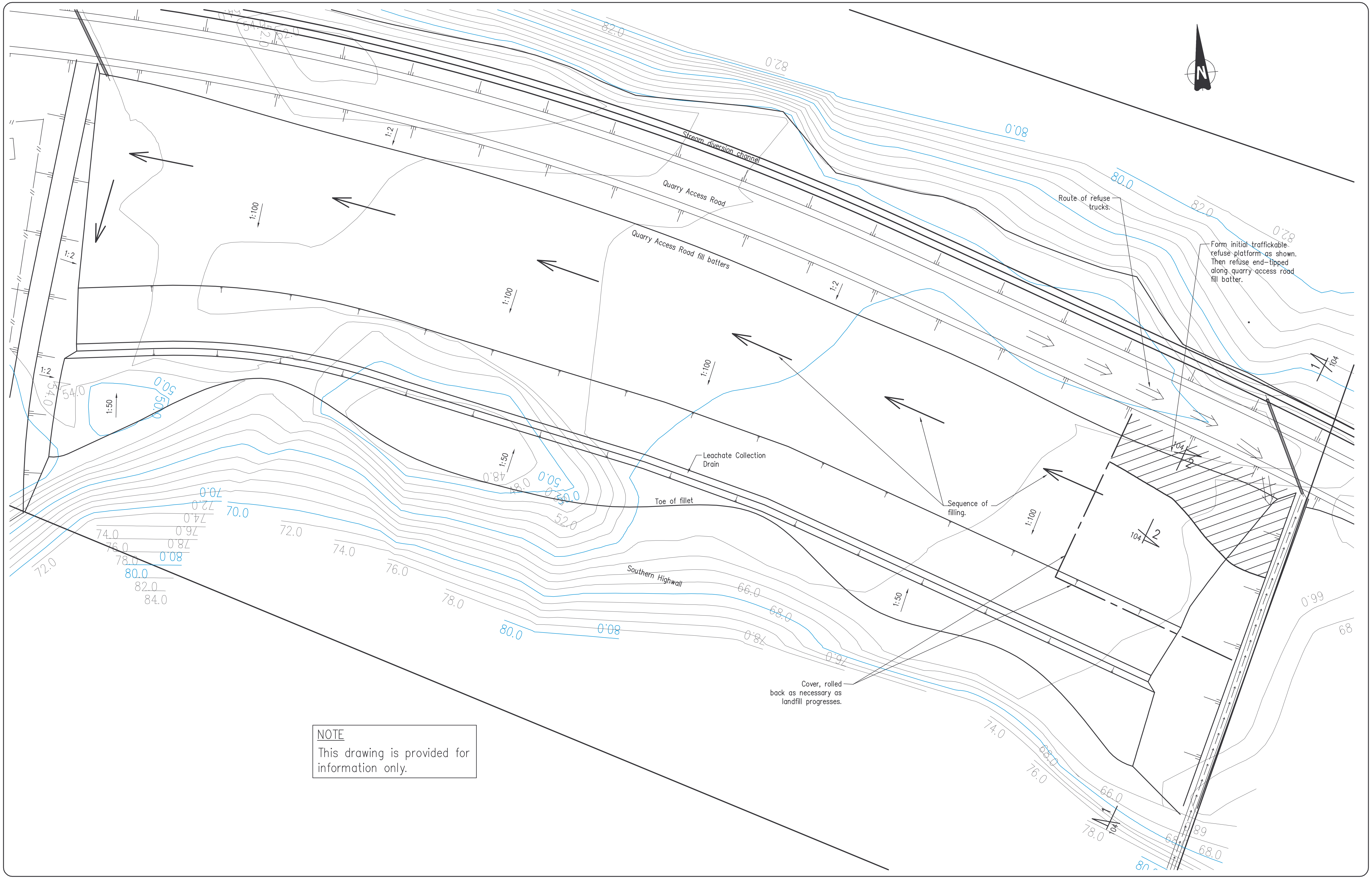
GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

GENERAL LAYOUT AND SURVEY CONTROL

A1
Scale 1:500(A1) 1:1000(A3)
Project No. 4964312
Drawing No. 102
Issue A



Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	L. Shui	HY	Apr 03
Drawn	NJS	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

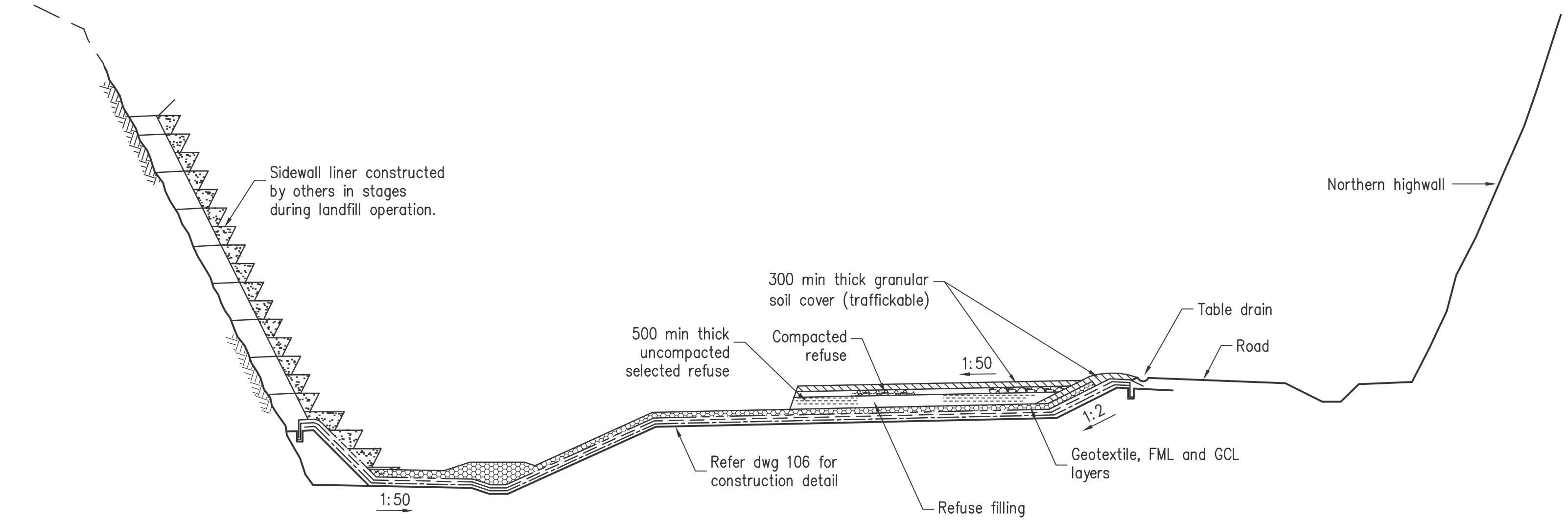
WASTE MANAGEMENT PROJECT

CONSTRUCTON OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

REFUSE FILLING SEQUENCE LAYOUT PLAN (BY OTHERS)

A1 | Scale 1:250(A1) 1:500(A3)

Project No. 4964312 | Drawing No. 103 | Issue A



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103
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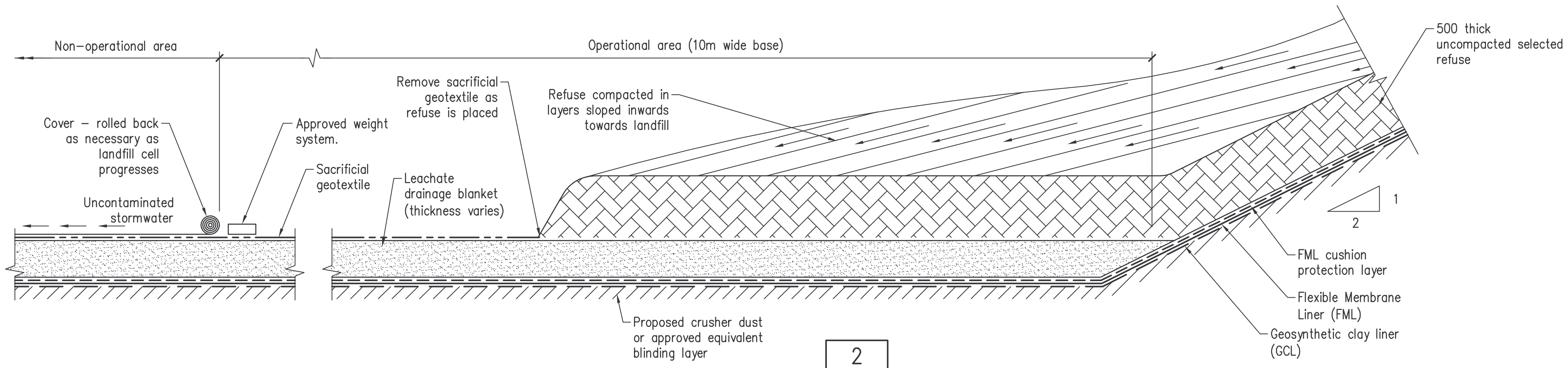


2
103
1:25

NOTE
This drawing is provided for information only.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	HY	KO	Apr 03
Drawn	IML	HY	
Approved	K Oldham	Status	Construction

Meritec

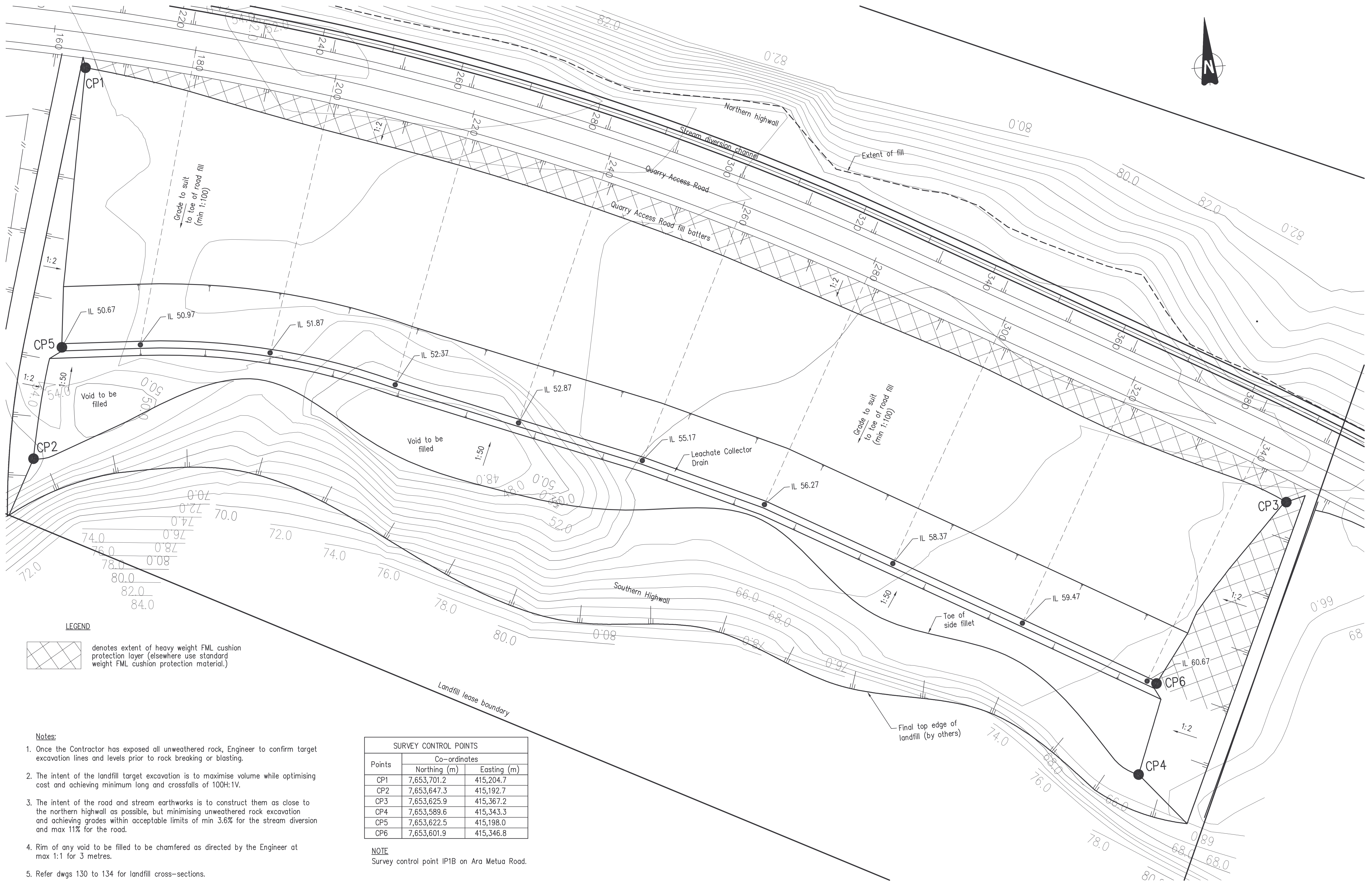
GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

REFUSE FILLING SEQUENCE SECTIONS (BY OTHERS)

A1
Scale AS SHOWN
Project No. 4964312
Drawing No. 104
Issue A



LEGEND

denotes extent of heavy weight FML cushion protection layer (elsewhere use standard weight FML cushion protection material.)

Notes:

1. Once the Contractor has exposed all unweathered rock, Engineer to confirm target excavation lines and levels prior to rock breaking or blasting.
2. The intent of the landfill target excavation is to maximise volume while optimising cost and achieving minimum long and crossfalls of 100H:1V.
3. The intent of the road and stream earthworks is to construct them as close to the northern highwall as possible, but minimising unweathered rock excavation and achieving grades within acceptable limits of min 3.6% for the stream diversion and max 11% for the road.
4. Rim of any void to be filled to be chamfered as directed by the Engineer at max 1:1 for 3 metres.
5. Refer dwgs 130 to 134 for landfill cross-sections.

SURVEY CONTROL POINTS		
Points	Co-ordinates	
	Northing (m)	Easting (m)
CP1	7,653,701.2	415,204.7
CP2	7,653,647.3	415,192.7
CP3	7,653,625.9	415,367.2
CP4	7,653,589.6	415,343.3
CP5	7,653,622.5	415,198.0
CP6	7,653,601.9	415,346.8

NOTE
Survey control point IP1B on Ara Metua Road.

Issue	Description	Date	App'd
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Design	CD	DB	Apr 03
Drawn	NJS	CD	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

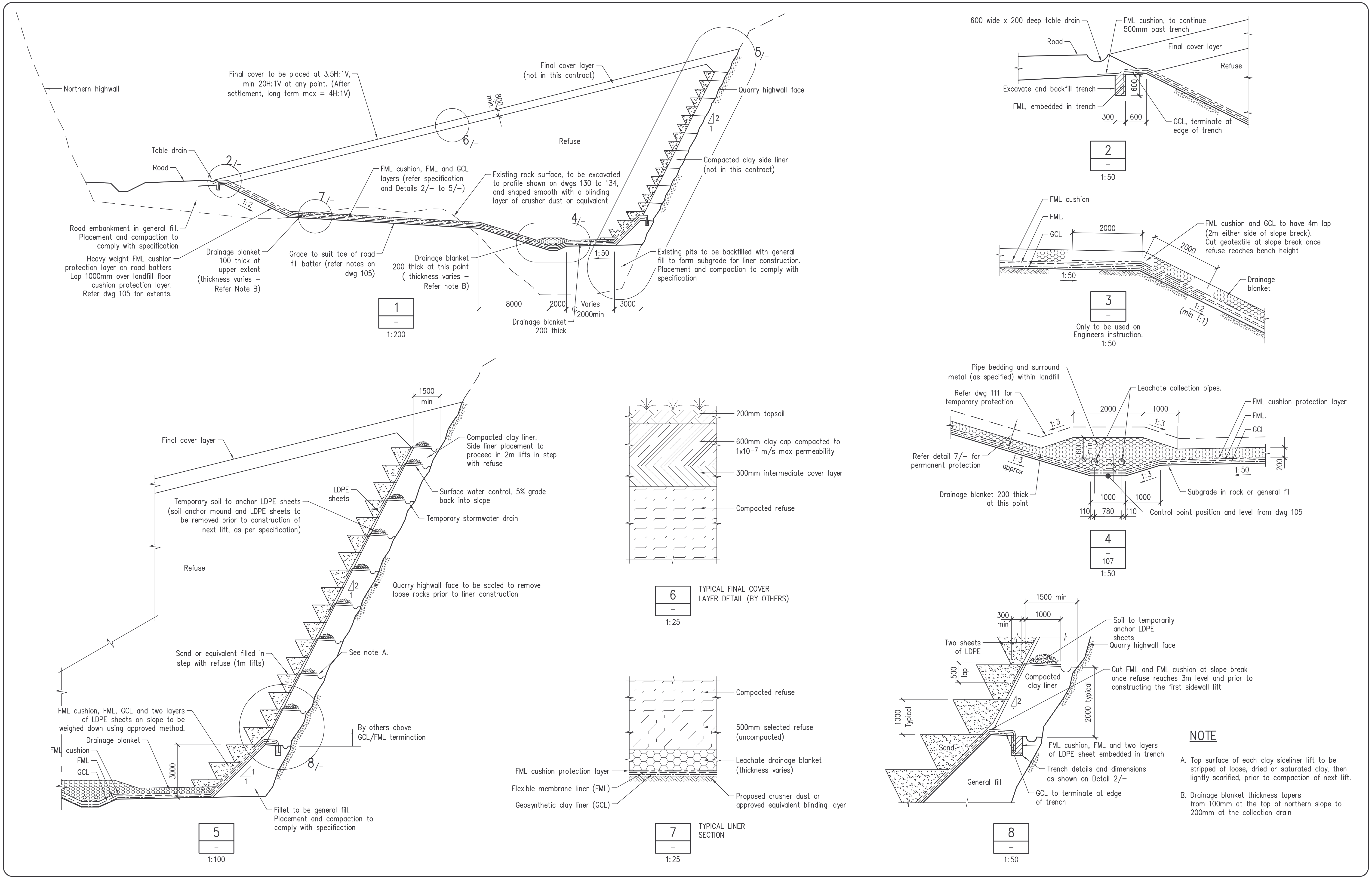
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

BULK EARTHWORKS TARGET EXCAVATION PLAN

A1 20 10 0 20 40mm

Scale 1:250(A1) 1:500(A3)

Project No. 4964312 | Drawing No. 105 | Issue A



Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	CD	DAB	Apr 03
Drawn	CC	CD	
Approved	K. Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

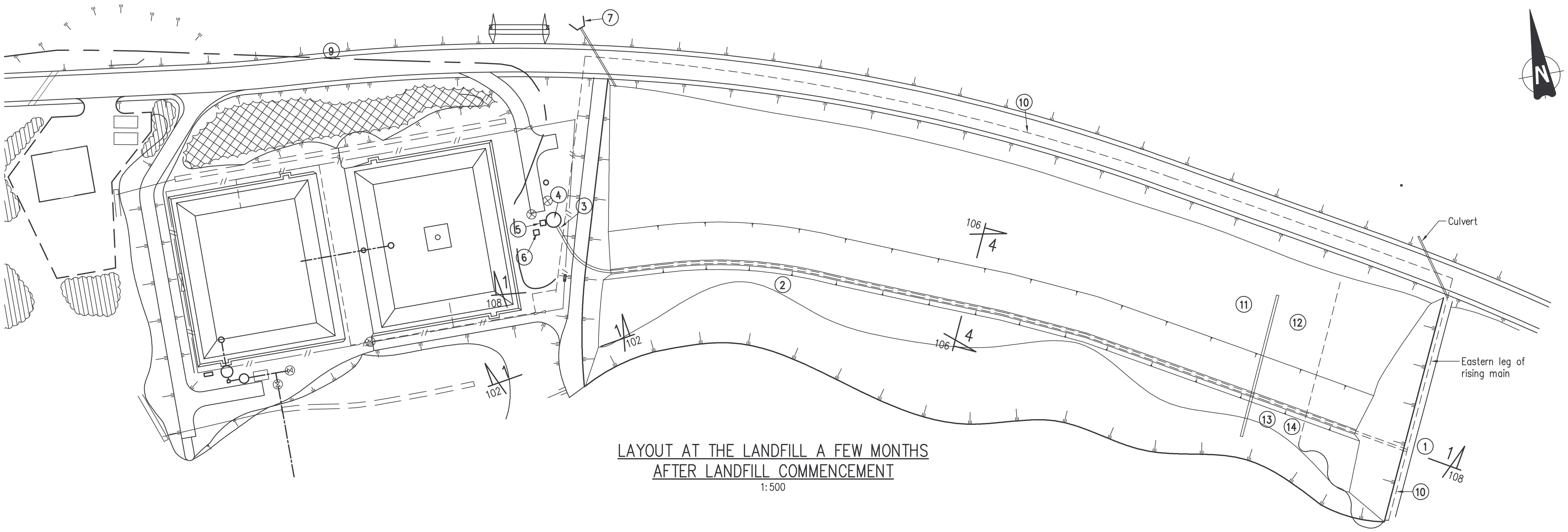
WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

LINER AND COVER DETAILS

A1 Scale As shown (A1)

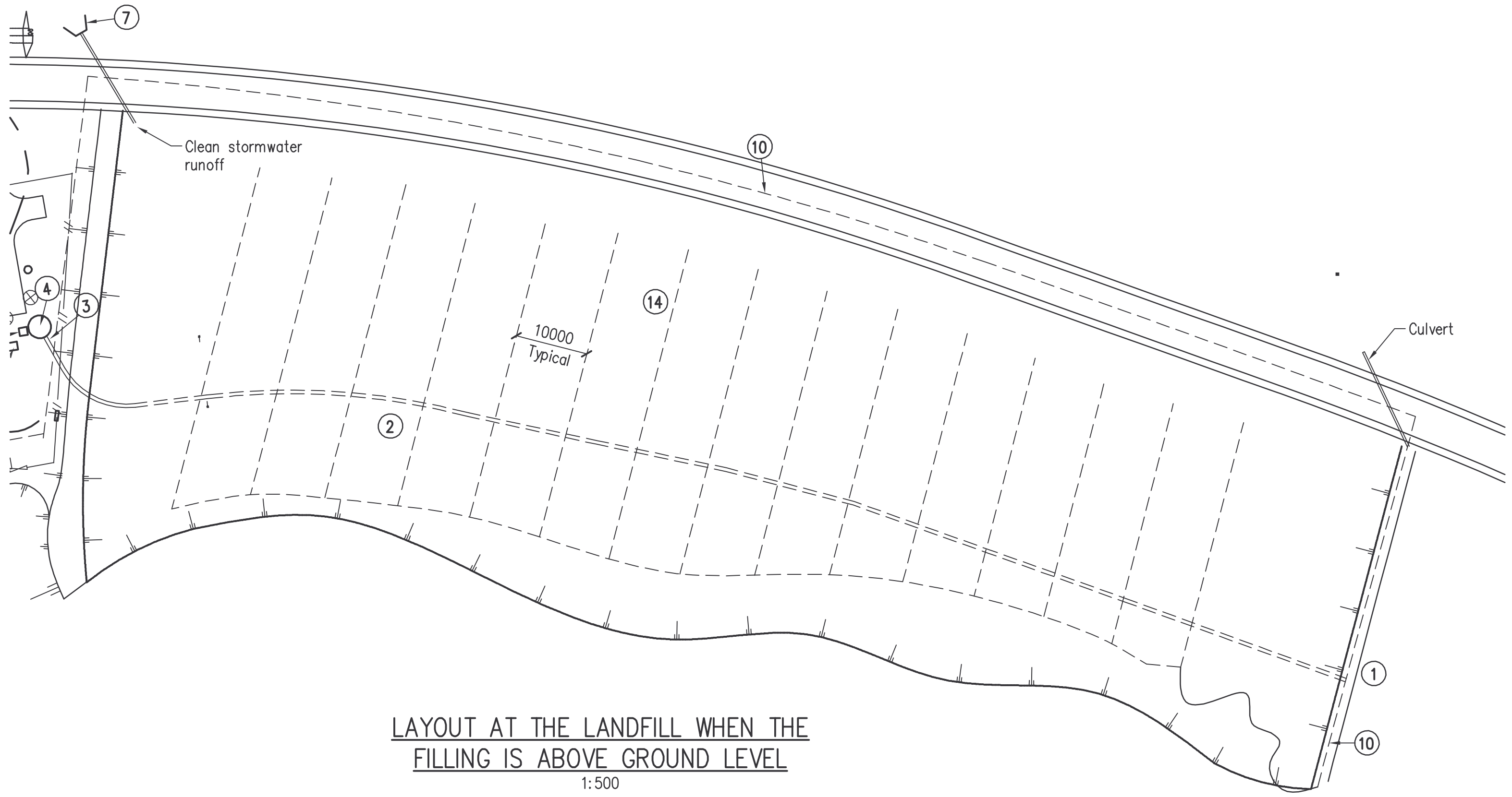
Project No. 4964312 Drawing No. 106 Issue A



