FAR NORTH DISTRICT COUNCIL

POST CLOSURE CARE MANAGEMENT PLAN FOR KAIKOHE LANDFILL

INTRODUCTION

KAIKOHE LANDFILL

1 HISTORY

Most of the 14 hectares of the present Lindvart Park Recreation Reserve was purchased in the early 1930's by the then Kaikohe Town Board. In the early 1950's it was allowed that the terms of Mr Lindvart's 1930 bequest of 2,000 pounds be changed to cover the upkeep of the park. In October 1951 the name of the Kaikohe Recreation ground was changed to Lindvart Memorial Park. An area of approximately seven hectares immediately adjacent to the original reserve, became apart of the reserve in the late 1960's.

1.1 Classification

Lindvart Park reserve is designated D20 (Recreation Reserve) with an underlying zoning of Residential 'A'. Under the proposed District Plan 1996 the site is zoned Recreational Reserve.

1.2 Land Use

Much of the original park consisted of low lying swamp and unusable terrain. Landfilling provided the means to create flat areas for sports fields. The Rugby League field and part of the existing Hockey fields lies above old landfill.

1.3 Legal Description

Pt 3 & 4 DP 22327, Blk XV Omapere S.D. Map Reference: PO5:835-428.

1.4 Reinstatement

The entire landfill will be clay capped to the requirements of the resource consent NLD 95-7503.

01.3: "final cover of not less than 600mm of recompacted clay with a permeability of less than 10^{-7} meters per second".

Final cover has the following purposes:

(i) Control minimise water ingress;
(ii) Provide final contour;
(iii) Provide gas control;
(iv) Allow plant growth;
(v) Permit end use.

The objective of clay capping is to enclose the refuse in a seal by placing very low permeability material on the sides and top of landfill in order to keep out as much water as possible, this has the positive effect of reducing leachate production but can have the draw back of slowing down the breakdown of materials within the landfill and hence cause the production of landfill gas to continue for many years.

The contour of the landfill was decided through public consultation. Various options were prepared and presented by Littoralis Landscape Architecture. The preferred option was chosen after public submissions and meetings. Refer to Appendix 2 for "Landscape Development Report", Littoralis Landscape Architecture, April 1996.

1.5 *Source of Refuse*

The landfill was in operation since prior to 1950 and until 1989 serviced the Borough of Kaikohe and surrounding areas, (there is evidence that some refuse from Bay of Islands County Council was also landfilled on site). After local body amalgamation in 1989, the Kaikohe landfill received refuse from a larger area as small rural dumps were closed and refuse transfer stations built to service the areas affected, e.g. Opononi, Horeke. Likewise District kerbside refuse collections from areas such as South Hokianga, Kerikeri and Kawakawa increased the volume of refuse being landfilled at Kaikohe. The pre-closure volume of waste landfilled at Kaikohe is of the order of 12-14,000 cubic metres compacted (including daily and intermediate cover) per annum. (This equates to 5-6,000 tonnes/annum).

A public tipping face was operational throughout the life of the landfill. Far North District Council enforced a policy of prohibiting disposal of hazardous waste (including paint, glue, oil, caustic waste, etc.) and a hazardous waste compound was installed to provide a convenient and safe drop off point. Similar compounds are available at staffed transfer stations, preventing the unauthorised disposal of potentially toxic material.

A combined effort by Northland Regional Council and local authority ensured electrical equipment containing PCB was collected and transported to France for high temperature destruction.

The refuse contained within Kaikohe landfill, is predominantly household waste with a small component from the commercial premises. It is estimated that 40% of refuse volume is compostable (i.e. green matter, food waste) it is this component that gradually decays in the presence of moisture to form biogas.

2 *ASSESSMENT OF ENVIRONMENTAL EFFECTS*

Assessment of environmental effects of closed capped landfill, the following effects require managing:

Silt Run-off (i) During clay capping and top soiling operations;
(ii) After grass and vegetation cover is established.
Stormwater Control
Leachate Collection and Treatment
Settlement/Subsidence
Landfill Gas

The landscape development report offers various options for vegetation of the clay capped land form.

