KERRIGAN ENGINEERS LTD

ENGINEERING REPORT

For H & S Lensen

Engineering Assessment for Onsite Waste Disposal and Excavation Works for New Utility Building at 120 Windhawk Rise, Hawkebury, Marlborough

March 2018 - **FINAL**

By Graham Kerrigan

Job Number: 3960

On Site Waste Disposal and Excavation Works

ONSITE WASTE DISPOSAL REPORT

Location	:	120 Windhawk Rise, Hawkesbury, Marlborough
Legal Description	:	Lot 2 , DP 10132
Client	:	H & S Lensen

A SYNOPSIS

A.1 INTRODUCTION

The following reports the engineering issues for onsite waste water disposal for a proposed 4 bedroom house. The report also comments on excavations works necessary for the construction of a new utility bunker shed as part of the new house development.

The onsite waste water assessment and recommendations for excavation works are necessary to supplement a Resource consent application for a discharge permit and land use consent as the site is designated a Soil Sensitive Area according to Councils Environment planning maps.

A.2 SUMMARY

The owner plans to construct a 3 bedroom dwelling. The site is a rural, grassed, ridge formation.

The property is suited to onsite waste disposal via primary treatment and on site low pressure effluent disposal (LPED) following the Onsite Domestic wastewater Management Standard NZS 1547:2012.

The proposed excavation activity can be carried out without detrimental environmental effects so long as the recommendations in this report are followed.

A.3 RECOMMENDATIONS

With regard to the onsite waste disposal for the dwelling the following recommendation should be adhered to:

- The proposed dwelling is 3 bedrooms, which generate a design loading of 1200litres per day. This loading should not be exceeded.

- The site is suited to primary treated effluent via standard 4000 litre septic tank constructed to NZS 1546.1:2008

- The onsite disposal is via a irrigation bed formed from 200x200 gravel filled trenches. The design irrigation rate (DIR) is 3.0mm/day. Currently there is insufficient topsoil to the bed location, additional topsoil is required. The

existing grass and roots of the proposed irrigation area should be stripped and stored, additional topsoil from the building works shall be placed to ensure at least 250mm of topsoil surrounding the proposed irrigation pipe work. The side cast topsoil and grass should be reinstated. The additional topsoil assists in nutrient reduction and moisture uptake and evapotranspiration from planting between the trenches.

- The required irrigation area will be 400m2. This should be created from an array of lines laid parallel to the contours and at 1m centres. The irrigation lines are 25mm diameter LPED pipes in a perforated shrouded cover pipe and laid in 200x200 gravel filled trenches per AS/NZS 1547:2012 requirements.

- Uphill drainage flow shall be cut of with a formed shallow swale drain to ensure no uphill runoff enters the irrigation area.

- We recommend that only registered tradesmen familiar with the construction of an LPED land application system and working to the National Plumbing and Drainage code NZS/AS 3500 should carry out all plumbing and drainage works associated with this treatment and land application system.

- We recommend that the installation and operation be verified by a Chartered Professional Engineer. This verification should include confirmation that the construction and pump discharge requirements meet with the design.

With regard to the excavations for the formation of the bunker utility shed the following recommendation should be adhered to:

- We have carried out penetrometers at for the proposed house area and the proposed bunker utility shed and the ground is firm and compliant with NZS3604:2011.

- Fill areas in excess on 600mm deep to be designed by a Chartered Professional Engineer familiar with the concerns of Loess soils.

- Batter slopes over 600mm high, not retained by a structure will be sloped at 2H:1V and the slope protected by geo-fabric to sustain plant growth.

- Filter cloths and Nova coil slotted agricultural drains will be laid behind the retaining wall before backfilling.

- Service trenches on slope areas of the land will require backfilling with lime stabilized backfill (5%) and fitted with simple concrete cut-off dams.

- Where slope exceeds 1 in 6 gradients services trench and pipes to be fitted with simple concrete cut-off dams at 10m centres, elsewhere place cut off at 20m centres.

- There is a small area between the proposed house and the utility shed should include a cut of drain be located just above the proposed bank excavation to ensure no upfill runoff enters.

- The above mitigation measures should be inspected throughout the course of construction and this should be noted in the building consent monitoring schedule.

B ENGINEERING REPORT

B.1 INTRODUCTION

The following reports on treatment and onsite waste disposal to land and excavation works associated with the construction of a utilities bunker shed. The report is necessary to supplement a Resource Consent application as the activity is being undertaken in a zoned soil sensitive area – loess soils.