LAYOUT AT THE LANDFILL A FEW MONTHS AFTER LANDFILL COMMENCEMENT

1:500

(1) Rodding point
(2) Leachate collection pipeline (dual)
(3) Anchor block
(4) Leachate pump station
(5) Washdown facility standpipe and hose.
(6) Electrical control panel
(7) Stormwater outlet structure
(8) Portable stormwater pump
(9) Power supply cable
(10) Leachate rising main
(11) Temporary cover
(12) Operating area
(13) Area with temporary cover
(14) Perforated recirculation pipe



LAYOUT AT THE LANDFILL WHEN THE FILLING IS ABOVE GROUND LEVEL

1:500

Key:

- - - - Trenched Pipeline
~~~~ Hose (Above ground)

1:500

Issue	Description	Date	App'd
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Verify all dimensions before commencing work

		Checked	Date
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Drawn	CC	TAD	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

LEACHATE COLLECTION SYSTEM LAYOUT

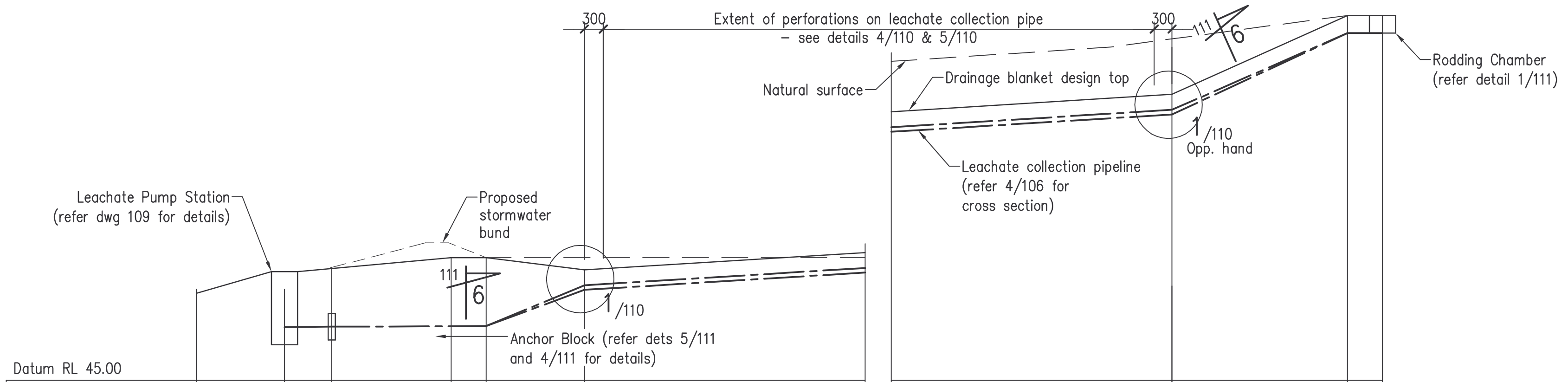
A1 20 10 0 20 40mm

Scale 1:500(A1) 1:1000(A3)

Project No. 4964312

Drawing No. 107

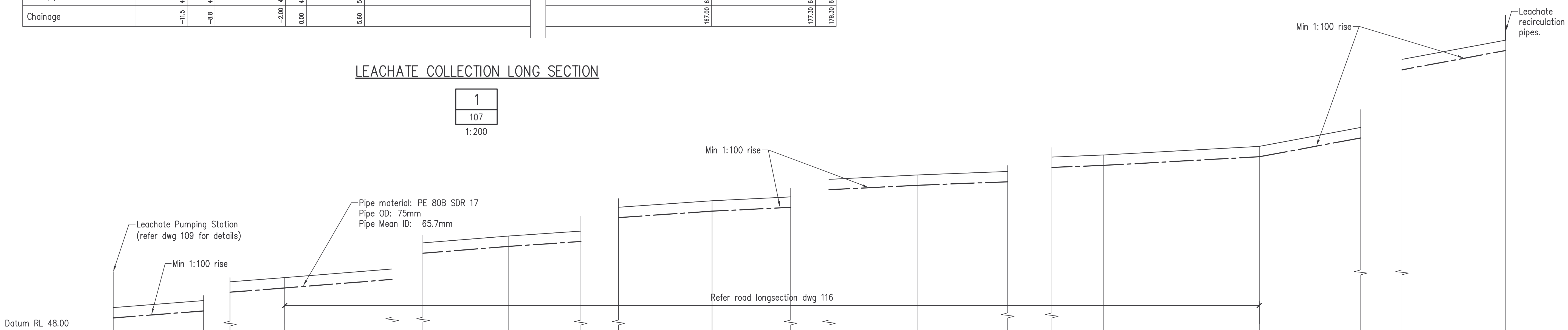
Issue A
~~~~



Natural surface	50.60	51.45	52.00	52.00	52.00	64.47	65.80	65.80
Floor level (Drainage blanket design top (DBDT))				52.00	51.67	61.67	65.80	
Cut to DBDT				0.00	0.33	2.80	0.00	
Bedding and backfill		Clay				Aggregate	Clay	
Dual pipe I.L.	48.04	48.06	48.08	48.10	50.82	60.82	64.80	65.80
Chainage	−11.5	−8.8	−2.00	0.00	5.60	167.00	177.30	179.30

LEACHATE COLLECTION LONG SECTION

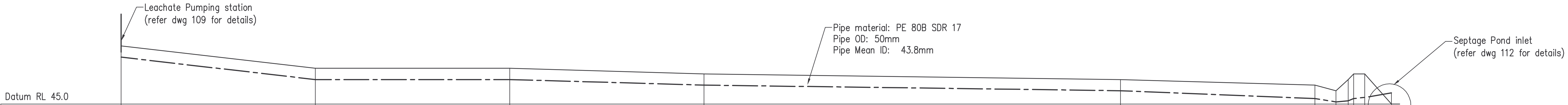
1
107
1:200



Design finished surface	50.10	50.10	53.09	57.10	60.50	63.00	64.92	65.75	76.00
Pipe I.L.	46.84	49.20	52.09	56.10	59.50	62.00	63.92	64.75	75.00
Chainage		0.00	37.50	87.50	137.50	187.50	237.50	252.50	307.50

LEACHATE RISING MAIN LONGSECTION – PS TO RECIRCULATION PIPES (INDICATIVE ONLY)

1:200



Natural surface		50.10	48.20	48.20	47.70	47.20	46.70	46.20	47.20	47.70	47.70	45.00
Pipe I.L.	46.84	49.10	47.20	47.20	46.70	46.20	45.50	45.20	45.30	45.50	45.60	46.00
Chainage		0.00	17.5	35.00	52.50	90.00	107.50	109.40	110.50	111.00	112.00	114.40

LEACHATE RISING MAIN LONGSECTION – PS TO SEPTAGE PONDS (INDICATIVE ONLY)

(Refer dwg 112 for layout)

1:200

Issue	Description	Date	App'd
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Verify all dimensions before commencing work

		Checked	Date
Design	HY	TAD	Apr 03
Drawn	NJS	HY	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

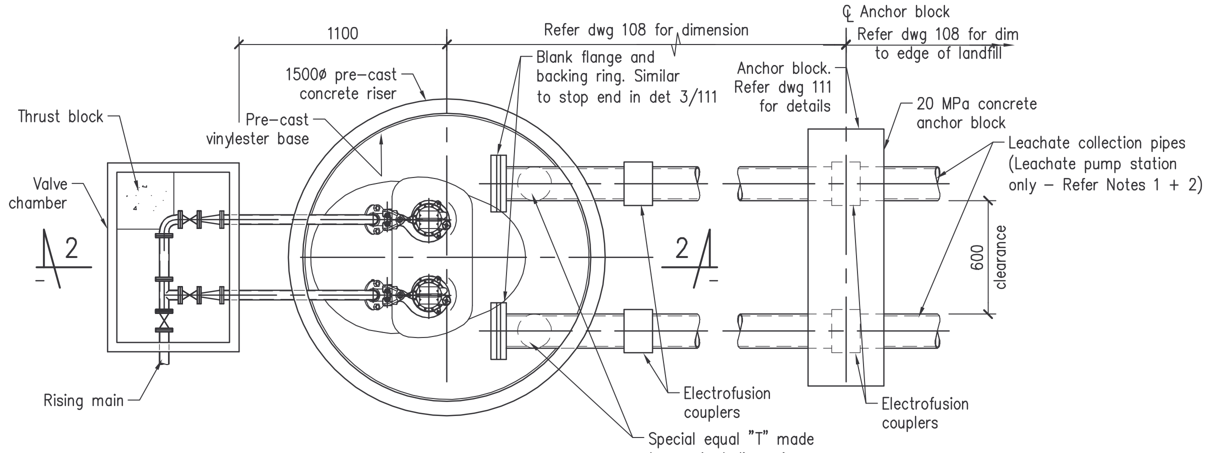
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

LEACHATE PIPELINES LONG SECTIONS

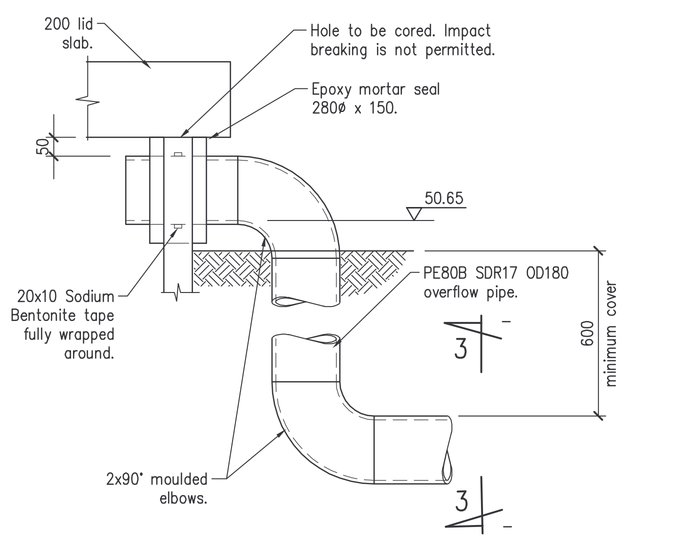
A1 20 10 0 20 40mm

Scale 1:200(A1) 1:400(A3)

Project No. 4964312 | Drawing No. 108 | Issue A

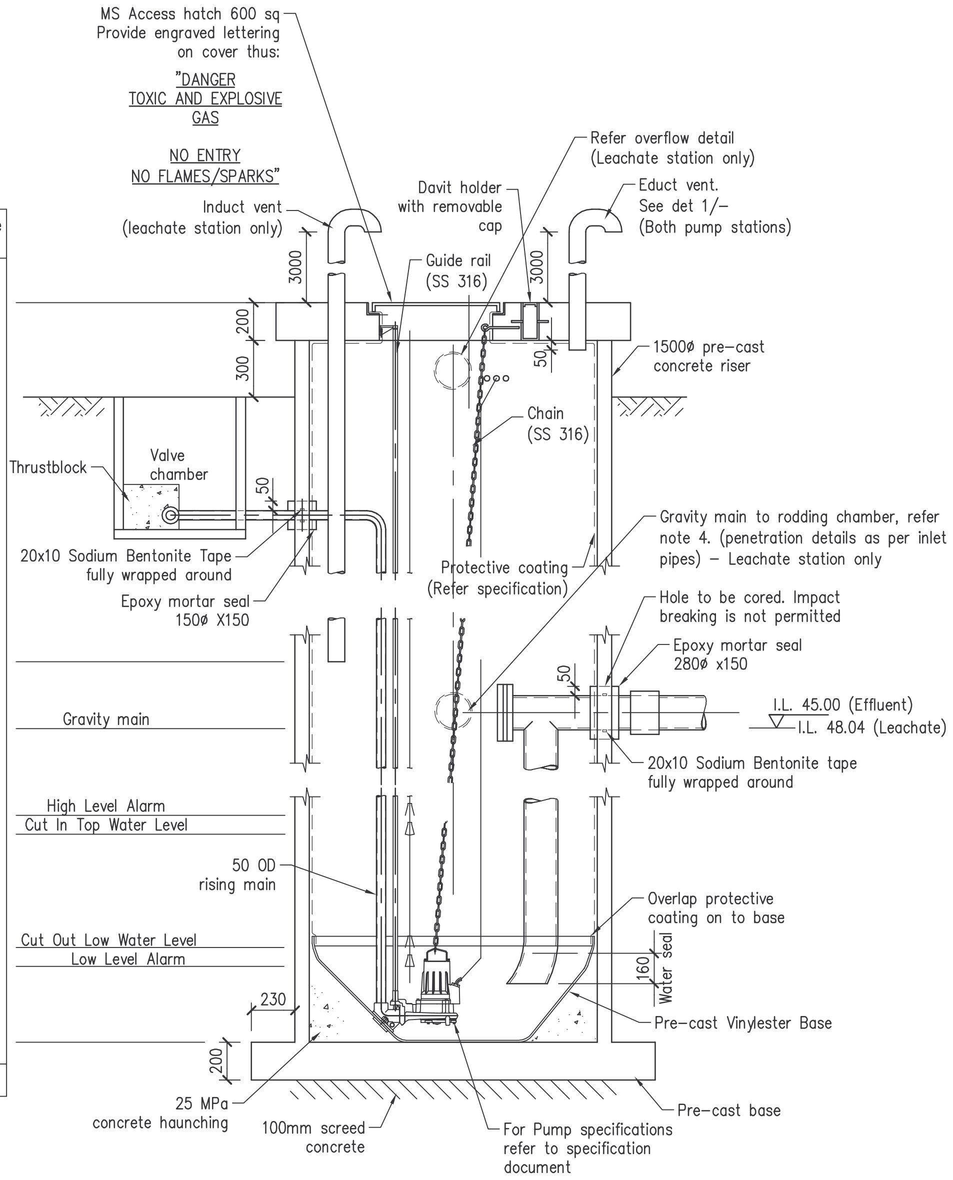


PUMP STATION
PLAN
1:20



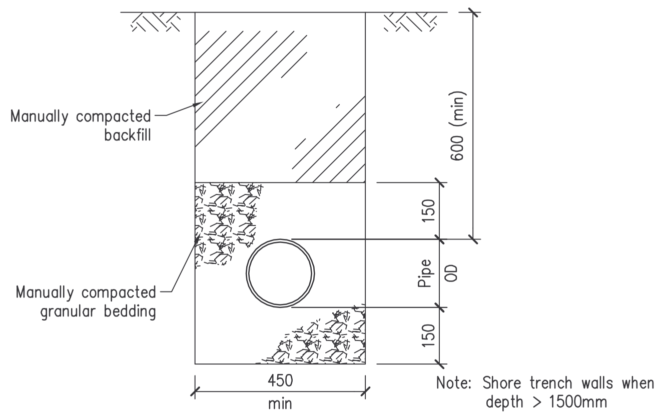
OVERFLOW DETAIL
(LEACHATE STATION ONLY)
1:10

Levels for Effluent Pump Station	Levels for Leachate Pump Station
RL 47.70	RL 51.10
RL 47.20	RL 50.60 Finished Ground level
	49.04
	48.04
46.33 46.23	48.04 47.94
43.70 43.60	47.30 47.20
43.20	46.84
Refer Note 2	



PUMP STATION SECTION

2
–
1:20

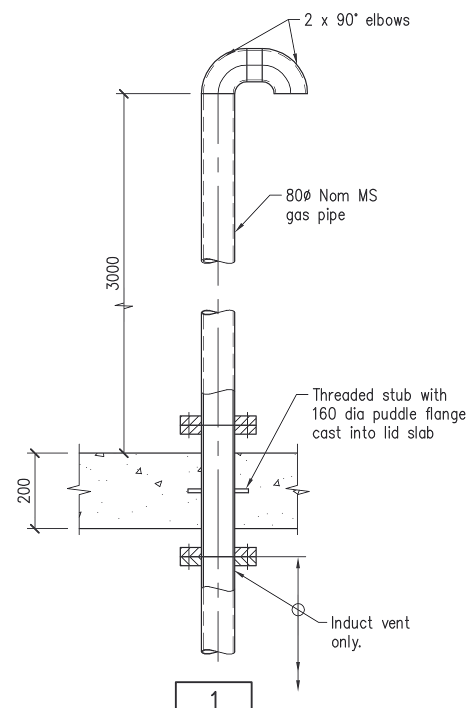


3
112
124

RISING MAIN
TYPICAL TRENCH CROSS-SECTION
1:10

Notes:

1. Note that the effluent pump station has only one inlet drain and no need for anchor blocks
2. Leachate pump station and Effluent pump station are similar except for pumps, levels and inlet arrangements.
3. All pipework of induct and educt vents to be hot dip galvanised.
4. A manually controlled flap gate shall be installed to control flow into the gravity outlet from the leachate pump station. The gate shall be manually operated from the access hatch. Design to be approved by Engineer.



1
–
1:10

Issue	Description	Date	App'd
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Drawn	MNL	HY	
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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

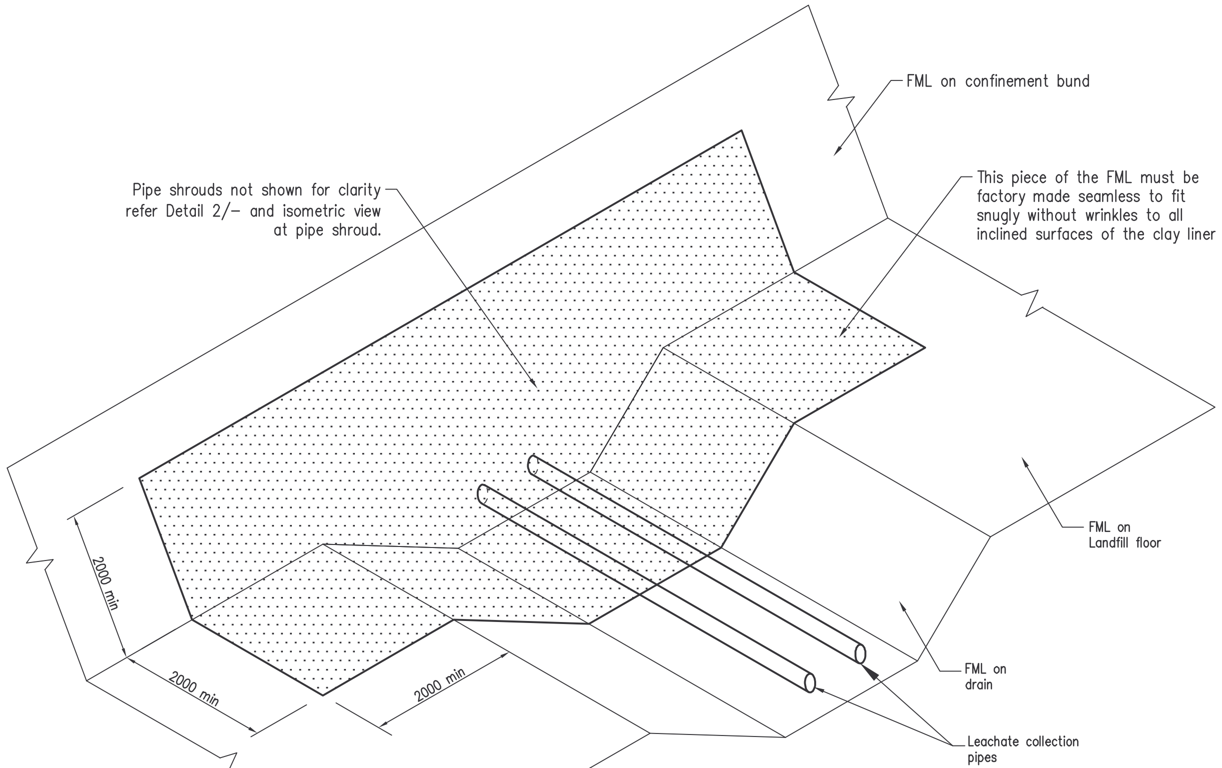
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

LEACHATE AND SEPTAGE PUMPING STATION

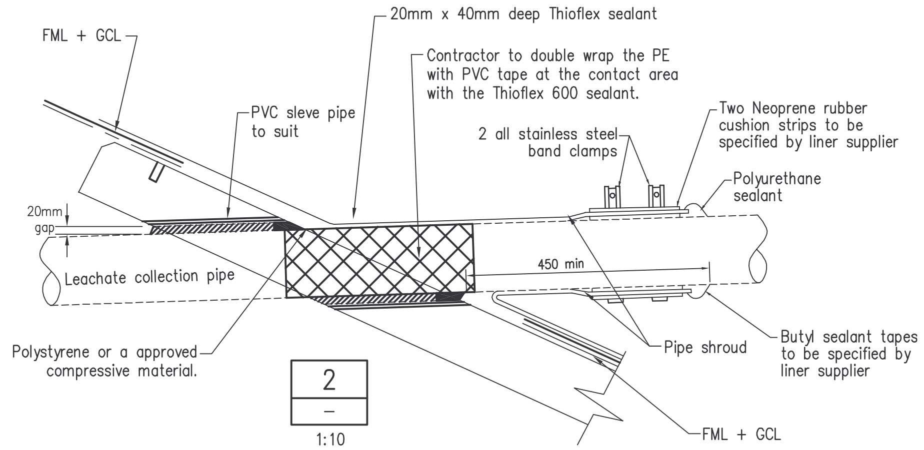
A1 20 10 0 20 40mm

Scale As shown (A1)

Project No. 4964312 | Drawing No. 109 | Issue A



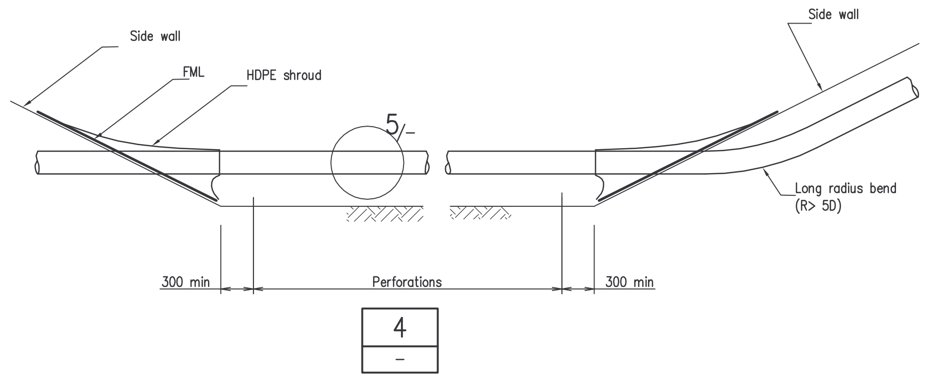
ISOMETRIC VIEW "A"
1:50



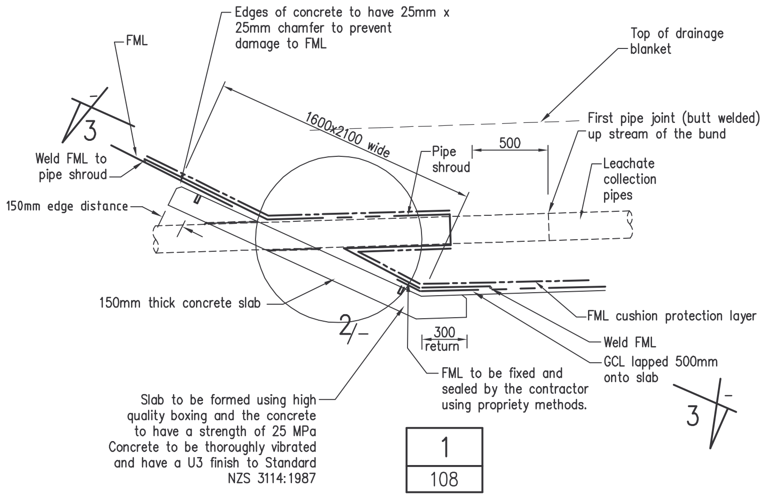
1:10
SECTION AT PIPE PENETRATION

Notes:

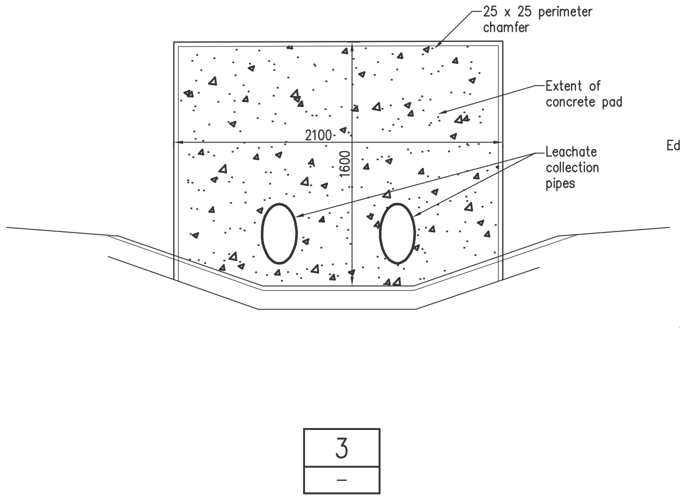
1. The FML and pipe shroud details given on this drawing show only the minimum requirements. The FML contractor shall improve these details to meet the guarantee conditions required by the contract.
2. For the purposes of the guarantee requirements, the details given on this drawing (with or without any amendments by the Contractor) shall be deemed as an integral part of the Contractor's design of the FML installation.
3. All amendments to this drawing by the Contractor shall be subject to the approval by the Engineer prior to commencement of the FML installation. The Contractor shall make all reasonable efforts to find solutions expeditiously to meet the Engineer's requirements on FML and pipe shroud installations.
4. The Contractor shall allow for this approval process in his tender. No extra payments or time extensions shall be granted due to delays, if any, caused by the approval process.
5. The Contractor shall submit shop drawings for the installation of the FML and the pipe shrouds, and allow for the preparation of the shop drawings in his tender.
6. Suggested construction sequence. The contractor is free to provide his own sequence:
   - Excavate trench and lay a convenient length of pipe.
   - Backfill trench up to 2m above pipe invert.
   - Construct concrete apron with PVC sleeve.
   - Slide in the FML piece shown in Isometric View "A", allowing the pipes to protrude through preformed holes in the FML piece.
   - Install the shrouds.
   - Lay the FML and protection layers, including drainage blanket as much as possible.
   - Lay the pipe bedding, complete the pipeline and complete the blanket.