Through further public involvement various options may be explored regarding the mix of the following:

(i) Grassland - requires regular mowing and have a slope suitable for existing town maintenance equipment.
(ii) Indigenous Shrubland - mix of nature shrubs such as manuka, flax, etc., reduces the area requiring mowing and protects batter slopes from erosion.
(iii) Theme Area - possible useful plant collection.
(iv) Viewing Terraces for Rugby League field.

SOURCE OF CLAY CAPPING MATERIAL

The stripping material from two local shale pit quarries was tested to determine its suitability for clay capping. The two local quarries are:

(i) Northland College shale pit east of Kaikohe;
(ii) Whitehills (transit) shale pit west of Kaikohe;

Random samples were taken from both quarries by Works Civil North Limited and tested by Materials Laboratory, Whangarei.

SOURCE	DATE	PERMEABILITY
Northland College Quarry	24/3/97	0.77×10^{-7} m/sec
Whitehills Quarry	24/4/97	0.19×10^{-7} m/sec

See Appendix 3 for laboratory test results.

While on the surface the five metre high mound will be aesthetically pleasing with it native vegetation, walkways, cycle paths, bird life habitats and fitness trails. It is what is beneath all of this that requires careful monitoring and after care to ensure that the environment is not affected.

2.1 *Silt Run-off*

During the laying and compacting of clay capping material, careful attention will be required to prevent silt run-off into the receiving waters. If required straw/hay bales may be used to contain silt run-off.

2.2 *Stormwater Control*

The land form will be contoured to prevent gully development. Surface water from the crown of the landfill will be directed to a stormwater collection pipe that carries the water down the eastern batter slope into the concrete dish drain.

REFER TO DRAWING MARKED "STORMWATER"

Stormwater swale drains will be grassed but should they show signs of eroding, the drains will be concrete lined.

Attentions will be required to ensure that localised settlement does not create flowpaths/collection points that lead to gully development. (See Settlement/Subsidence).

Stormwate from eastern, western and northern boundaries will be directed into the Council maintained stormwater system, with the discharge passing through a litter/solids separator prior to discharging into an open drain down Thorpe Road.

2.3 Leachate Collection & Treatment

An extensive leachate collection network of slotted pipes and drainage metal feeds leachate into the leachate pump chamber situated in the north-eastern corner of the landfill. Leachate is then pumped to the Kaikohe Sewerage Treatment Plant.

Ongoing maintenance of this system is required, including maintenance of the submersible pump, level switches and telemetry.

A remote monitoring system allows the status of the leachate pump to be checked by telephone:

Phone:	401 2573
Password:	99
Enquiries:	8
Site:	244

This system will provide Pump: ON/OFF
High Float: ON/OFF
System Fault: ON/OFF

The conductive and corrosive nature of leachate requires the periodic cleaning of level probes and regular maintenance of the submersible pump.

Unforeseen events include:

(i) Pump failure - in this event, Impact Services Ltd have spare pumps available;
(ii) Telemetry failure - operation of pump will continue as normal but no remote monitoring will be available until fault rectified;
(iii) Leachate leaks from batter slope.

It is expected that some leachate leakage from the batter slopes will be noticed immediately after clay capping due to the increased loading on the mound. Should this flow prove to be persistent, shallow leachate collection drains (4" nonaflow and drainage metal) may be required. Leachate collected will be directed down to ground level collection drains. The integrity of the clay capping on the flat crown of the landfill is the key to ensuring minimal leachate production, but should any slumping or settlement occur which allows water ponding on the crown, leachate production will rise accordingly. Hence the importance of monitoring the contour of the flat crown of the landfill, using settlement indicator pegs if necessary, cannot be over stated. A simple check involves checking for water ponding after rain.

2.4 *Settlement/Slumping/Subsidence*

As the organic component of the refuse decays landfill gas is generated and voids are created in the refuse mass. Over time settlement is expected and it will not occur evenly over the landform

Differential settlement will create cracks that allow water ingress through the clay capping, the water subsequently accelerates the decay process and increases the rate of settlement. The most effective means of preventing future problems is to carefully monitor the contour and ensure that localised settlement does not allow ponding to occur. Water ingress is not considered to be a problem on the 3:1 batter slopes but requires careful attention on the flat crown. Extra thickness of clay capping is planned for the crown (i.e. 750 mm instead of 600mm).

Best engineering practice appears to favour some moisture ingress into the refuse mass to ensure a relatively rapid decay of the organic component. This ensures that the major settlement and landfill gas production occurs over the early stages of after care.