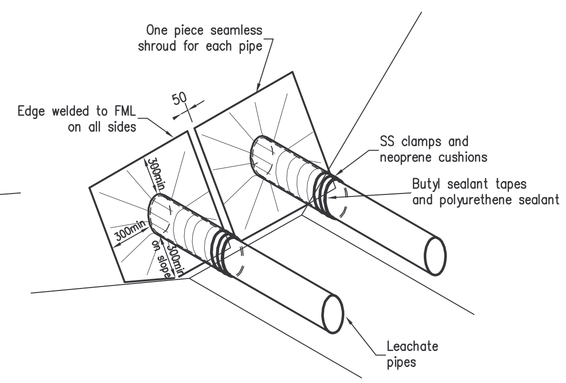
EXTENT OF PERFORATIONS IN LEACHATE PIPE
1:25



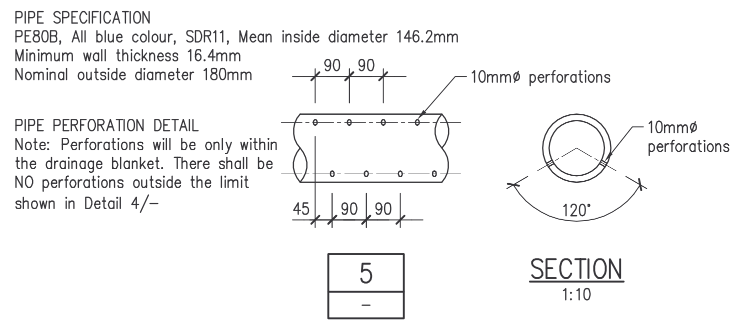
1:25
(See also Isometric View "A")



1:25



ISOMETRIC VIEW AT PIPE SHROUD
1:25



1:10
SECTION
1:10

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	HY	TAD	Apr 03
Drawn	NJS	HY	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

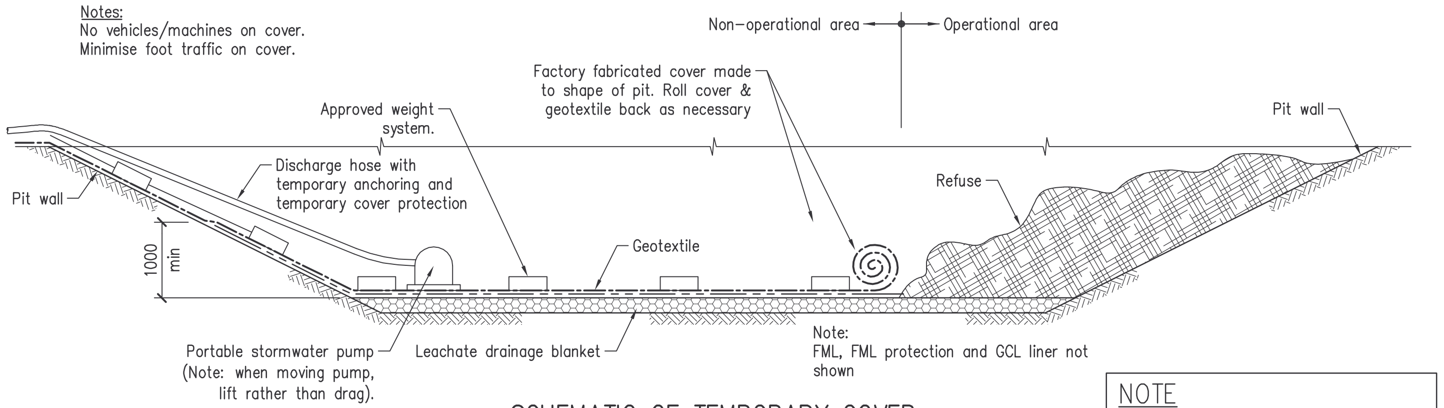
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

LEACHATE PIPE & LINER DETAILS. FML PENETRATION DETAIL

A1 20 10 0 20 40mm

Scale As shown (A1)

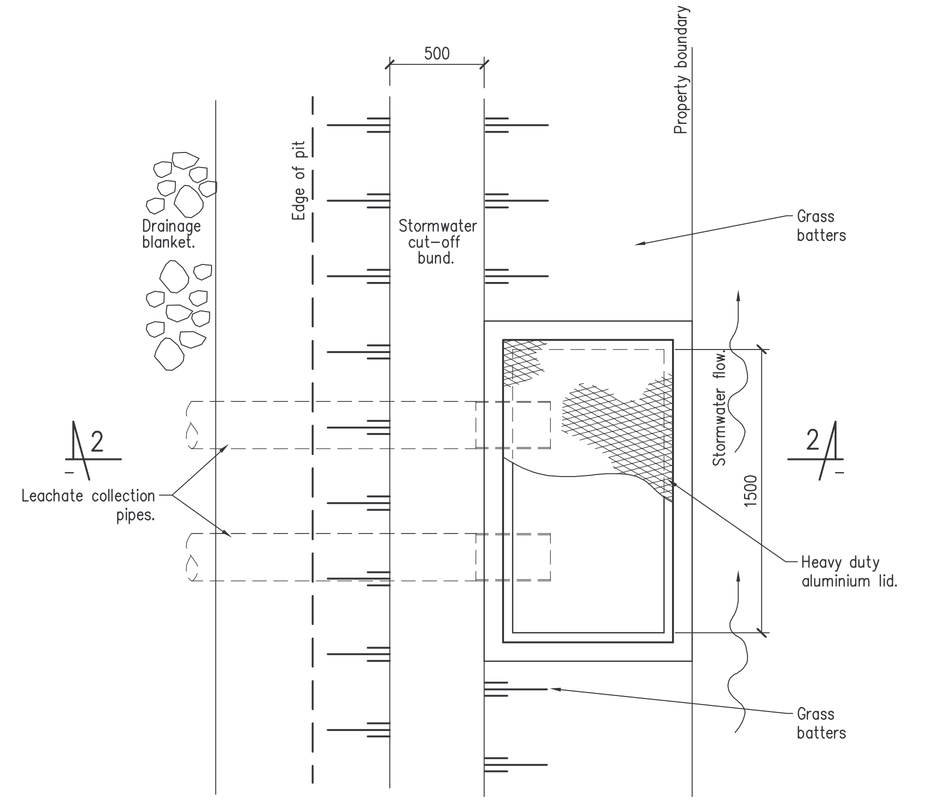
Project No. 4964312 | Drawing No. 110 | Issue A



SCHEMATIC OF TEMPORARY COVER

1:50

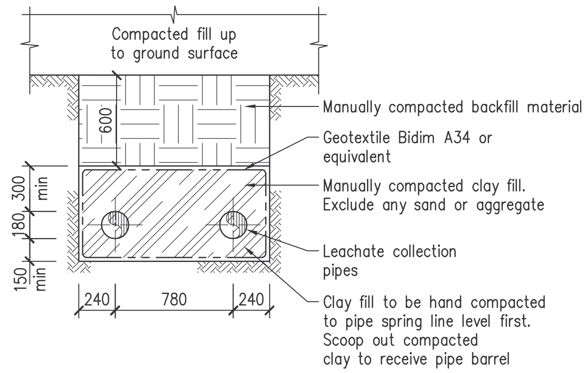
NOTE
This detail is provided for information only.



1
108

RODDING CHAMBER

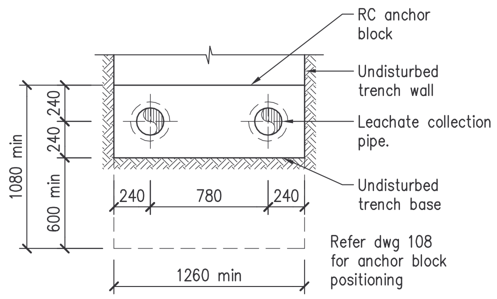
1:20



TYPICAL TRENCH CROSS-SECTION

6
108

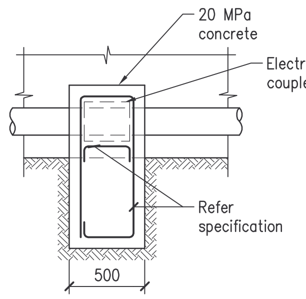
1:25



5
108

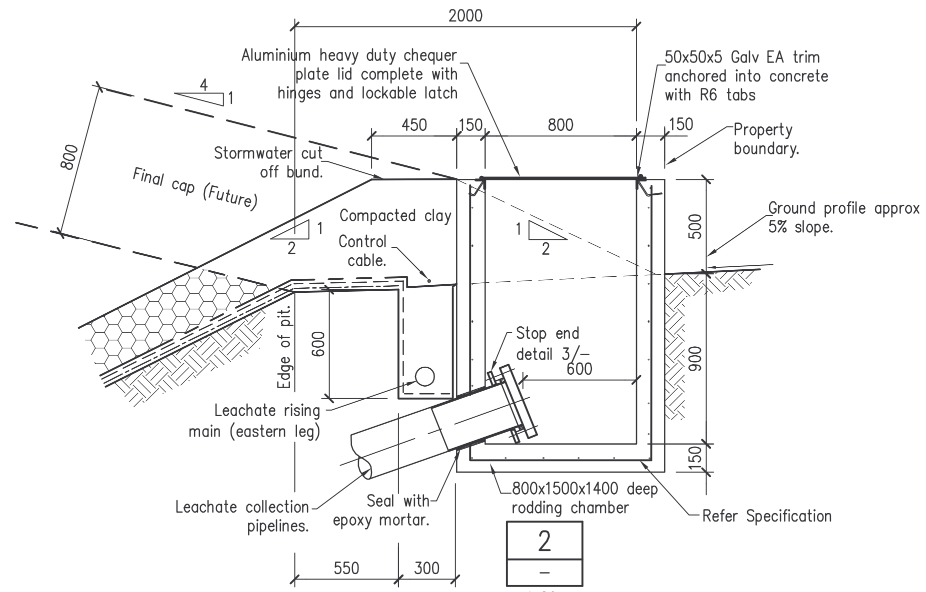
ANCHOR BLOCK ELEVATION

1:25



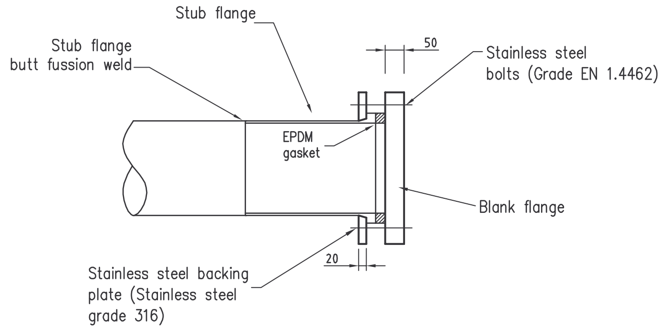
4
108

1:25



2
–

1:20



3
–

LEACHATE PIPE STOP END

1:10

Issue	Description	Date	App'd
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Drawn	NJS	HY	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

LEACHATE PIPE & LINER DETAILS.

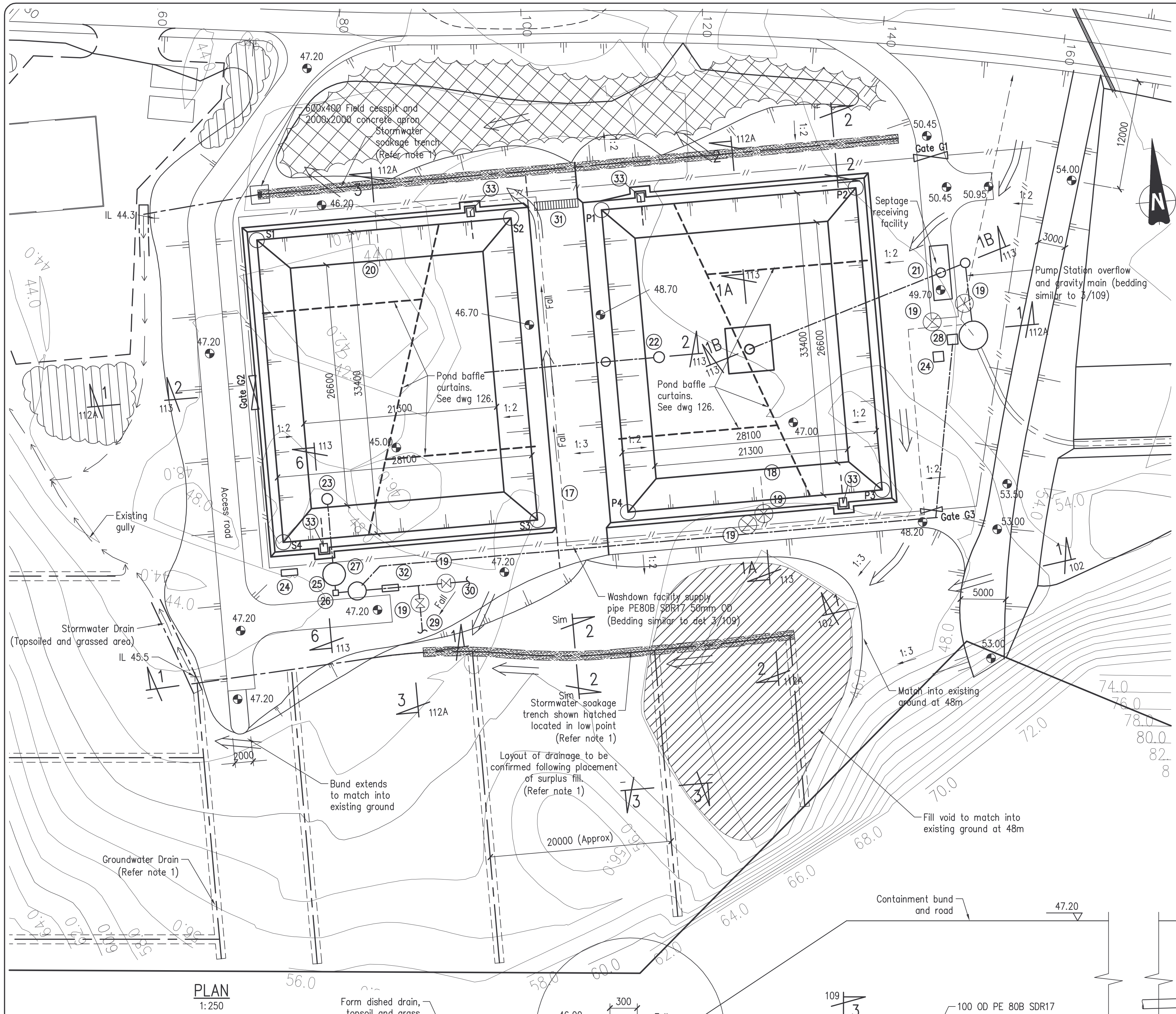
A1 20 10 0 20 40mm

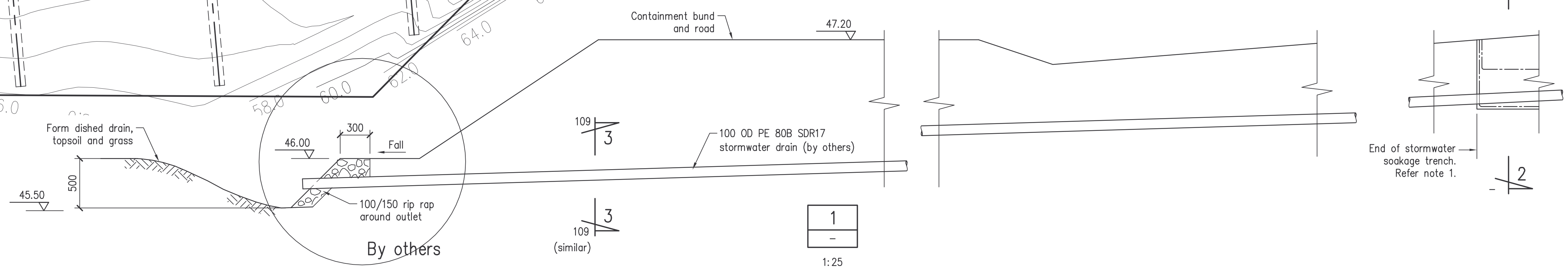
Scale As shown (A1)

Project No. 4964312

Drawing No. 111

Issue A





KEY TO FACILITY ITEMS

NOTE The items as drawn on the plan are indicative only and do not represent the actual size of the structures.

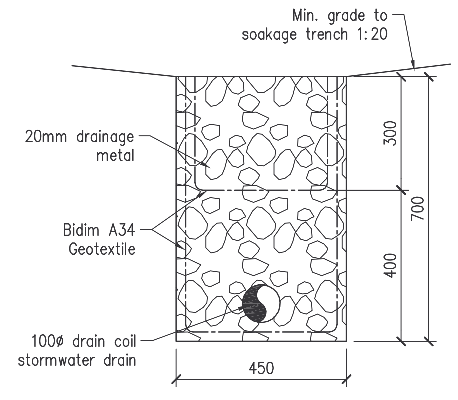
- (17) Leachate rising main to septage ponds
- (18) Leachate inlet to primary pond
- (19) Control valve
- (20) Leachate inlet to secondary pond
- (21) Receiving manhole
- (22) Outlet from primary pond
- (23) Outlet from secondary pond
- (24) Electrical control panel
- (25) Effluent pump station
- (26) Valve chamber
- (27) Sand filter and booster pumps
- (28) Washdown facility stand pipe and hose.
- (29) Pipeline to disposal area
- (30) Pipeline to landscaped area
- (31) Steps (900 wide)
- (32) Provision for future disinfection facility.
- (33) Mixing (and spray aeration) pump. 4 only (2 per pond). Refer dwg 126

—//— Denotes 7 wire fence as per drawing 124

⟸ Denotes extreme event flow path.

NOTE

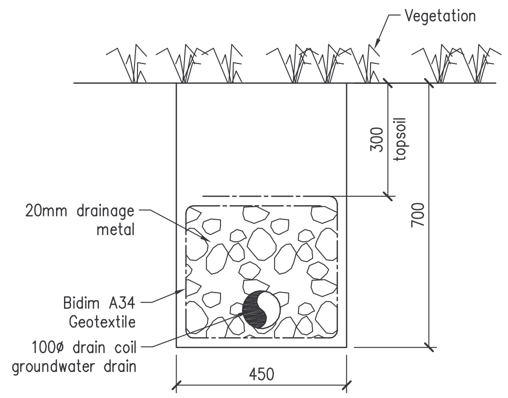
1. All groundwater drains and stormwater soakage will be constructed by others.



Note:
The top drainage metal layer and the top geotextile will need periodic replacement depending on sediment load.

SECTION THROUGH STORMWATER SOAKAGE TRENCH

1:10 (By others)



SECTION THROUGH GROUNDWATER DRAIN

1:10 (By others)

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A	Issued for construction	7.11.03	MvW

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GOVERNMENT OF THE COOK ISLANDS

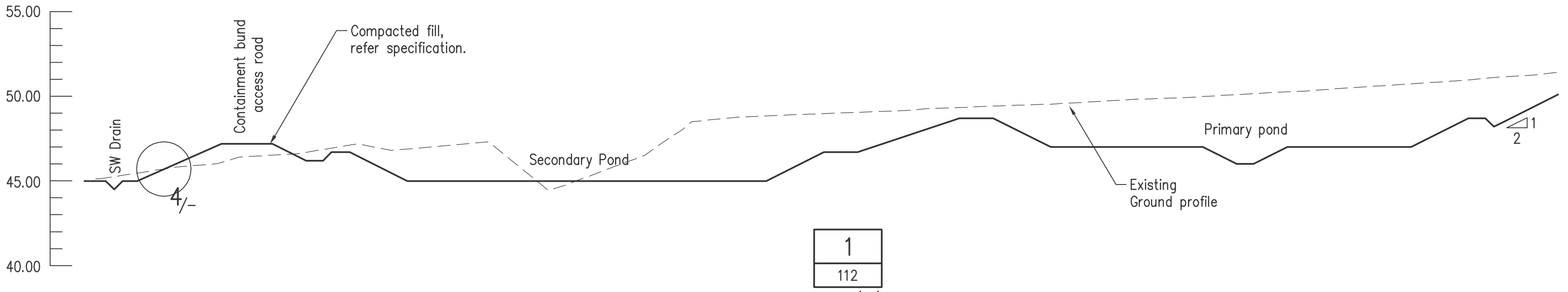
WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

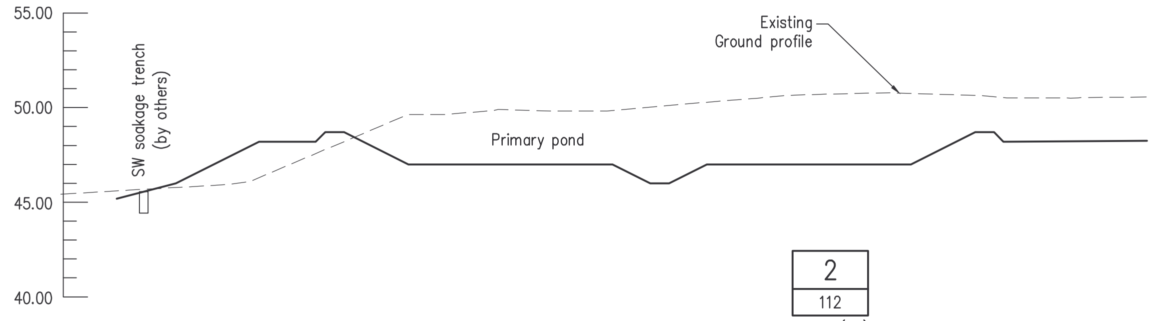
SEPTAGE RECEIVING FACILITY LAYOUT PLAN

A1 Scale AS SHOWN

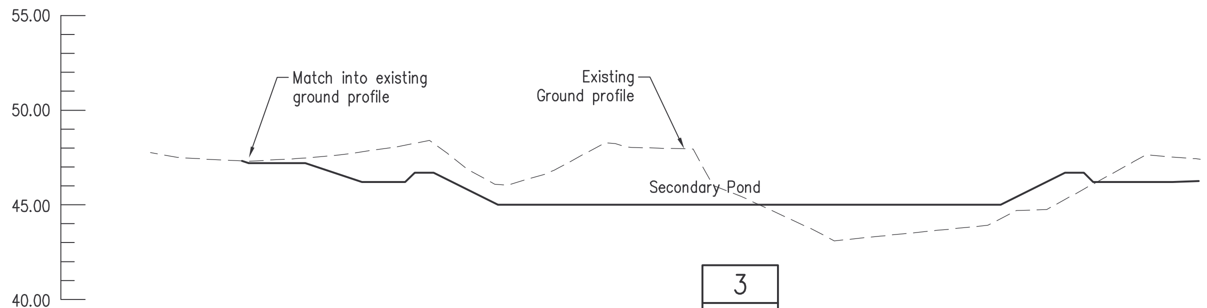
Project No. 4964312 Drawing No. 112 Issue A



1
112
1:200 (A1)



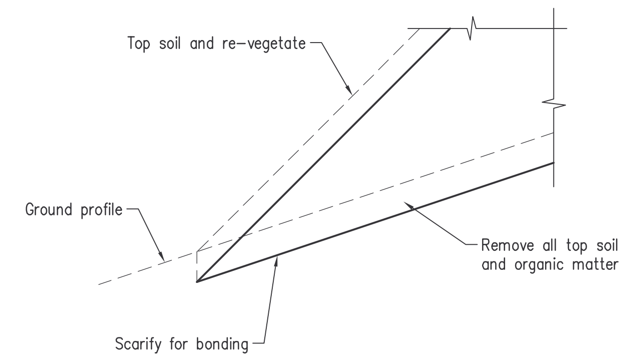
2
112
1:200 (A1)



3
112
1:200 (A1)

NOTE

1. Septage pond Formation levels may vary depending on the balance of cut/fill from the project.



TYPICAL DETAIL AT FILL TOE

4
-
1:25 (A1)

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
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Drawn	NJS	TAD	
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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

SEPTAGE PONDS CROSS SECTIONS

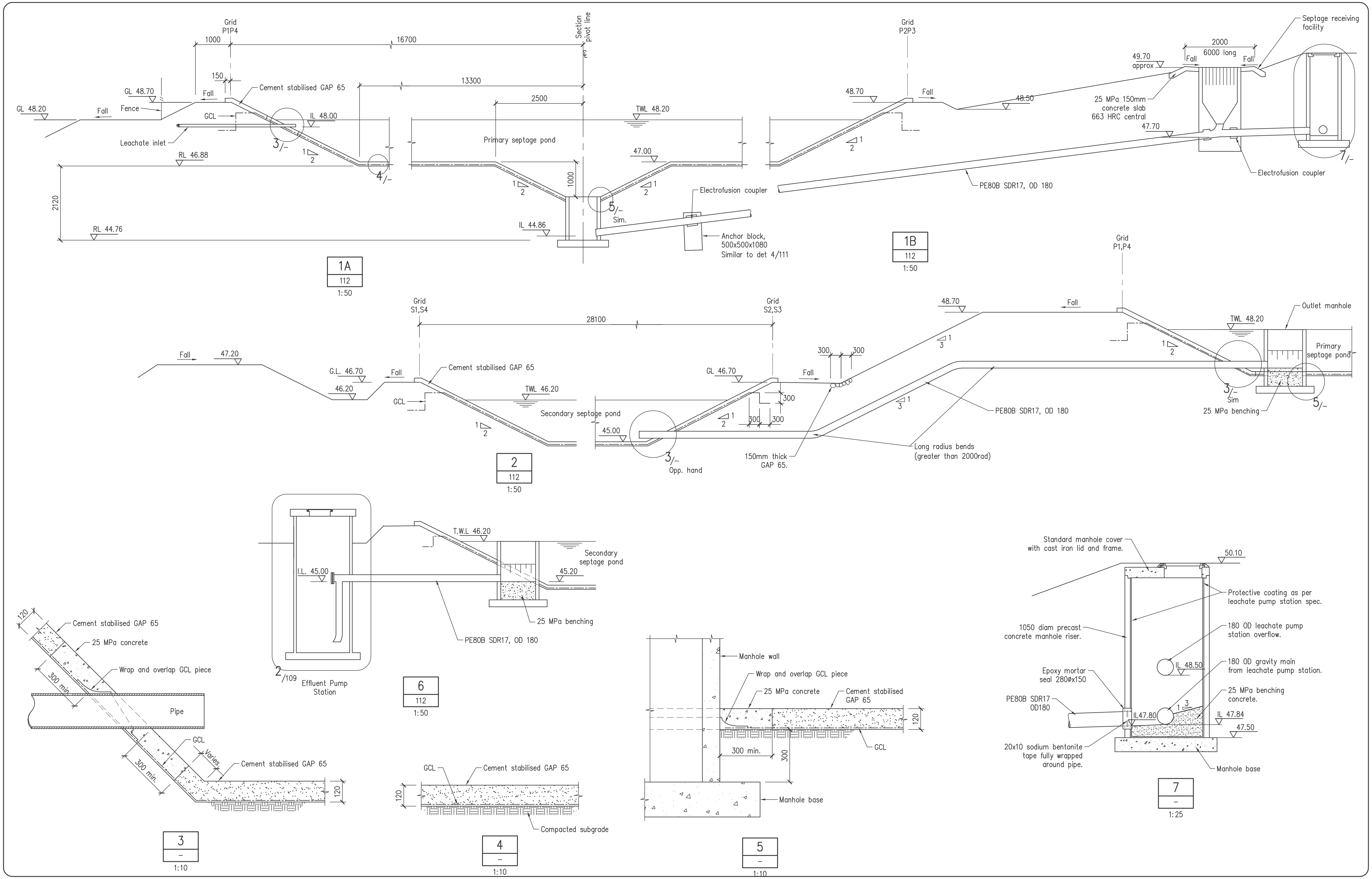
A1 20 10 0 20 40mm

Scale AS SHOWN

Project No. 4964312

Drawing No. 112A

Issue A



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GOVERNMENT OF THE COOK ISLANDS

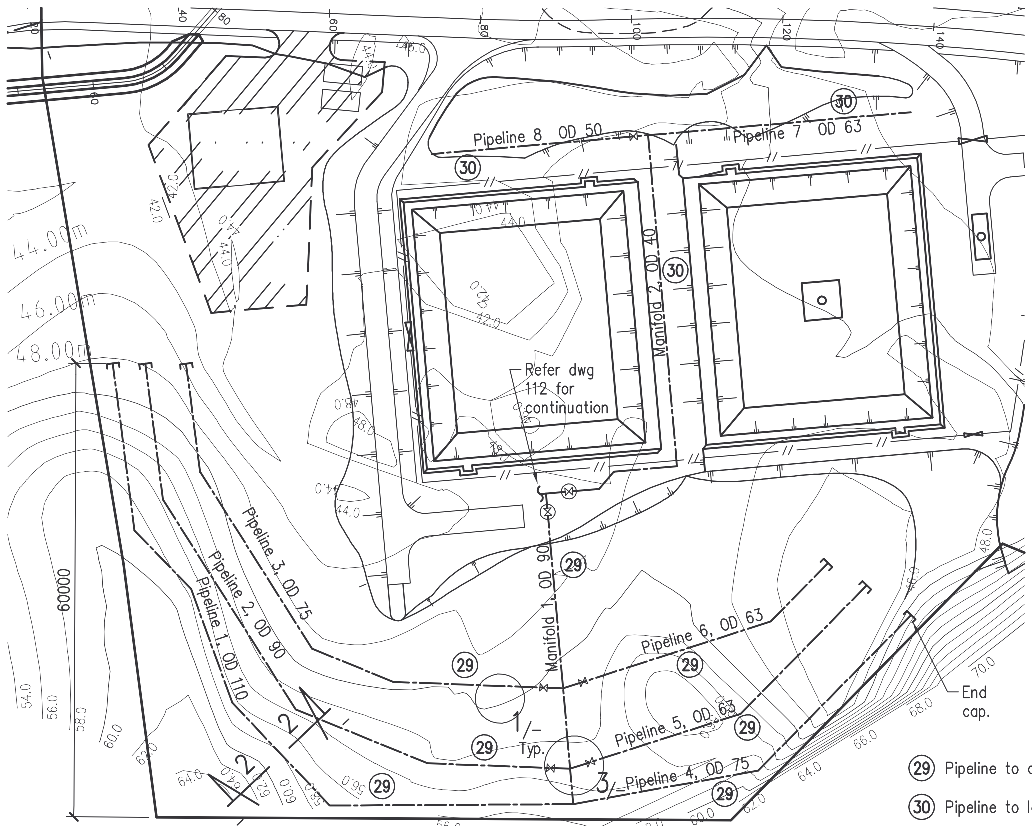
WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

SEPTAGE POND AND EFFLUENT DISPOSAL SYSTEM DETAILS

A1 Scale As shown (A1)

Project No. 4964312 Drawing No. 113 Issue A



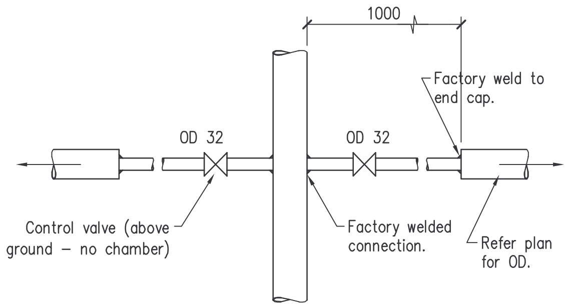
(29) Pipeline to disposal area

(30) Pipeline to landscaped area

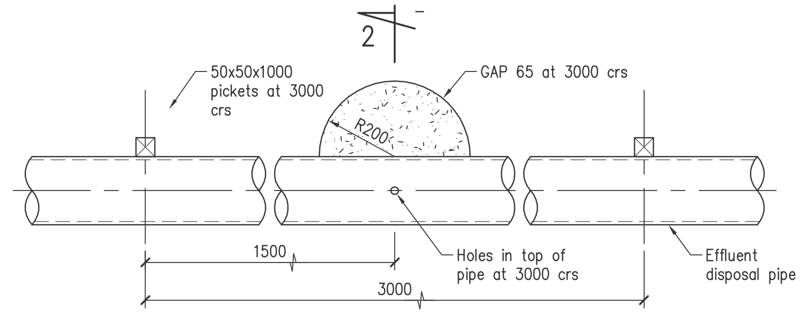
NOTE

1. All pipelines and manifolds shall be PE 80B SDR17.
2. All pipelines other than manifolds shall be laid along the contours.

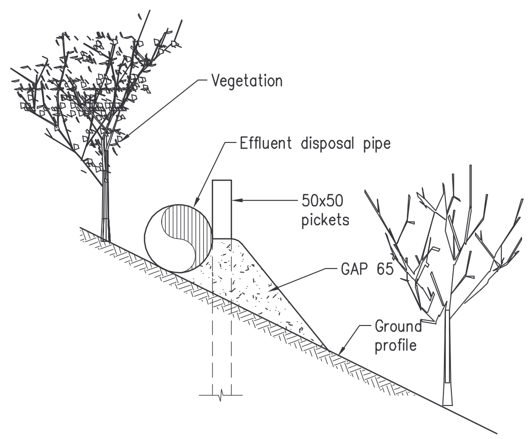
PLAN
1:500



3
–
Typical
1:10



1
–
NTS



2
–
NTS

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	TAD	HY	Apr 03
Drawn	CC	TAD	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

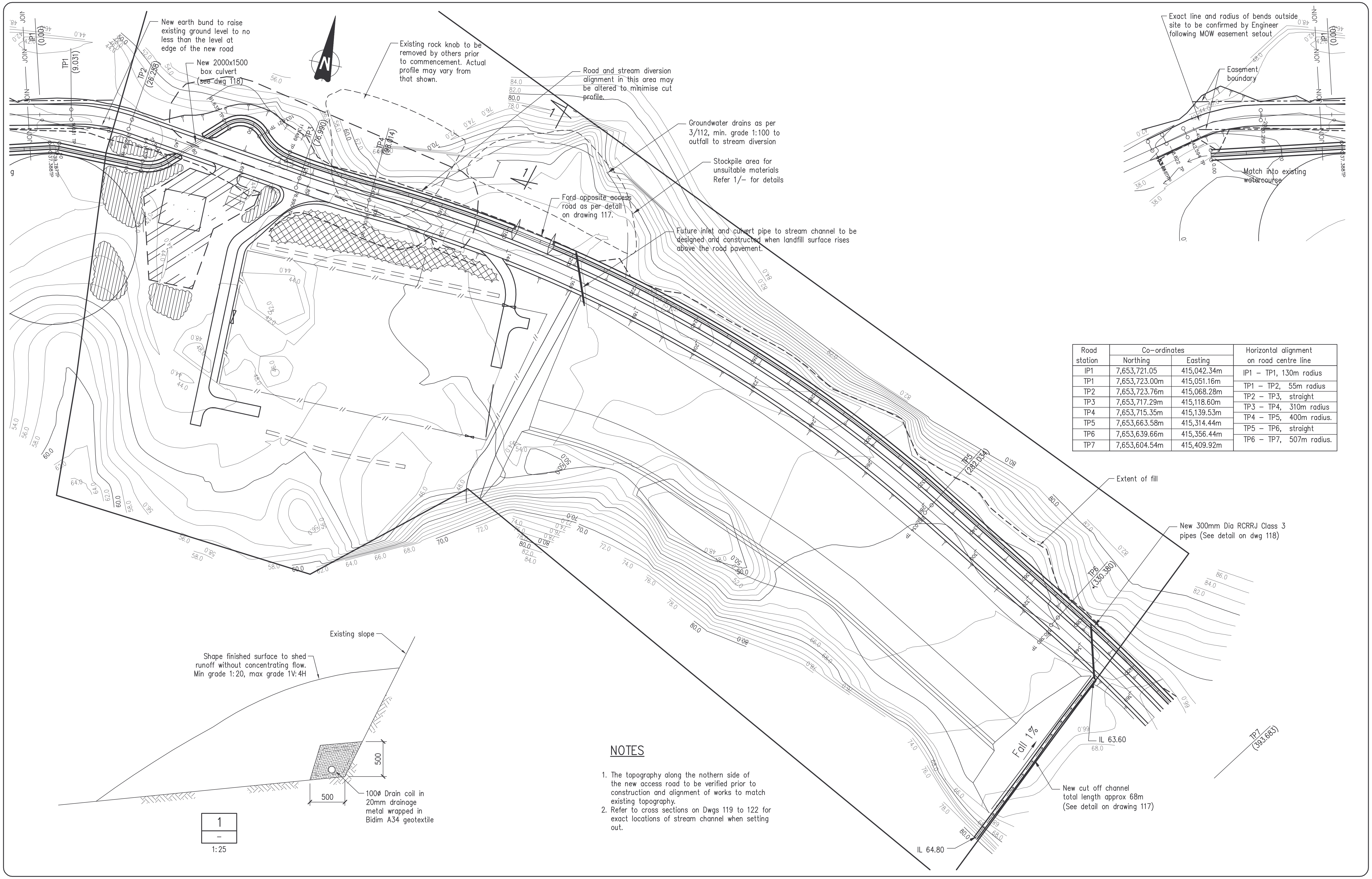
WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

EFFLUENT DISPOSAL SYSTEM DETAILS

A1 | Scale As shown (A1)

Project No. 4964312 | Drawing No. 114 | Issue A



Road station	Co-ordinates		Horizontal alignment on road centre line
	Northing	Easting	
IP1	7,653,721.05	415,042.34m	IP1 – TP1, 130m radius
TP1	7,653,723.00m	415,051.16m	TP1 – TP2, 55m radius
TP2	7,653,723.76m	415,068.28m	TP2 – TP3, straight
TP3	7,653,717.29m	415,118.60m	TP3 – TP4, 310m radius
TP4	7,653,715.35m	415,139.53m	TP4 – TP5, 400m radius.
TP5	7,653,663.58m	415,314.44m	TP5 – TP6, straight
TP6	7,653,639.66m	415,356.44m	TP6 – TP7, 507m radius.
TP7	7,653,604.54m	415,409.92m	

NOTES

1. The topography along the nothern side of the new access road to be verified prior to construction and alignment of works to match existing topography.
2. Refer to cross sections on Dwgs 119 to 122 for exact locations of stream channel when setting out.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	NJS	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

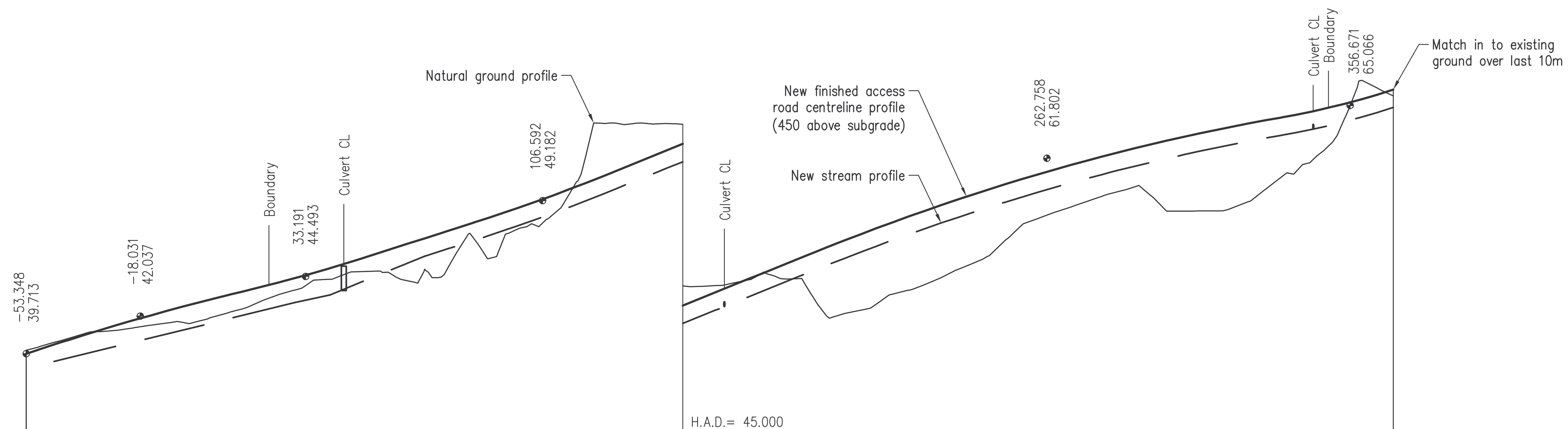
WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

ACCESS ROAD AND STREAM DIVERSION LAYOUT PLAN

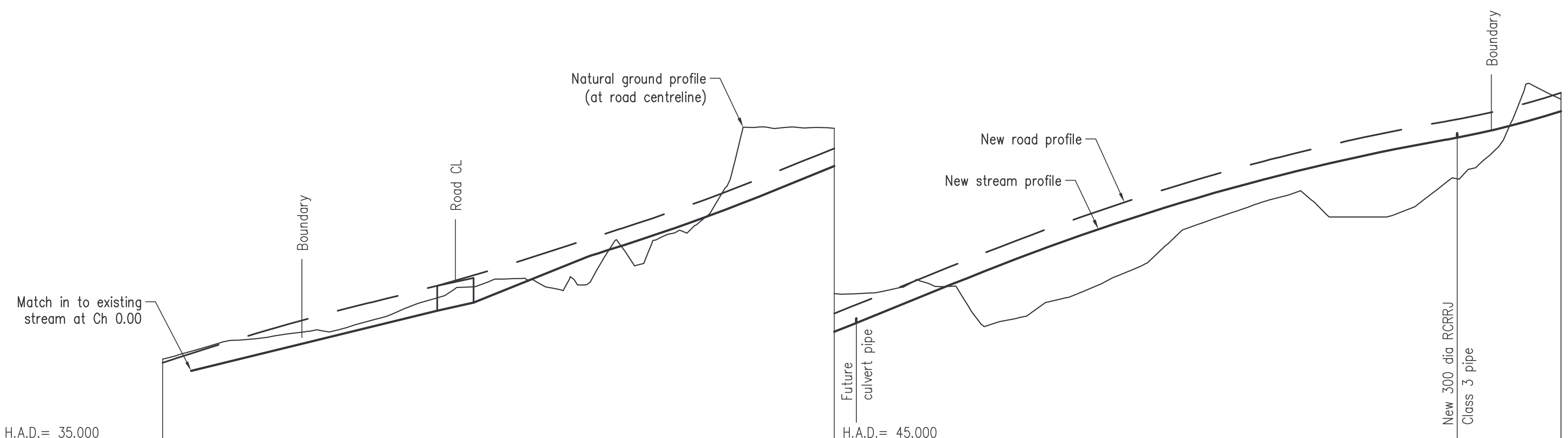
A1 Scale 1:500(A1) 1:1000(A3)

Project No. 4964312 | Drawing No. 115 | Issue A



EXISTING GROUND LEVEL	39.926, 40.103, 40.677, 41.086, 41.314, 41.599, 41.719, 42.293, 43.003, 43.658, 44.306, 44.785, 44.595, 44.899, 45.979, 45.601, 47.503, 48.361, 52.008, 53.947, 53.939, 53.901, 53.922, 54.261, 54.388, 53.317, 52.198, 52.796, 53.643, 54.420, 55.318, 56.750, 58.075, 58.772, 59.464, 60.040, 58.537, 58.540, 58.714, 59.811, 60.988, 62.563, 66.615, 65.664
FINISHED LEVEL	39.713, 39.934, 39.974, 40.415, 40.579, 41.197, 41.768, 42.345, 42.877, 43.330, 43.380, 43.537, 43.869, 44.194, 44.396, 44.962, 45.569, 45.767, 46.205, 46.844, 47.291, 47.483, 47.831, 48.126, 48.666, 48.805, 49.520, 50.278, 50.891, 51.074, 51.882, 52.690, 53.498, 54.306, 55.114, 55.902, 55.924, 56.714, 57.474, 58.202, 58.899, 59.565, 60.199, 60.801, 61.372, 61.911, 62.017, 62.419, 62.895, 63.339, 63.752, 64.138, 64.144, 64.339, 64.495, 64.924, 65.442, 66.048
ROAD CHAINAGE	-53.348, -50.000, -49.300, -42.594, -40.000, -30.000, -20.099, -20.000, -10.000, 0.000, 9.031, 10.000, 13.248, 20.000, 26.258, 30.000, 40.000, 50.000, 53.135, 60.000, 70.000, 76.990, 80.000, 85.439, 90.000, 98.014, 100.000, 110.000, 120.000, 127.745, 130.000, 140.000, 150.000, 160.000, 170.000, 180.000, 189.776, 190.000, 200.000, 210.000, 220.000, 230.000, 240.000, 250.000, 260.000, 270.000, 280.000, 282.034, 290.000, 300.000, 310.000, 320.000, 330.000, 330.380, 335.741, 340.000, 350.000, 360.000, 370.000
HORIZONTAL DATA	D; R=50.000 L=22.295; D=29.330; R=50.000 L=17.227; D=50.732; R=-300.000 L=21.024; R=400.000 L=184.020; D=48.346; R=505.275 L=64.017
VERTICAL DATA	P; R=-3500.000 L=62.559; R=2500.000 L=39.887; P=6.389% L=32.305; R=2500.000 L=42.305; P=8.081% L=62.030; R=-3169.682 L=145.967; R=1132.158 L=41.859

ACCESS ROAD – LONG SECTION
1:1000 hor
1:200 vert



STREAM INVERT LEVEL	38.00	42.87	43.35	46.291	63.30
STREAM CHAINAGE	0.00	74.50	85.50	120.00	
AVERAGE GRADIENT	6.5%		4.36%	8.5%	Parallel with access road –1m approx
MATERIAL	Plain Riprap		Box culvert	Grouted Riprap in fill (refer to typical cross sections on dwg 117)	

NEW STREAM DIVERSION – LONG SECTION
1:1000 hor
1:200 vert

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	NJS	LS	
Approved	K Oldham	Status	Construction