Drawing 3 shows the recent staged filling of the landfill, the older filled areas are expected to show little settlement and landfill gas production since these areas have been covered with intermediate cover only, allowing water ingress. The area requiring attention is that area landfilled just prior to clay capping.

2.5 Landfill Gas

Landfill gas will be produced in the landfill as a result of biological decomposition. Landfill gas consists mainly of methane and carbon dioxide but can contain other gases including volatile organic compounds.

The following matters require addressing:

1) Methane fires may occur that are not visible in daylight;

2) Concentrations of methane and/or carbon dioxide may occur in manholes and chambers and may migrate through pipes or permeable soils and accumulate in poorly ventilated areas and result in either asphyxiation of explosions.

Migration Control

Since no building structures are present close to the landfill, the risk of explosive gas migration to enclosed structure is relatively low, however vigilance is required to ensure future development of the landfill as a recreational reserve does not include proposals such as enclosed buildings without due consideration to the risk of accumulating migrating gas. Mitigating design could involve polythene sealing cover beneath any concrete slab and sufficient ventilation in any structural design.

It is proposed that a vent be installed on the leachate pump chamber and signage added that warns of possible explosive or asphyxiating gases being present in chamber.

Any personnel working on site should not descend into any trench/excavation or chamber on site without first checking for the presence of landfill gas, wearing appropriate safety gear, and having someone stand outside the excavation to assist if required.

Gas migration into the stormwater system beneath the Rugby League field could also cause problems. It is proposed that the existing manhole covers be replaced with stormwater grates to ensure venting.

It is not expected that any gas collections for commercial use will be viable however should landfill gas prove to be a problem, one of the following methods may be installed:

1) Vertical in situ rubble chimney;
2) Driven wells (i.e. perforated steel pipe);
3) In situ perforated pipe system.

2.6 *Monitoring After Closure*

After the landfill is capped and re-vegetated there will be a need for ongoing monitoring to observe the following:

- Leachate generation (pump run time is available from remote monitoring telemetry);
- Gas generation;
- Integrity of capping;
- Degree and effect of settlement.

Leachate will continue to be monitored by Northland Regional Council. Leachate sample from Northland Regional Council sampling point 1556 will be analysed at least annually for determinants as per Schedule 1, attached.

Stormwater shall be sampled on a six monthly interval, samples taken from the stormwater manhole adjacent to Station Road. Samples shall be analysed for determinants selected by the Regional Council from Schedule 2, attached.

Should leachate generation and strength show signs of reducing over time, it is planned to reduce the sampling frequency.

New Lined Area - Detail Showing Connection Of Leachate Collection

Preparation Of Liner For New Area

Willows Removed & Clay Capping In Progress On Southern Batter Slope
(Note: Topsoil Stockpile On Landfill Crown)

Refuse Unloading At Tip Face

Viewing Terrace Prior To Clay Capping

Viewing Terraces After Clay Capping

Batter Slope Clay Capping Eastern Boundary
(Concrete Lined Swale Drain)

Leachate Pump Chamber With Telemetry Chamber

Stormwater Manhole At Eastern Side of Rugby League Field

View Of Clay Capped Viewing Terrace From Rugby League Field

View Along Eastern Batter Slope. Willow Trees Are
Being Progressively Removed As Clay Capping Proceeds

Works Consultancy Services Limited
Materials Laboratory
46 Port Road
Whangarei
24 March 1997

The Manager
Works Civil Construction
P.O.Box 262
KAIKOHE

For the attention of Mr D.Mariassouce

Dear Sir

INVESTIGATION FOR KAIKOHE LANDFILL CLAY COVER: LAB. No A67/97

1. AIM

To determine the permeability of a sample of shale ex Northland College quarry stockpile.

2. PROCEDURE

2.1 The material sampled on the 13/3/97 by Mr D.Mariassouce of Works Civil Construction Kaikohe was delivered to the laboratory on 13/3/97.

2.2 The sample was sieved over a 19mm test sieve and the retained material discarded.

2.3 To determine an approximate maximum dry density a portion of the passing 19mm material was compacted at an assessed optimum water content into a laboratory CBR mould in accordance with NZS 4402:1986 test 6.1.1 (standard compaction).