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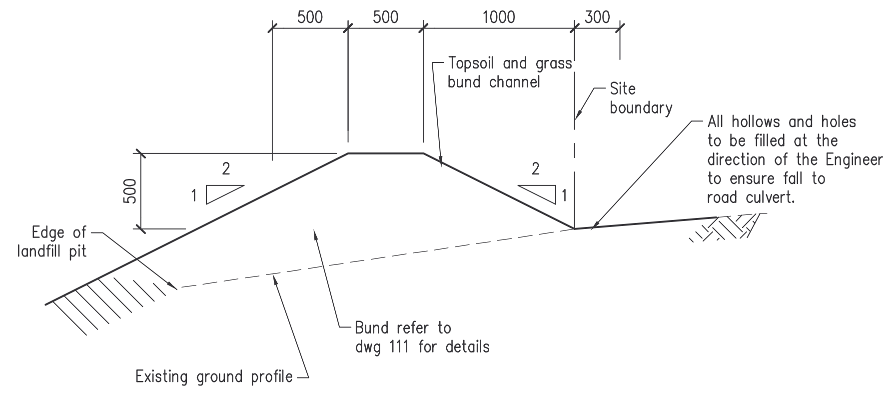
GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENTPROJECT

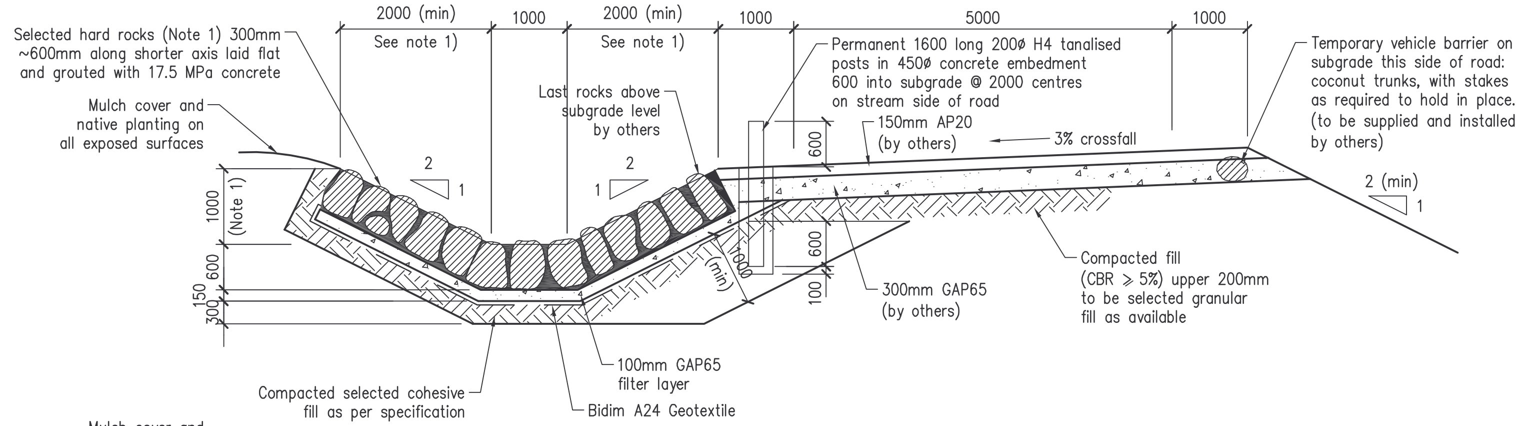
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

ACCESS ROAD AND STREAM DIVERSION LONGITUDINAL SECTIONS

A1 20 10 0 20 40mm
Scale As shown (A1)
Project No. 4964312
Drawing No. 116
Issue A



NEW CUT OFF CHANNEL ALONG EASTERN BOUNDARY
1:25 (A1)
1:50 (A3)



TYPICAL CROSS–SECTION IN FILL
1:50 (A1)
1:100 (A3)

1
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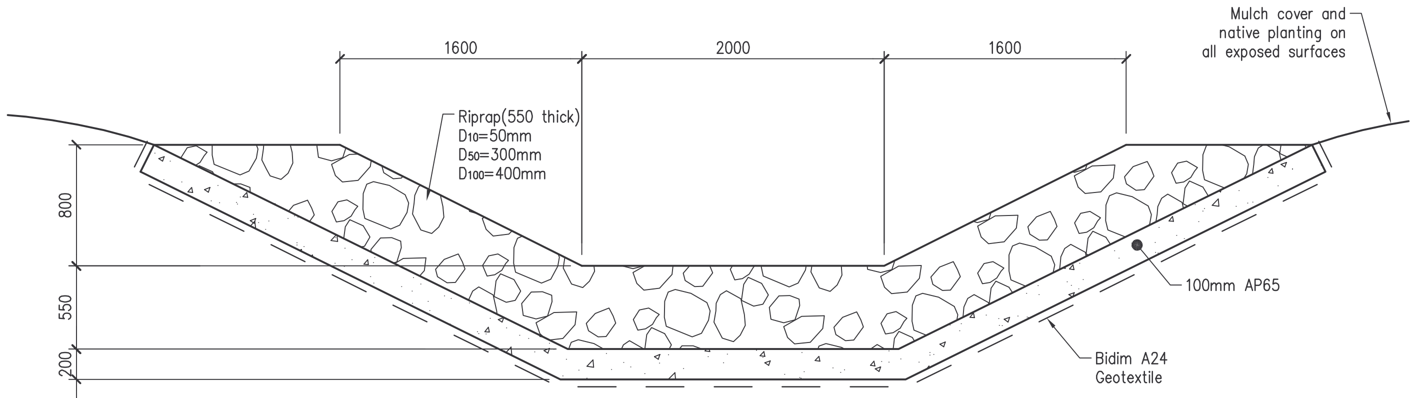
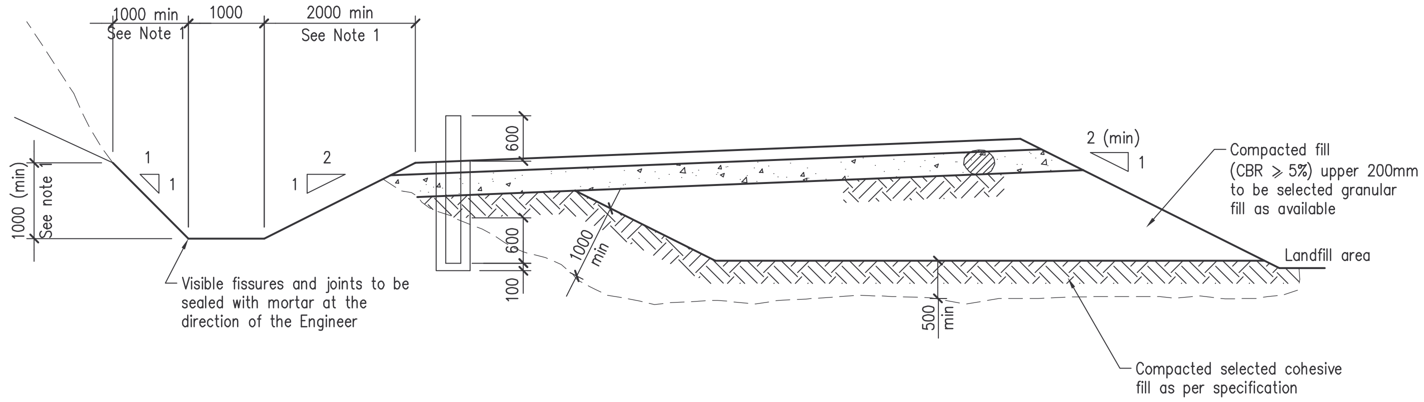
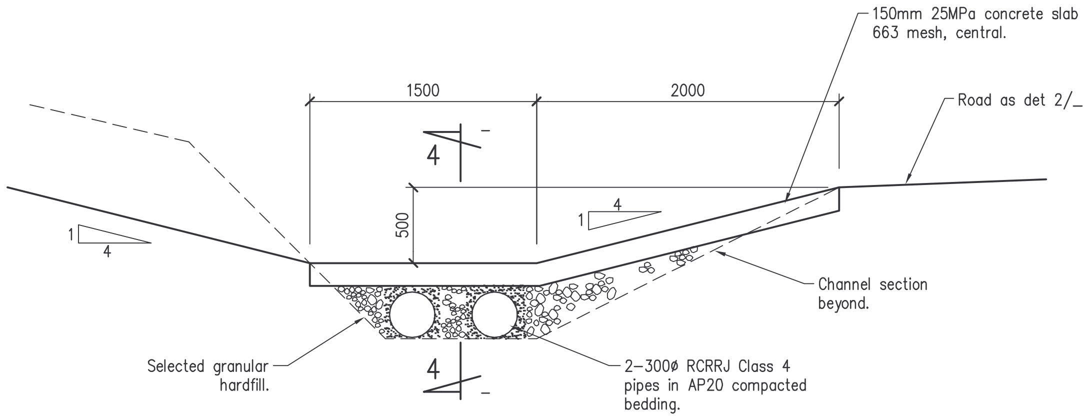


NEW STREAM CHANNEL
DOWNSTEAM CULVERT OUTFALL
1:25 (A1)
1:50 (A3)

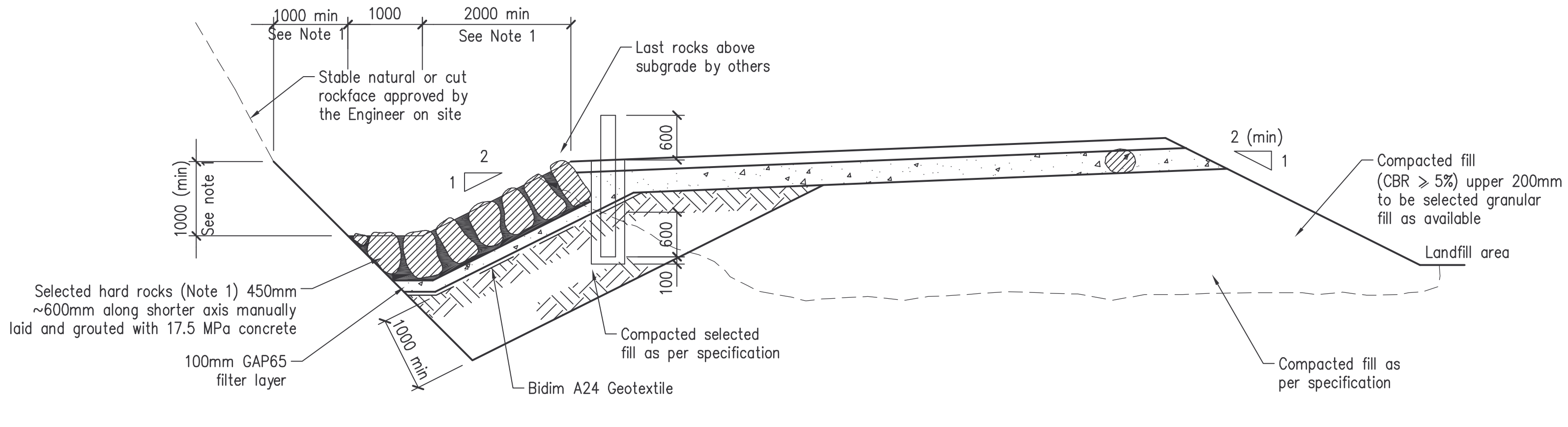


TYPICAL CROSS–SECTION CHANNEL IN CUT ROCK
1:50 (A1)
1:100 (A3)
(Refer 1/– for road dimensions & pavement)

2
–



SECTION THROUGH FORD
1:25



TYPICAL CROSS–SECTION (CHANNEL ADJACENT TO ROCK FACE)
1:50 (A1)
1:100 (A3)
(Refer 1/– for road dimensions & pavement)

3
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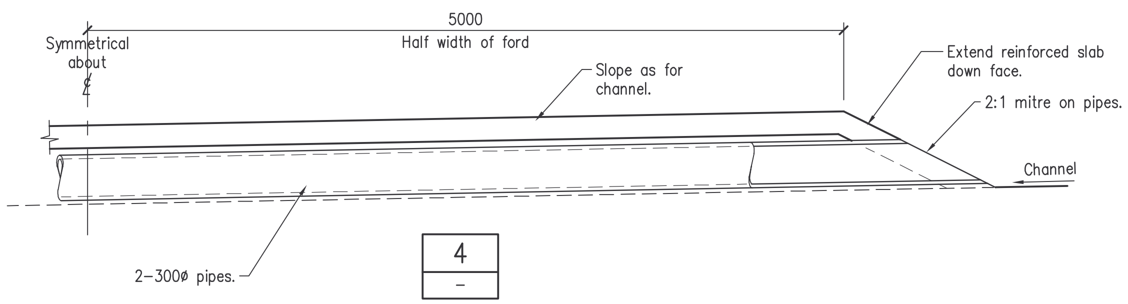

4
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1:25

NOTE

1. The exact depths of the stream diversion channels vary at each chainage. (Refer Drawing 116) The channel offset shall vary accordingly, to suit the batter slope and site contours.
2. Where subgrade is in–situ weathered or unweathered rock, metal courses shall consist of max 100mm AP20 only.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	NJS	LS	
Approved	K Oldham	Status	Construction

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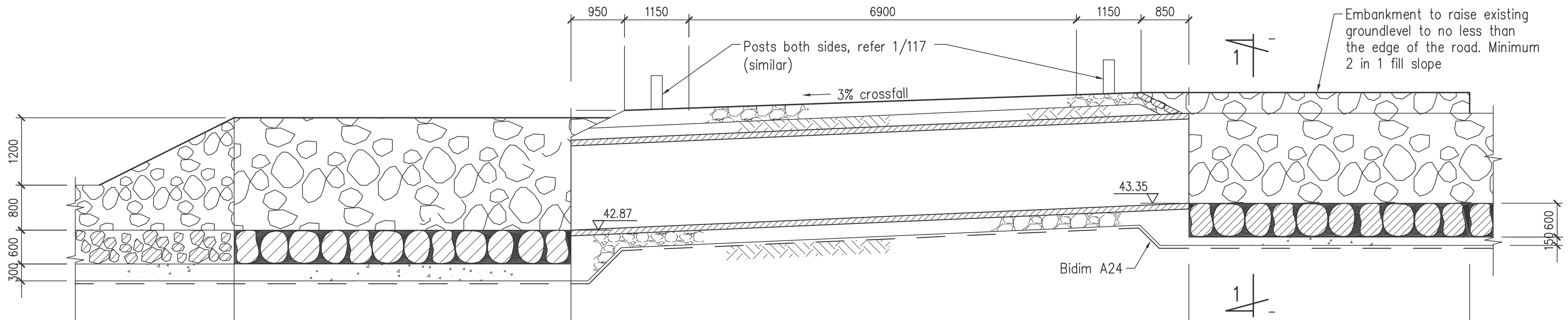
GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

STREAM DIVERSION DETAILS SHEET 1

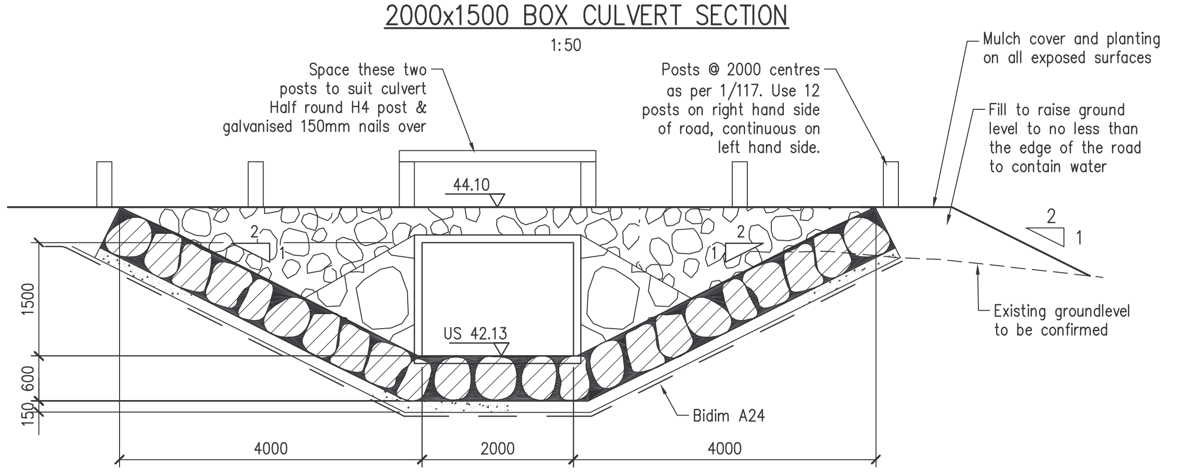
A1 20 10 0 20 40mm
Scale AS SHOWN
Project No. 4964312
Drawing No. 117
Issue A



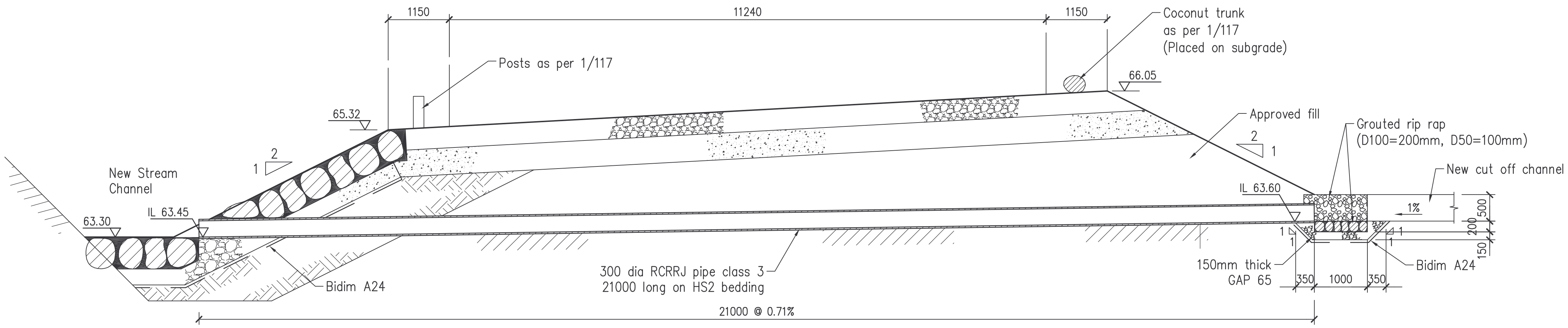
Distance		6000	11000	5000
Construction Details	Rip rap D10=50mm D50=300mm D100=400mm	Selected hard solid rocks 450mm to 600mm along shorter axis, manually laid and grouted with 17.5 MPa concrete, min 600mm thick	1–2000x1500 Box Culvert (For TNZ HO load conditions) Humes or approved equivalent on 250mm GAP 65 granular base on approved subgrade. All unsuitable material shall be removed at the direction of the Engineer.	See typical cross-sections on dwg 117
Invert Levels and Gradient	~3%	~3%	4.36%	Channel bottom widths vary from 1m to 2m

2000x1500 BOX CULVERT SECTION

1:50



1
–
1:50



300 DIA PIPE CULVERT SECTION

1:50

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

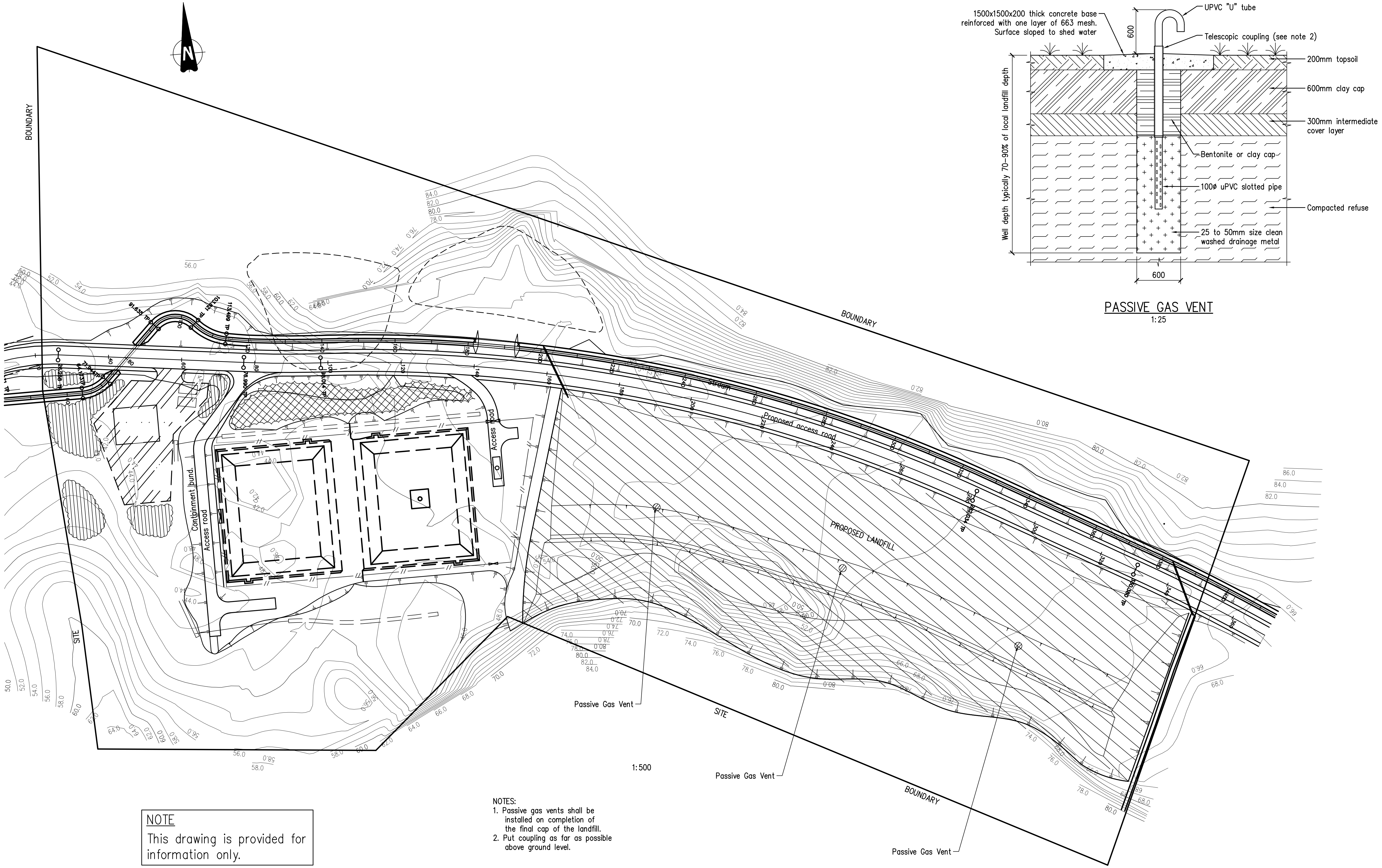
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

STREAM DIVERSION DETAILS SHEET 2

A1 20 10 0 20 40mm

Scale As shown (A1)

Project No. 4964312 | Drawing No. 118 | Issue A



NOTES:
1. Passive gas vents shall be installed on completion of the final cap of the landfill.
2. Put coupling as far as possible above ground level.