2.4 A sample of the passing 19mm material was then compacted at the maximum density achieved in 2.3 above, into a 200mm diameter laboratory permeability cell and tested in accordance with Method of Test for Laboratory Permeability WI WH LA 377.

3. RESULTS

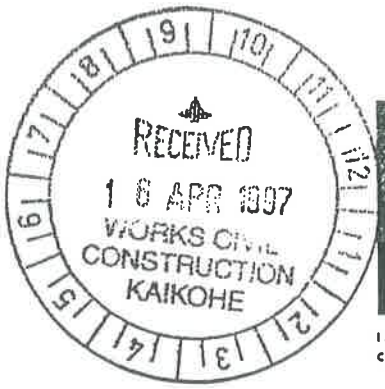
3.1 The passing 19mm material had a natural water content of 12.8% which was assessed to be the optimum water content. The laboratory dry density achieved when compacted at this water content was 1.78 t/m^3.

3.2 The permeability test was run for five days and eight separate readings of permeability were taken during the five days. The final four readings after the test had stabilised produced an average result of $0.77 * 10^{-7}$ m/sec.

Clause 3 of the document supplied calls for the clay cover to have a permeability of less than 10^{-7} metres per second and the sample tested complies with this requirement.

Yours faithfully

Bruce Saint
Laboratory Manager



OPUS
INTERNATIONAL CONSULTANTS

Clause 3 of the document supplied calls for the clay cover to have a permeability of less than 10^{-7} metres per second and the sample tested complies with this requirement.

Yours faithfully
OPUS INTERNATIONAL CONSULTANTS

Bruce Saint
Laboratory Manager

Copy to Matt Kearney
FNDC 16.4.97.

F 1868

3

Materials Laboratory
46 Port Road
Whangarei

24 April 1997

The Manager
Works Civil Construction
P.O.Box 262
KAIKOHE

For the attention of Mr D.Mariassouce

Dear Sir

INVESTIGATION FOR KAIKOHE LANDFILL CLAY COVER: LAB. No A89/97

1. AIM

To determine the permeability of a sample of shale ex Whitehills quarry face and floor.

2. PROCEDURE

2.1 The material sampled on the 7/4/97 by Mr D.Mariassouce of Works Civil Construction Kaikohe was delivered to the laboratory on 7/4/97.

2.2 The sample was sieved over a 19mm test sieve and the retained material discarded. The material was assessed to be below optimum water content and water was added to achieve this condition.

2.3 To determine an approximate maximum dry density a portion of the passing 19mm material was compacted at an assessed optimum water content into a laboratory CBR mould in accordance with NZS 4402:1986 test 6.1.1 (standard compaction).

2.4 A sample of the passing 19mm material was then compacted at the maximum density achieved in 2.3 above, into a 200mm diameter laboratory permeability cell and tested in accordance with Method of Test for Laboratory Permeability WI WH LA 377.

3. RESULTS

3.1 The passing 19mm material initially had a natural water content of 13.9%, and then 17.4% after adding water to the material to achieve an assessed optimum water content.

The laboratory dry density achieved when compacted at this water content was 1.70 t/m^3.

3.2 The permeability test was run for five days and ten separate readings of permeability were taken during the five days. The final four readings after the test had stabilised produced an average result of $0.19 * 10^{-7}$ m/sec.

STORMWATER.

FAR NORTH DISTRICT COUNCIL

50
30
10
0m

PIONEER VILLAGE

STORMWATER GRATES

RECREATION ROAD

PARKING

SITE KEPT OPEN TO INTERSECTION OF STATION AND RECREATION ROADS

STATION ROAD

38 CAR PARKING

PUBLIC TOILETS

RUGBY, LEAGUE FIELD

SURFACE Vee DRAIN

1920 APPROX

GRASS TERRACES

SLOTTED PIPE BENEATH LEAGUE FIELD

MANHOLE

STORMWATER EXIT TO BURIED PIPES (TRASH RACK)