NOTE
This drawing is provided for information only.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	HY	KO	Apr 03
Drawn	MNL	HY	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

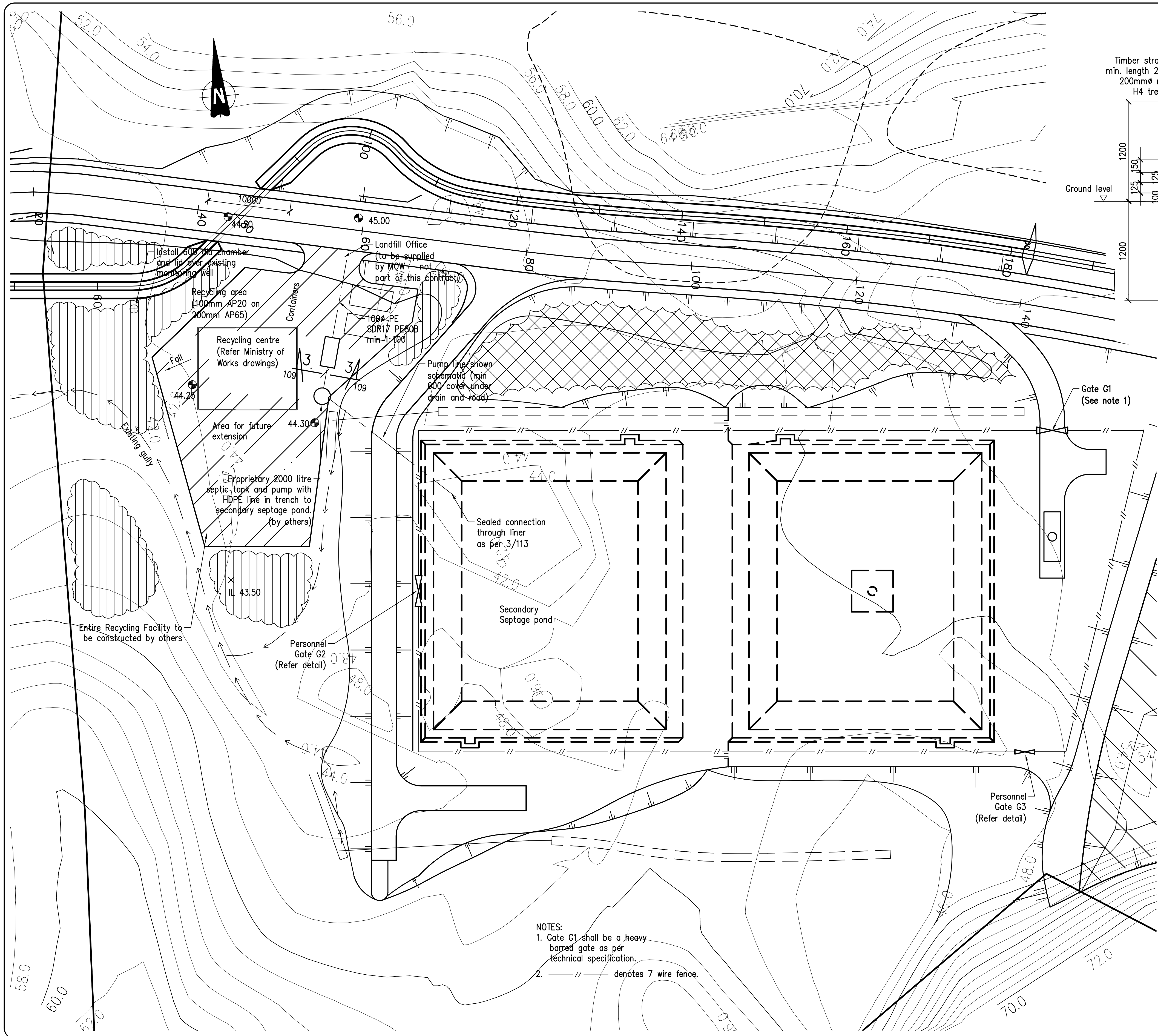
LANDFILL GAS LAYOUT AND DETAILS (BY OTHERS)

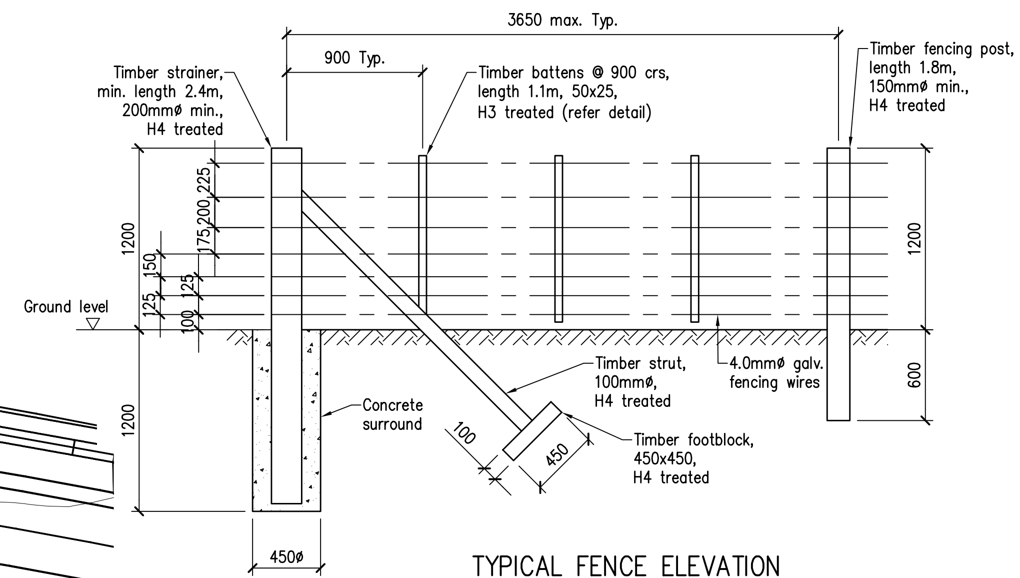
A1 20 10 0 20 40mm

Scale 1:500(A1) 1:1000(A3)

Project No.	Drawing No.	Issue
4964312	123	A

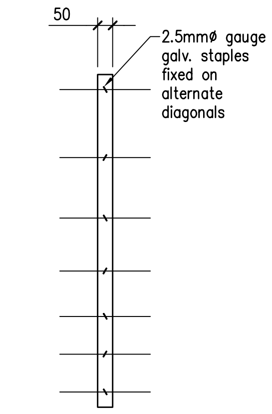
K:\Dept_49\Projects\4964312 - COO Waste Management Project\CAD\Issued\03.11.07_Construction\4964312_123_A.dwg, 13/11/2003 05:17:27 p.





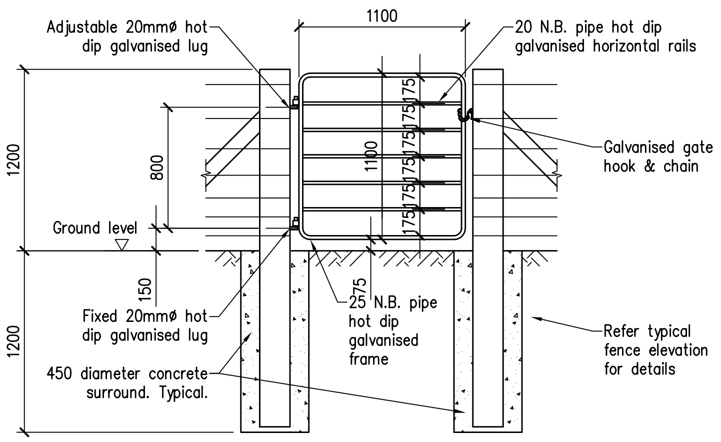
TYPICAL FENCE ELEVATION

1:25



BATTEN DETAIL

SHOWING CORRECT STAPLING METHOD



ELEVATION GATES G2 & G3

1:25

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Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	HY	KO	Apr 03
Drawn	MNL	HY	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

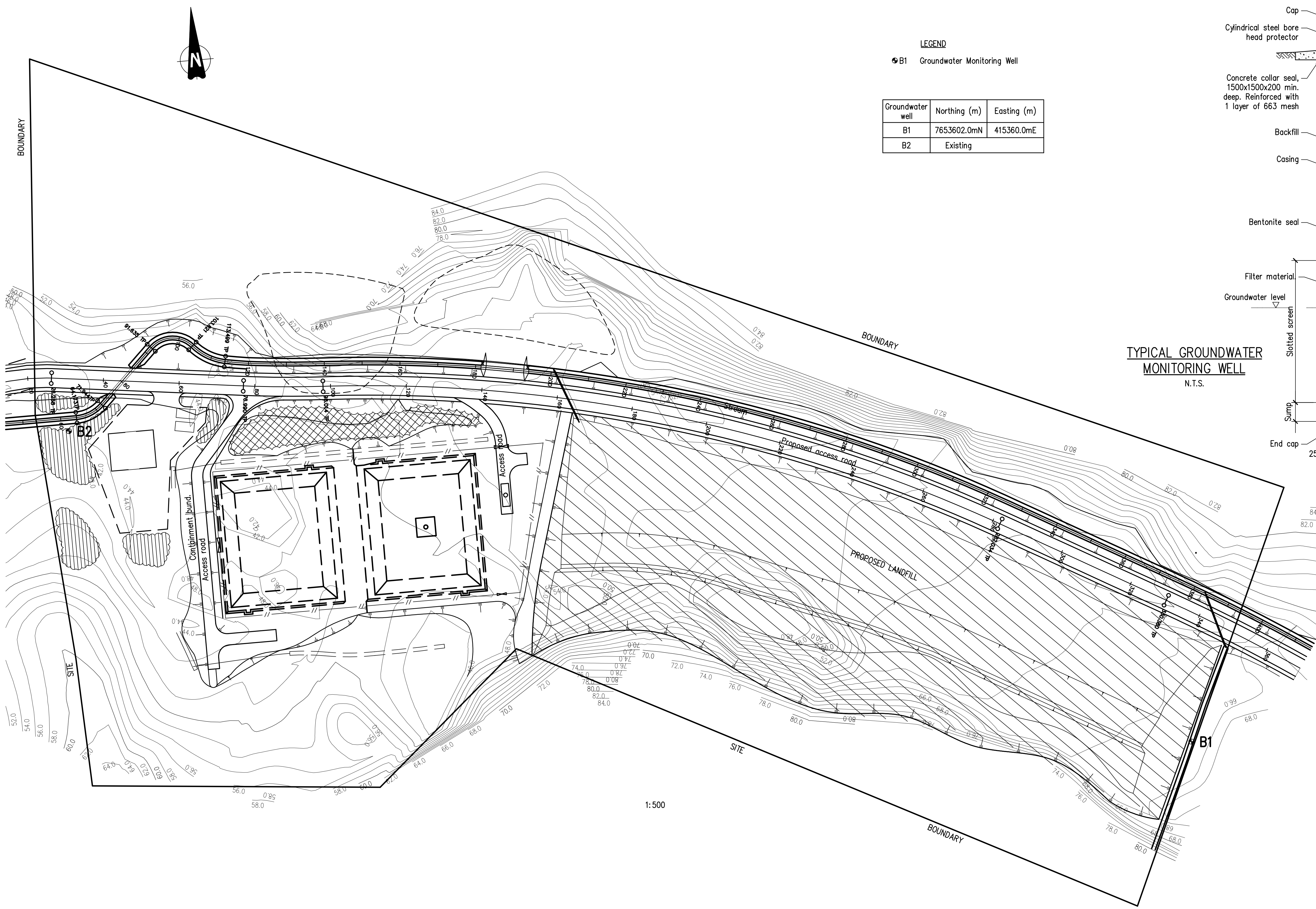
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

RECYCLING AREA LAYOUT, FENCING AND GATE DETAILS

A1 20 10 0 20 40mm

Scale 1:250(A1) 1:500(A3)

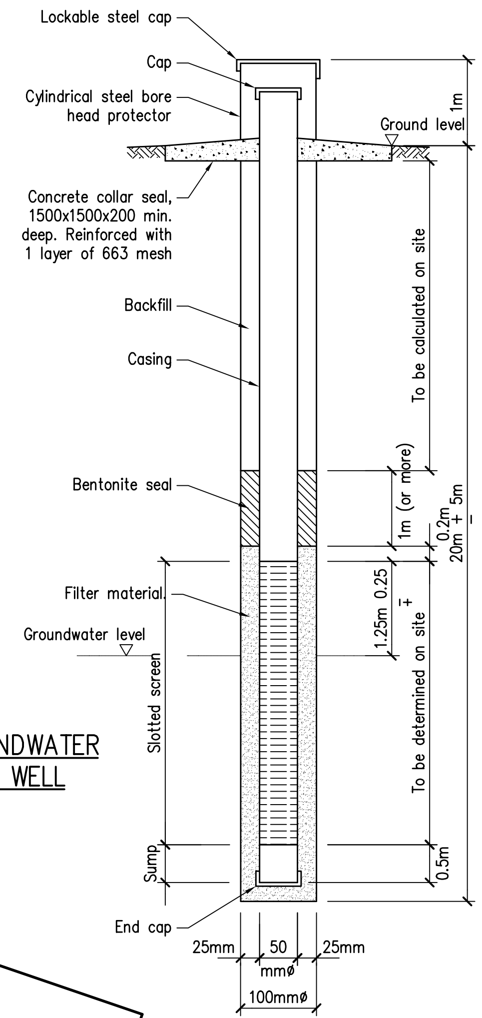
Project No. 4964312 | Drawing No. 124 | Issue A



LEGEND

B1 Groundwater Monitoring Well

Groundwater well	Northing (m)	Easting (m)
B1	7653602.0mN	415360.0mE
B2	Existing	



TYPICAL GROUNDWATER MONITORING WELL

N.T.S.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	HY	KO	Apr 03
Drawn	MNL	HY	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

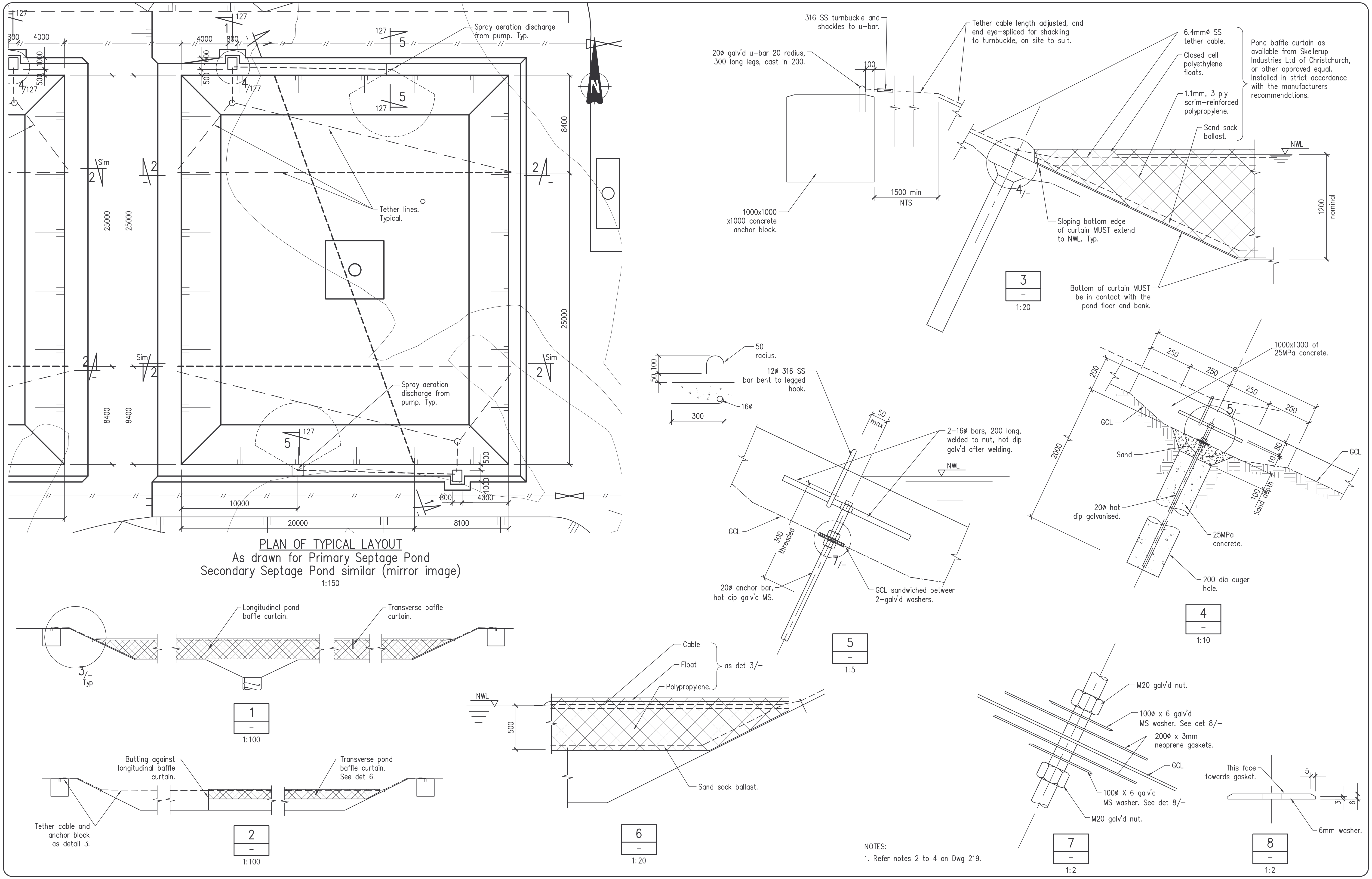
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

MONITORING WELL LAYOUT AND SECTIONS

A1

Scale 1:500(A1) 1:1000(A3)

Project No. 4964312 | Drawing No. 125 | Issue A



NOTES:

1. Refer notes 2 to 4 on Dwg 219.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	CBR	KO	Oct 03
Drawn	MNL	CBR	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

POND MIXING SYSTEM PLAN AND DETAILS

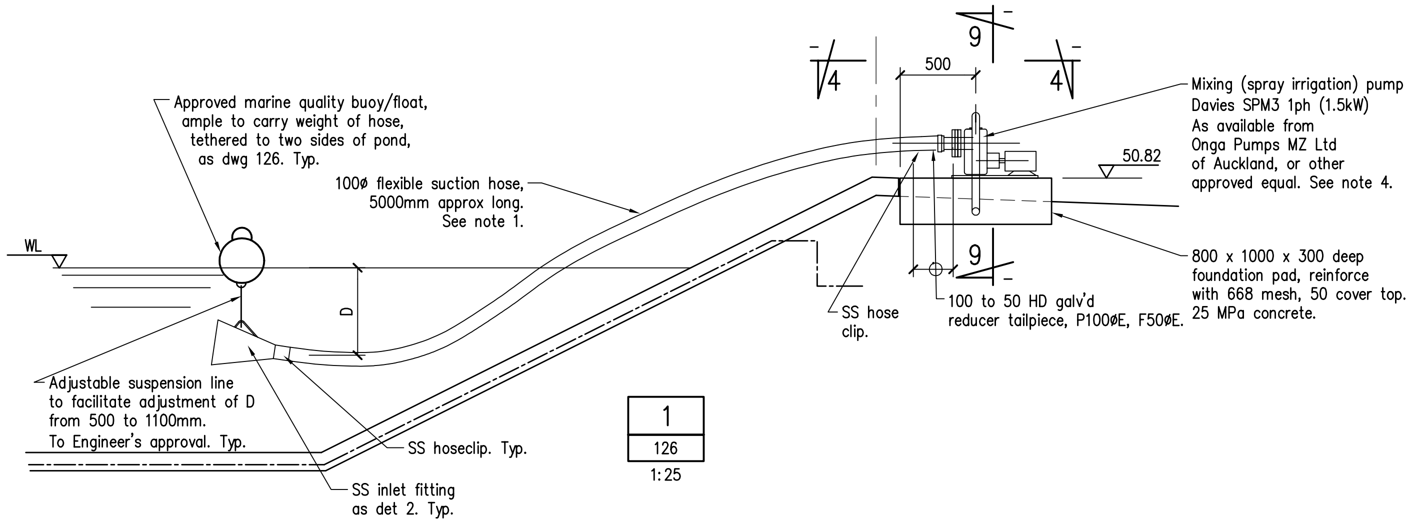
A1

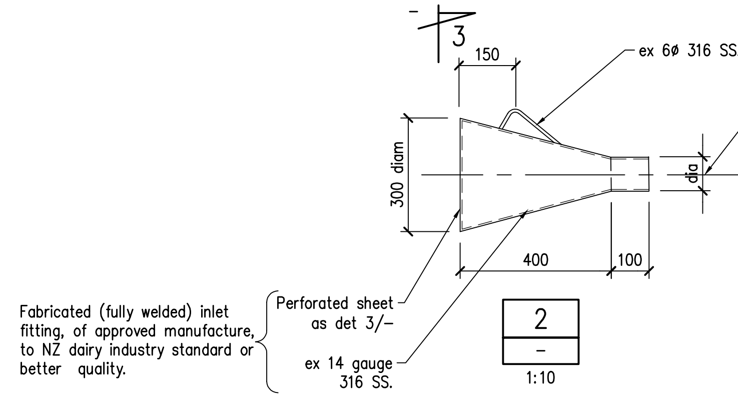
Scale As shown (A1)

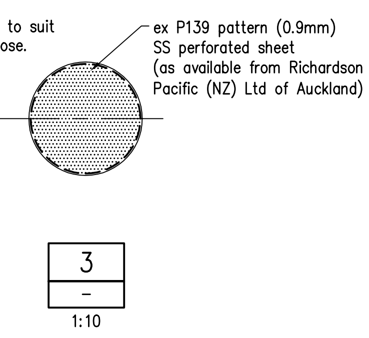
Project No. 4964312

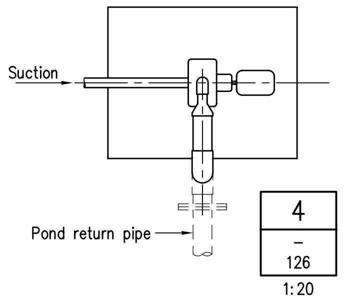
Drawing No. 126

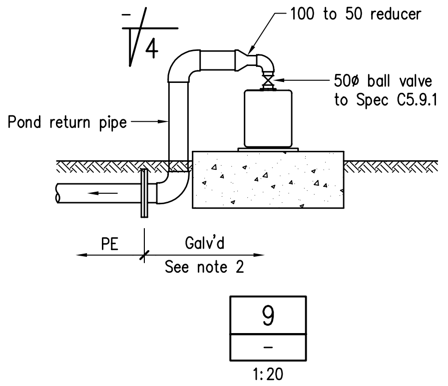
Issue A

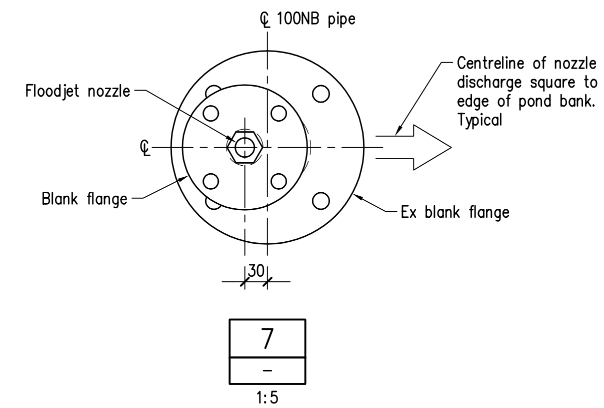


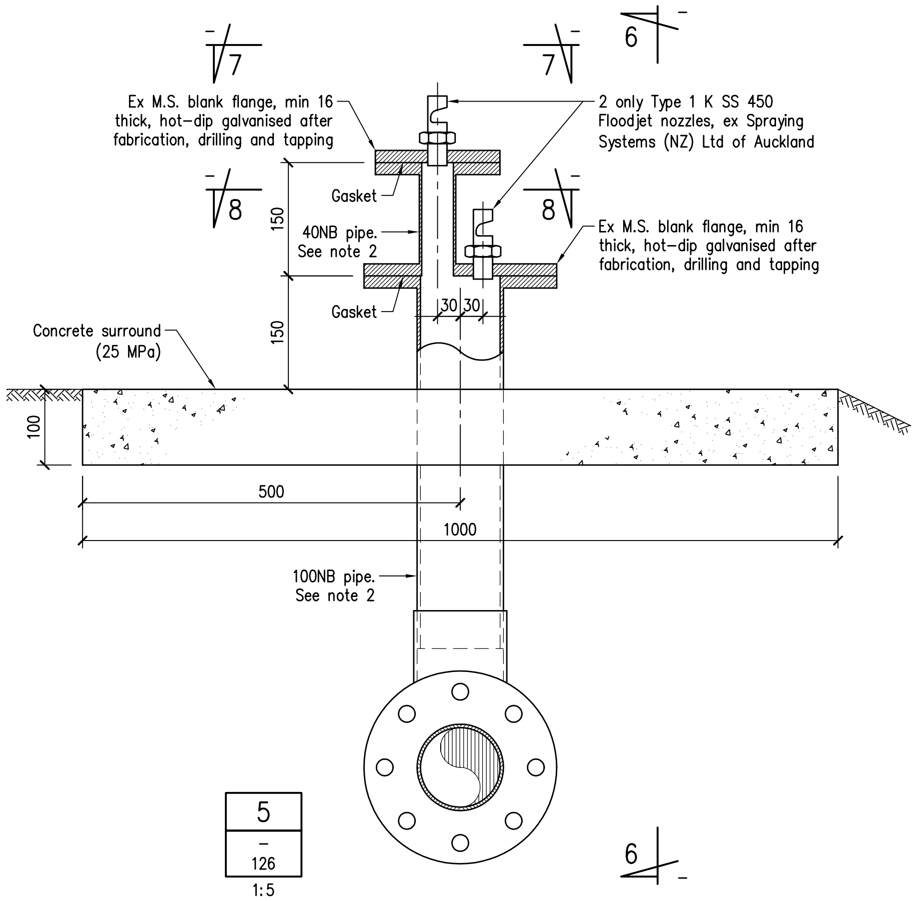


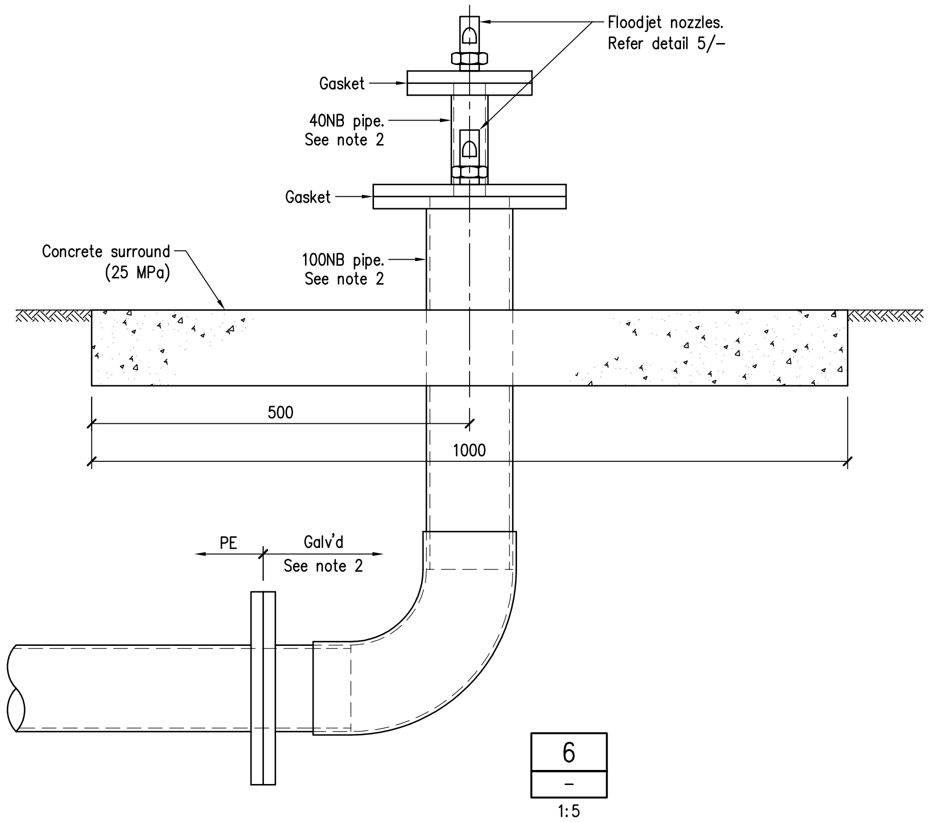


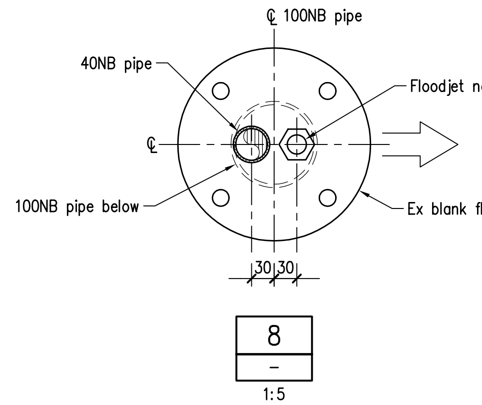












NOTES:

1. Flexible hose shall be Barflex "Black Boss" as available from the Paykels division of Wesfarmers Safety NZ Ltd, of Wiri Auckland, or other approved equal.
2. Apart from the SS fittings, all above ground pipework (ie. exposed to daylight) shall be galvanised medium weight, to BS 1387 with galvanised malleable iron fittings to BS 143 and BS 1256. Buried pipework to be to Spec Section C5.
3. All workmanship shall conform with the highest standards of accepted New Zealand trade practice.
4. The pond mixing pumps shall have hoseproof motors. The pump and motor at each pumpset shall be factory-mounted on a common baseplate and shall have a factory-fitted protective/safety guard over moving parts at the motor/pump connection.

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	CBR	KO	Oct 03
Drawn	MNL	CBR	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

POND MIXING SYSTEM PUMP PIPEWORK DETAILS

A1

Scale As shown (A1)

Project No. 4964312

Drawing No. 127

Issue A

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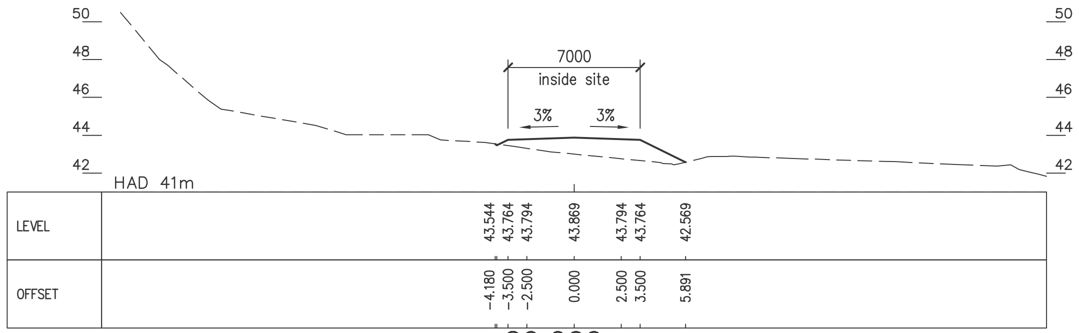
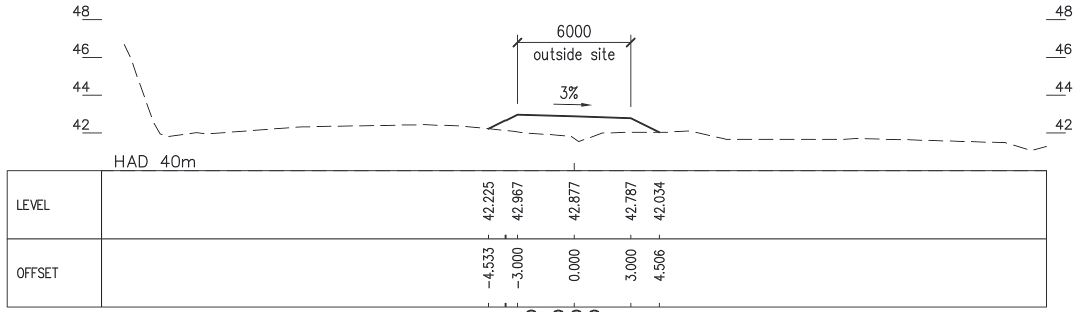
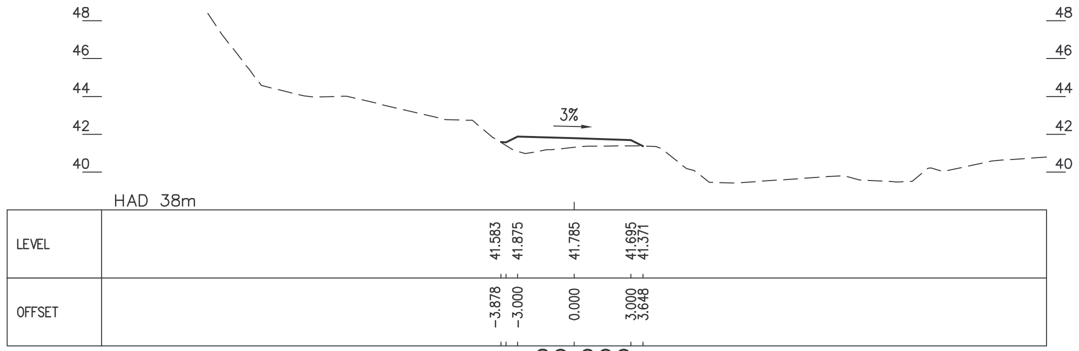


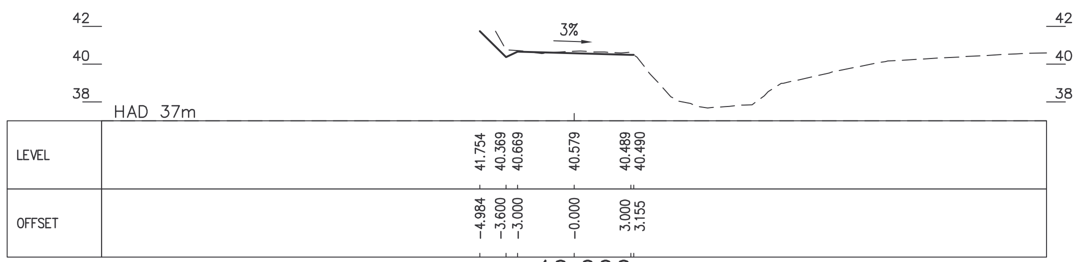
20.000



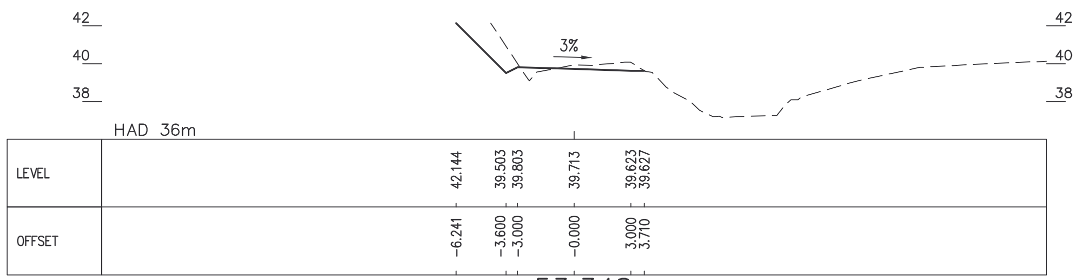
0.000



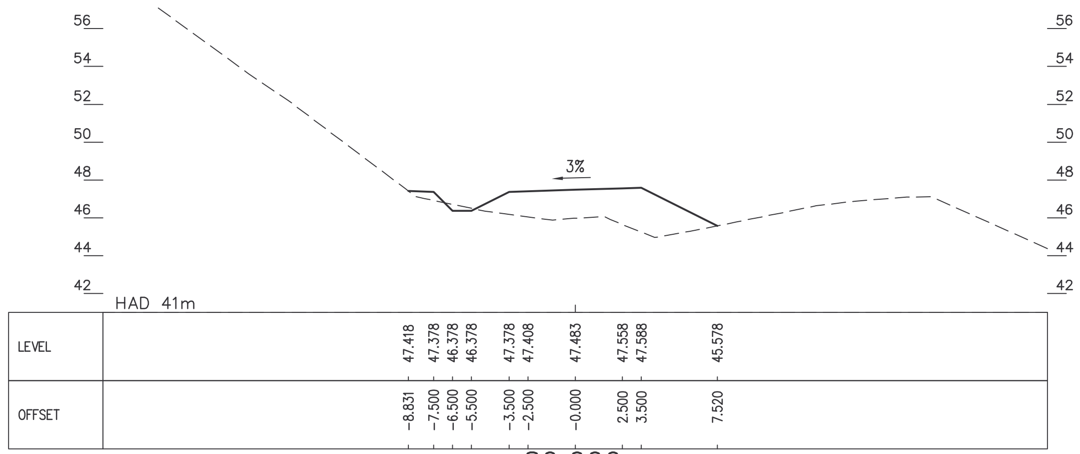
−20.000



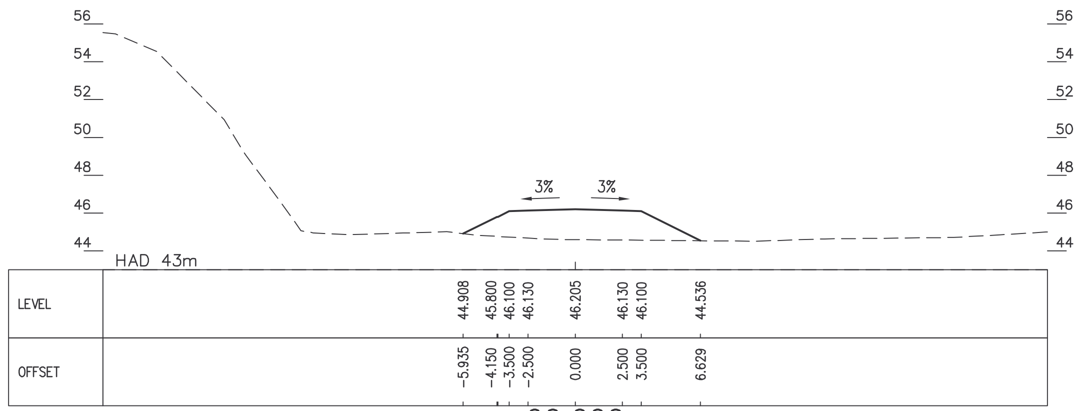
−40.000



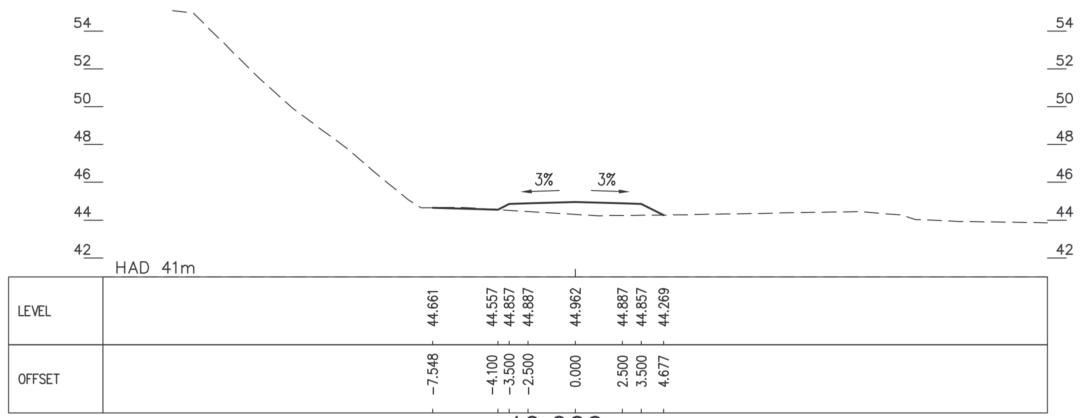
−53.348



80.000



60.000



40.000

THIS DRAWING SUPERSEDES
DRAWING No. 119

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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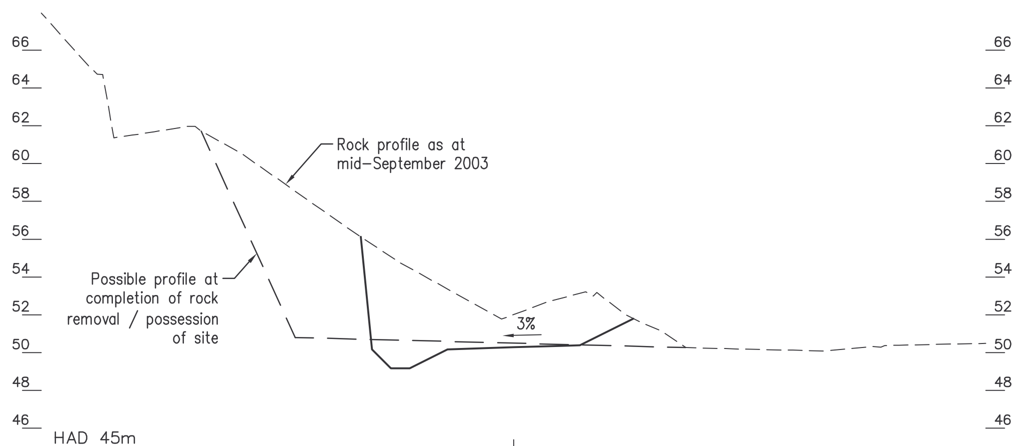
THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE
RAROTONGA LANDFILL AND
SEPTAGE PONDS

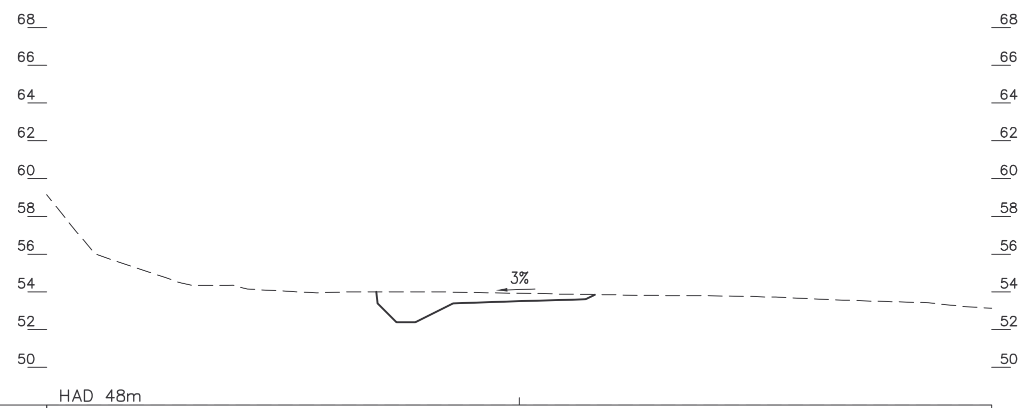
ACCESS ROAD
CROSS SECTIONS
SHEET 1

A1 20 10 0 20 40mm
Scale 1:200 (A1)
Project No. 4964312
Drawing No. 128
Issue A



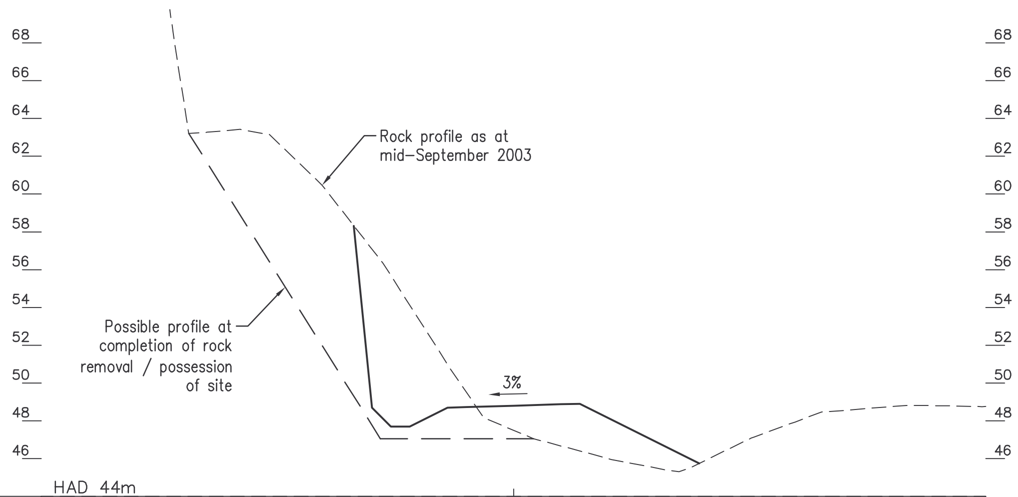
LEVEL	56.132	50.173	49.173	49.173	50.173	50.203	50.278	50.353	50.383	51.800
OFFSET	−8.096	−7.500	−6.500	−5.500	−3.500	−2.500	−0.000	2.500	3.500	6.335

120.000



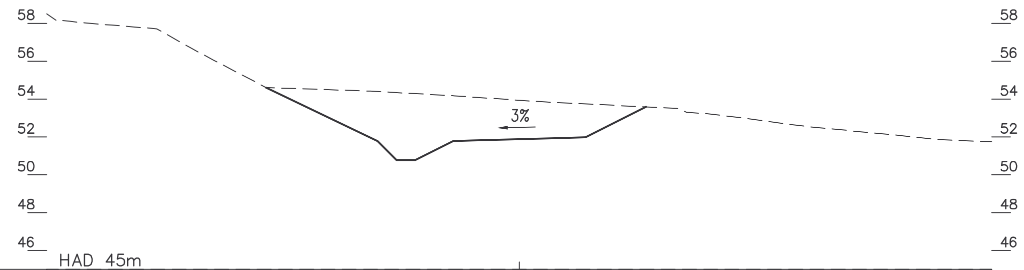
LEVEL	53.998	53.393	52.393	52.393	53.393	53.423	53.498	53.573	53.603	53.852
OFFSET	−7.561	−7.500	−6.500	−5.500	−3.500	−2.500	−0.000	2.500	3.500	3.998

160.000



LEVEL	58.323	48.698	47.698	47.698	48.698	48.728	48.803	48.878	48.908	45.749
OFFSET	−8.462	−7.500	−6.500	−5.500	−3.500	−2.500	0.000	2.500	3.500	9.818

100.000



LEVEL	54.415	51.777	50.777	50.777	51.777	51.807	51.882	51.957	51.987	53.587
OFFSET	−7.764	−7.500	−6.500	−5.500	−3.500	−2.500	−0.000	2.500	3.500	6.701

140.000

THIS DRAWING SUPERSEDES DRAWING No. 120

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

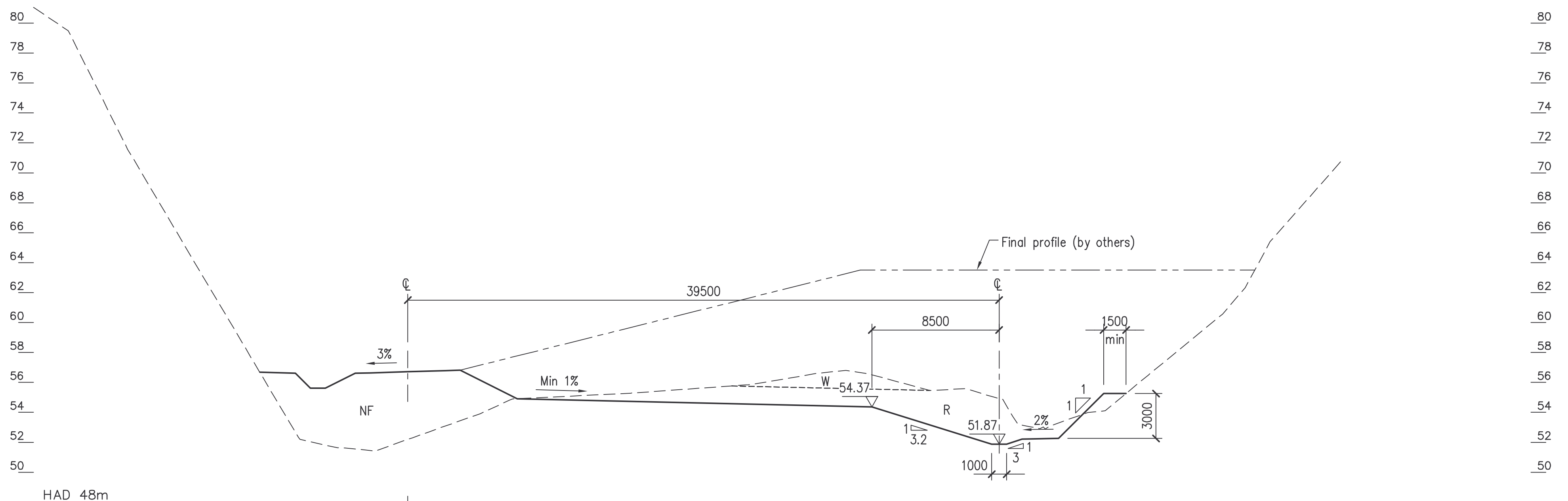
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