LINDVART PARK

CONCRETE LINED SWALE DRAIN

TOE OF LANDFILL

FLAX COLLECTION

CROWN OF LANDFILL

MIXED EXOTIC / INDIGENOUS BELT TO GRADUALLY REPLACE WILLOWS

LOW NATIVE SHRUBLAND WITH INTERPRETATION OF TRADITIONAL USES OF VARIOUS PLANTS

COLLECTOR PIPE FROM CROWN OF LANDFILL

OPENING TO LINDVART PARK

RECREATION OF MAORI AGRICULTURAL DEVELOPMENT

FUTURE TRANSFER / RECYCLING STATION LAYOUT INDICATIVE ONLY

OPEN GRASSLAND

HARDWOOD SCREENING TREES

CULVERT UNDER ROAD

SWALE DRAIN

MIXED EXOTIC / INDIGENOUS BELT TO GRADUALLY REPLACE WILLOWS

KEY

- GRASSED SPECTATOR TERRACING
- LOW INDIGENOUS SHRUBS WITH INTERPRETATION ON TRADITIONAL USES
- FLAX (HARAKEKE) COLLECTION
- EXOTIC TREE PLANTING
- INDIGENOUS TREES AND EXOTIC HARDWOOD PLANTING
- MOWN GRASSLAND
- PAVED PATH - FLEXIBLE SURFACING
- FITNESS TRAIL STATIONS
- STONE WALL AND STONE HEAPS
- PICNIC TABLES
- PARK BENCHES

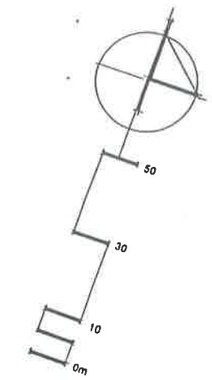
LITTORALIS LANDSCAPE ARCHITECTURE

KAIKOHE LANDFILL CLOSURE

DRAFT LANDSCAPE DEVELOPMENT CONCEPT

SCALE 1:750 (A1) APRIL 1996 REF: 65C1

LANDFILLING SEQUENCE.



FAR NORTH DISTRICT COUNCIL

1991 - 1996

1996 - CLOSURE

AREA OF GREATEST EXPECTED SETTLEMENT

KEY

- GRASSED SPECTATOR TERRACING
- LOW INDIGENOUS SHRUBS WITH INTERPRETATION ON TRADITIONAL USES
- FLAX (HARAKEKE) COLLECTION
- EXOTIC TREE PLANTING
- INDIGENOUS TREES AND EXOTIC HARDWOOD PLANTING
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LITTORALIS
LANDSCAPE ARCHITECTURE

KAIKOHE LANDFILL CLOSURE

DRAFT LANDSCAPE DEVELOPMENT CONCEPT

SCALE 1:750 (A1) APRIL 1996 REF: 65C1

LEACHATE COLLECTION.

50
30
10
0m

PIONEER VILLAGE

RECREATION ROAD

PARKING

SEWER

FAR NORTH DISTRICT COUNCIL

DISCHARGE TO SEWER

PUBLIC TOILETS

RUGBY, LEAGUE FIELD

38 CAR PARKING

SITE KEPT OPEN TO INTERSECTION OF STATION AND RECREATION ROADS

LEACHATE COLLECTION CHAMBER

LINDVART PARK

INSPECTION CHAMBERS

STATION ROAD

BURIED SLOTTED PIPE + DRAINAGE METAL/CLOTH

1920 APPROX

GRASS TERRACES

TOE OF LANDFILL

FLAX COLLECTION

CROWN OF LANDFILL

RECREATION OF MAORI AGRICULTURAL DEVELOPMENT

MIXED EXOTIC / INDIGENOUS BELT TO GRADUALLY REPLACE WILLOWS

LOW NATIVE SHRUBLAND WITH INTERPRETATION OF TRADITIONAL USES OF VARIOUS PLANTS

OPEN GRASSLAND

FUTURE TRANSFER / RECYCLING STATION LAYOUT INDICATIVE ONLY

OPENING TO LINDVART PARK

HARDWOOD SCREENING TREES

MIXED EXOTIC / INDIGENOUS BELT TO GRADUALLY REPLACE WILLOWS

KEY

- GRASSED SPECTATOR TERRACING
- LOW INDIGENOUS SHRUBS WITH INTERPRETATION ON TRADITIONAL USES
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- PICNIC TABLES
- PARK BENCHES

LITTORALIS
LANDSCAPE ARCHITECTURE

KAIKOHE LANDFILL CLOSURE

DRAFT LANDSCAPE DEVELOPMENT CONCEPT

SCALE 1:750 (A1) APRIL 1996 REF: 65C1