ACCESS ROAD CROSS SECTIONS SHEET 2

A1 20 10 0 20 40mm

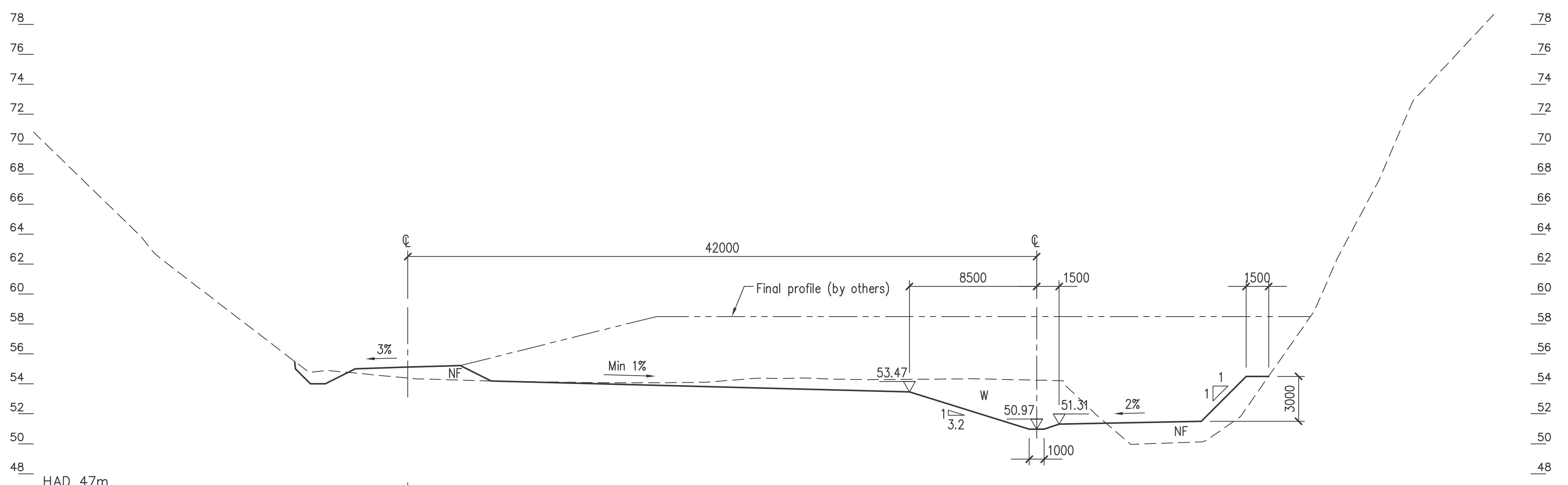
Scale 1: 200 (A1)

Project No. 4964312 | Drawing No. 129 | Issue A



LEVEL	56.680	56.609	55.609	55.609	56.609	56.639	56.714	56.789	56.819	54.908
OFFSET	-9.880	-7.500	-6.500	-5.500	-3.500	-2.500	-0.000	2.500	3.500	7.321

200.000



LEVEL	55.493	55.009	54.009	54.009	55.009	55.039	55.114	55.189	55.219	54.186
OFFSET	-7.548	-7.500	-6.500	-5.500	-3.500	-2.500	0.000	2.500	3.500	5.565

180.000

LEGEND

- NF New fill
- W Weathered rock
- R Unweathered rock
- G Green waste
- F Backfill
- r Refuse

(Source: Meritec Geotechnical Report)

THIS DRAWING SUPERSEDES DRAWING No. 121

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

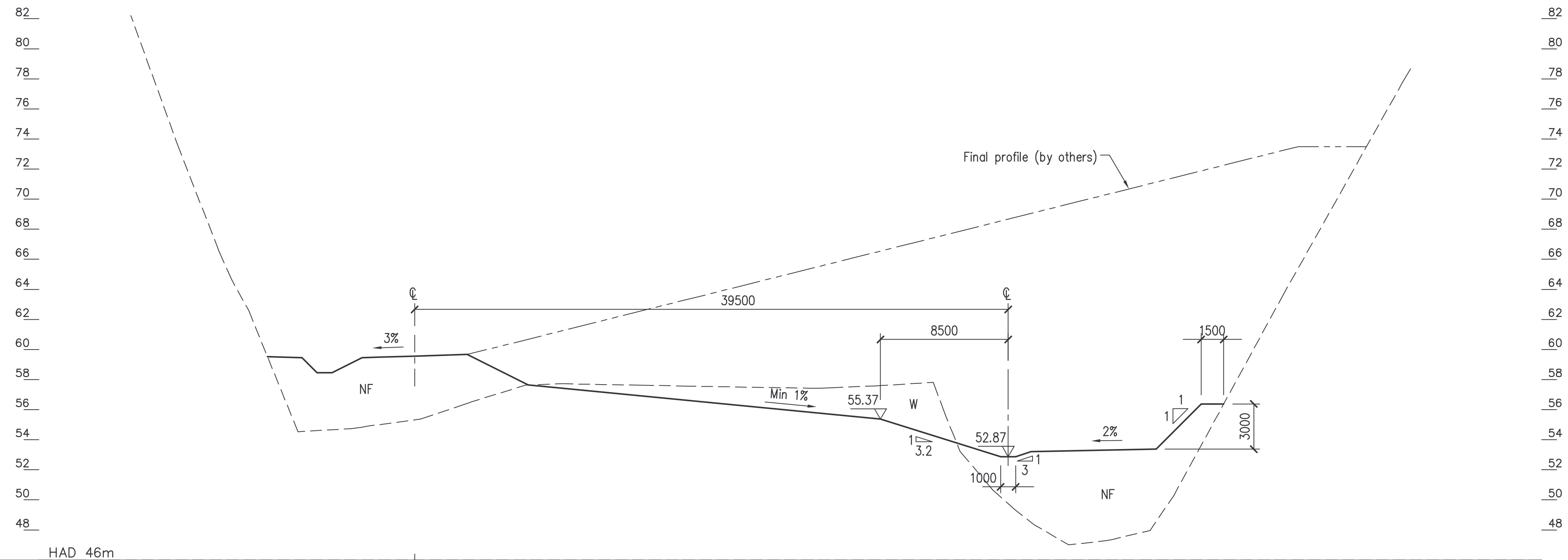
ACCESS ROAD CROSS SECTIONS SHEET 3

A1 Scale 1:200 (A1)

Project No. 4964312 Drawing No. 130 Issue A

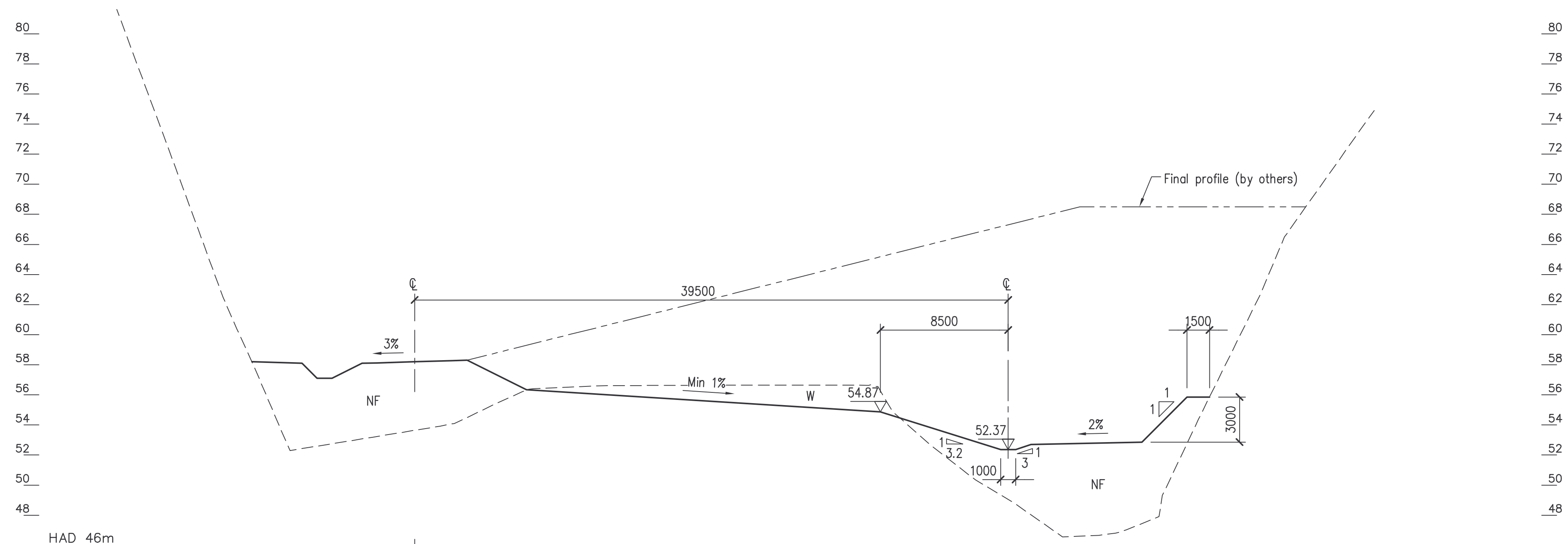
LEGEND

NF New fill
W Weathered rock
R Unweathered rock
G Green waste
F Backfill
r Refuse
(Source: Meritec Geotechnical Report)



LEVEL	59.529	59.460	58.460	58.460	59.460	59.490	59.565	59.640	59.670	57.637
OFFSET	-9.793	-7.500	-6.500	-5.500	-3.500	-2.500	0.000	2.500	3.500	7.565

240.000



LEVEL	58.197	58.097	57.097	57.097	58.097	58.127	58.202	58.277	58.307	56.335
OFFSET	-10.826	-7.500	-6.500	-5.500	-3.500	-2.500	-0.000	2.500	3.500	7.444

220.000

THIS DRAWING SUPERSEDES DRAWING No. 122

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

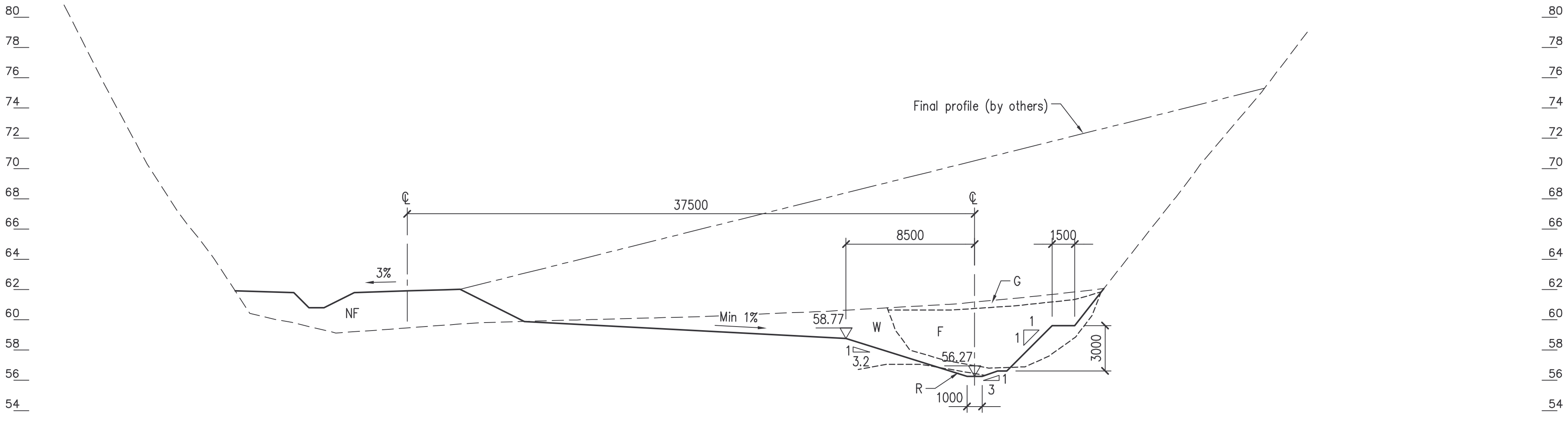
WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

ACCESS ROAD CROSS SECTIONS SHEET 4

A1 Scale 1: 200 (A1)

Project No. 4964312 | Drawing No. 131 | Issue A



LEVEL	61.922	61.806	60.806	60.806	61.806	61.836	61.911	61.986	62.016	59.892
OFFSET	-11.379	-7.500	-6.500	-5.500	-3.500	-2.500	0.000	2.500	3.500	7.748

280.000

LEGEND

NF New fill

W Weathered rock

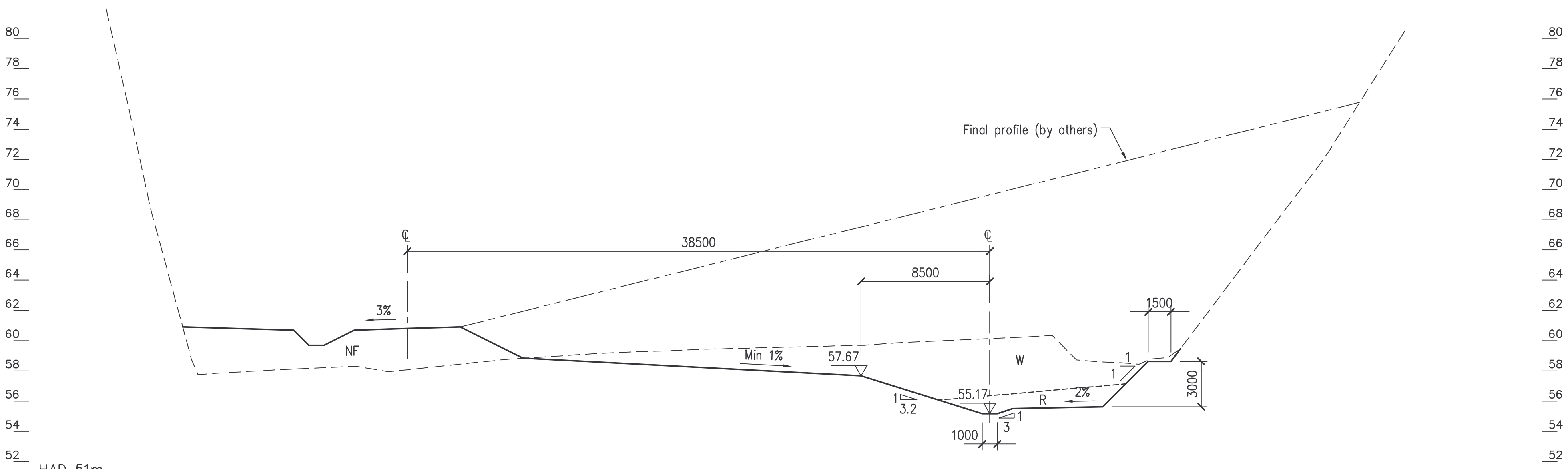
R Unweathered rock

G Green waste

F Backfill

r Refuse

(Source: Meritec Geotechnical Report)



LEVEL	60.916	60.696	59.696	59.696	60.696	60.726	60.801	60.876	60.906	58.836
OFFSET	-14.844	-7.500	-6.500	-5.500	-3.500	-2.500	-0.000	2.500	3.500	7.640

260.000

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

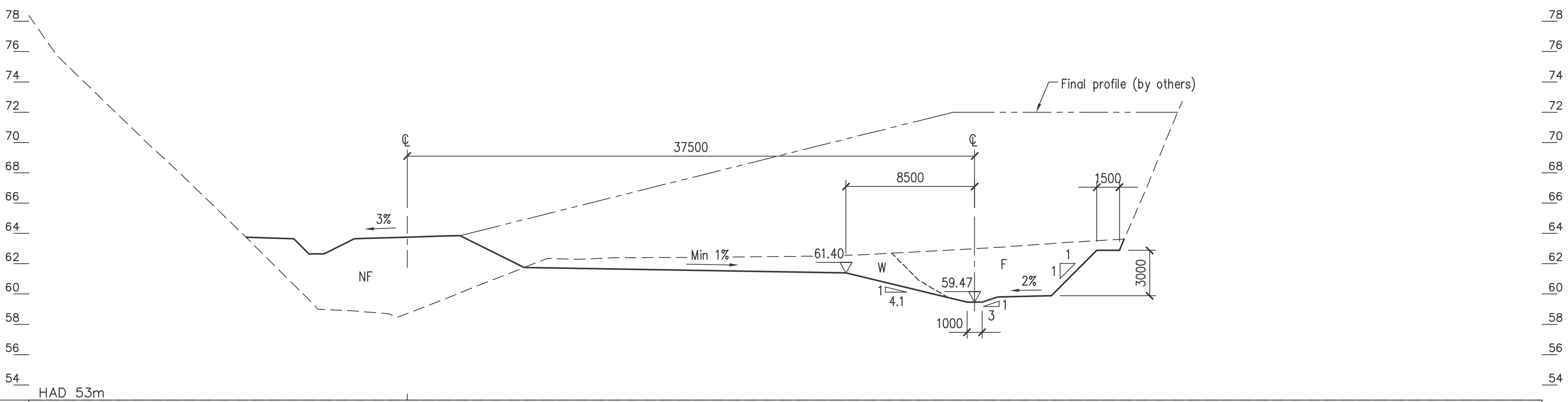
CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

ACCESS ROAD CROSS SECTIONS SHEET 5

A1 20 10 0 20 40mm

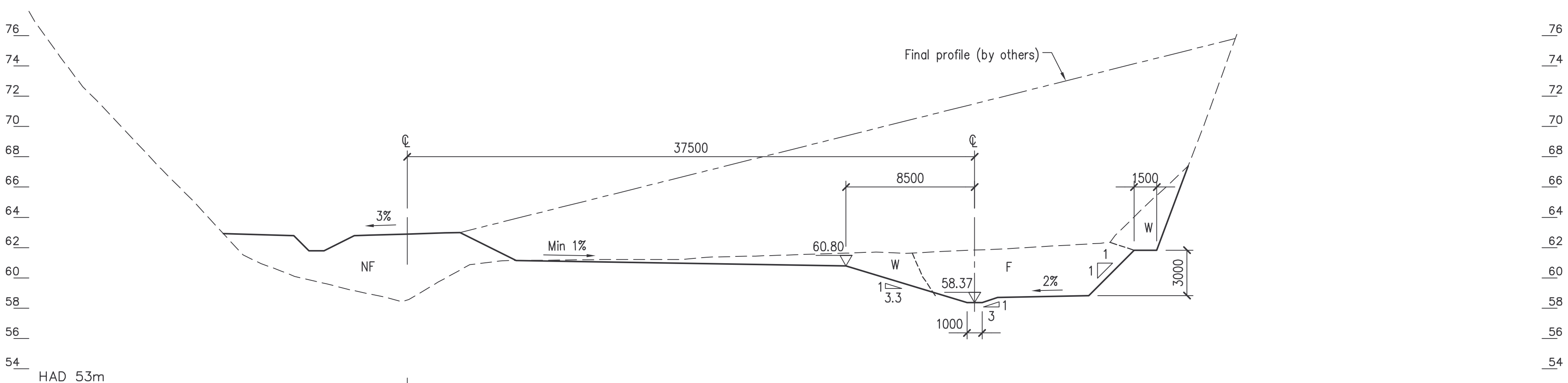
Scale 1: 200 (A1)

Project No. 4964312 | Drawing No. 132 | Issue A



LEVEL	63.742	63.647	62.647	62.647	63.647	63.677	63.752	63.827	63.857	61.747
OFFSET	-10.651	-7.500	-6.500	-5.500	-3.500	-2.500	0.000	2.500	3.500	7.722

320.000



LEVEL	62.930	62.790	61.790	61.790	62.790	62.820	62.895	62.970	63.000	61.148
OFFSET	-12.157	-7.500	-6.500	-5.500	-3.500	-2.500	0.000	2.500	3.500	7.205

300.000

LEGEND

NF New fill
W Weathered rock
R Unweathered rock
G Green waste
F Backfill
r Refuse
(Source: Meritec Geotechnical Report)

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

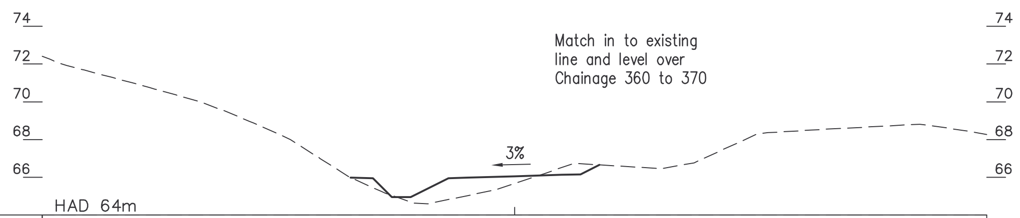
WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

ACCESS ROAD CROSS SECTIONS SHEET 6

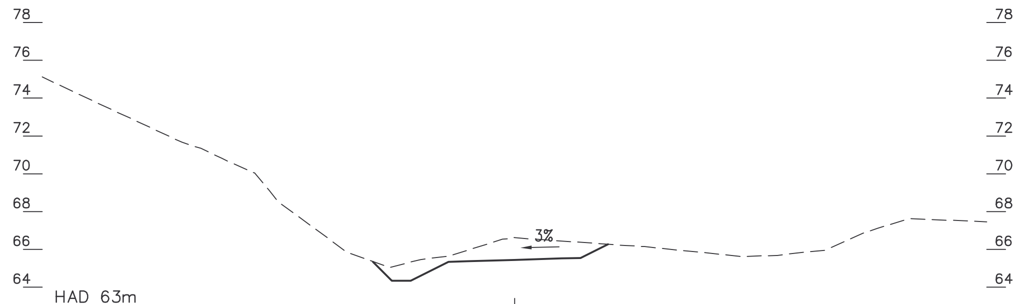
A1 Scale 1:200 (A1)

Project No. 4964312 Drawing No. 133 Issue A



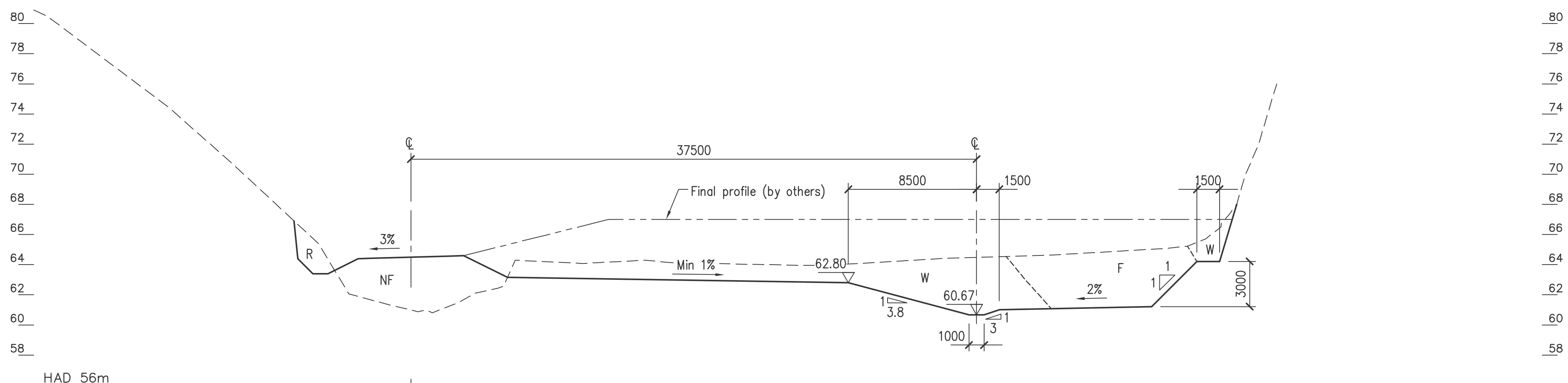
LEVEL	65.978	65.943	64.943	64.943	65.943	65.973	66.048	66.123	66.153	66.650
OFFSET	-8.675	-7.500	-6.500	-5.500	-3.500	-2.500	0.000	2.500	3.500	4.495

370.000



LEVEL	65.360	65.337	64.337	64.337	65.337	65.367	65.442	65.517	65.547	66.269
OFFSET	-7.502	-7.500	-6.500	-5.500	-3.500	-2.500	0.000	2.500	3.500	4.945

360.000



LEVEL	66.905	64.390	63.390	63.390	64.390	64.420	64.495	64.570	64.600	63.151
OFFSET	-7.752	-7.500	-6.500	-5.500	-3.500	-2.500	-0.000	2.500	3.500	6.398

340.000

LEGEND

NF New fill
W Weathered rock
R Unweathered rock
G Green waste
F Backfill
r Refuse
(Source: Meritec Geotechnical Report)

Issue	Description	Date	App'd
A	Issued for construction	7.11.03	MvW

Verify all dimensions before commencing work

		Checked	Date
Design	LS	KO	Apr 03
Drawn	IML	LS	
Approved	K Oldham	Status	Construction

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GOVERNMENT OF THE COOK ISLANDS

WASTE MANAGEMENT PROJECT

CONSTRUCTION OF THE RAROTONGA LANDFILL AND SEPTAGE PONDS

ACCESS ROAD CROSS SECTIONS SHEET 7

A1 20 10 0 20 40mm
Scale 1: 200 (A1)
Project No. 4964312
Drawing No. 134
Issue A