The property owners plan to install a septic tank and a low pressure effluent disposal, LPED, discharge irrigation system for a proposed three bedroom dwelling on the property.

B.2 INVESTIGATION

The site was investigated on the 27 June 2017 and revisited on 7 March 2018 and this investigation has included:

- Site Assessment for onsite waste disposal following procedures of AS/NZS 1547:2012.
- Penetrometer probes.
- Photographs.
- Deck study review of MDC Smart maps – Environment Plan – Overlay.
- Review of historical engineering report by J Smart dated March 1996.

B.3 SITE DESCRIPTION & GEOLOGY

The site is a grassed rural ridge formation. The site is about 100m elevation and at the top of a ridge formation it is generally flat. The ridge formation runs south – north and the western side of the ridge is the Brancott valley and the eastern side is a small valley formation.

We have carried out penetrometers at for the proposed house and utility shed area and the ground is firm and compliant with the proposed Firth waffle slab foundation the specific designed utility bunker shed foundation.

Our site assessment of the soils to this location has indicated approximately 100mm of topsoil, overlaying clay silt loams, overlaying dense silt clays. We note Council's environmental planning maps indicate the general area as being soil sensitive area identified as Loess soils. Our site investigation noted some dispersive soil evidence in the area and dispersive property was also noted in our soil samples.

The loess soils noted in this area are similar to those of the wither hills and well documented from the Marlborough Ridge subdivision.

The areas of the Wither hill formation and predominately the Marlborough ridge has been historically documented by M Yetton- Geotechnical Consulting Limited (report dated 3

August 1996 ref – 1039) and Davidson Partners Limited (report dated 21 January 1997 ref -5663). These past reports have highlighted specific geotechnical recommended minimum standards of construction in this loess soils area.

The following discussion and recommendations are based on the historical recommendations of these past reports.

B.4 ONSITE WASTE WATER ASSESSMENT

B.4. 1 Loading

The owners plan to construct a 3 bedroom dwelling. The occupancy generates a design loading of 1200 litres per day. This is based on 200 l/c/day and a standard occupancy of 2 person per bedroom, which equates to 6 persons usage.

B.4.2 Waste Water Treatment

The site evaluation generally followed the recommendations of NZS/AS 1547:2012 and appended to this report are the standard site and soil evaluation sheets.

The property is sufficiently large enough to accommodate primary treated effluent from a septic tank. A 4000 litre septic tank complaint with NZS/AS 1546.1:2008 will suffice.

B.4.3 Waste water Disposal

The property is sufficiently large to accommodate irrigation using LPED per appendix M of AS/NZS 1547:2012. The irrigation shall be via 200x200 gravel filled trenches at 1m centres to the topsoil layer.

Our site assessment of the soils to this location has indicated approximately 100mm of topsoil, overlaying clay silt loams, overlaying silts clays, over laying a dense layer of silt clays. The soils at the proposed irrigation location is considered category 4 and the Design Irrigation Rate (DIR) is considered to be 3mm per day per table M.1 of AS/NZS 1547:2012.

We note Council environmental planning maps indicate the general area as including soil sensitive material identified as Loess soils. Our site investigation noted some dispersive soil evidence in the area and our soils investigation noted that the silt clays (layer 3) as Loess soils.

However we consider that the overlay of category 4 soils to layer 2 will be the governing horizon in the design and as such the proposed DIR is 3mm per day (maximum). We consider the reduced flow permeating to the lower horizons would not be sufficient to cause problems to the underlying loess soils.

The AS/NZS 1547:2012 Standard requires that 250mm of topsoil to the irrigation pipework for underlying soils of category 5 nature. Hence to mitigate any possible effects on the underlying loess soils, and deeper less permeable soils, we propose that the topsoils layer be at least 250mm deep.

Currently there is about 100- 150mm of topsoil to the irrigation area, additional fill is necessary to build up the bed area above general ground level. Cut topsoil material from the formation of the shed and house foundation should suffice for this purpose. The existing layer of grass and roots should be removed to storage and the cut material from

the house and shed should be placed to form a minimum of 250mm surround to the irrigation pipe work and any cut grass be reinstated.

We consider that the underlying topsoil below the irrigation pipe work will be sufficient to slow waste soakage and assist in nutrient reduction to minimize any concerning risk to the underlying silts exhibiting a presence of loess.

We recommend that only registered tradesmen familiar with the construction of an LPED land application system and working to the National Plumbing and Drainage code NZS/AS 3500 should carry out all plumbing and drainage works associated with this treatment and land application system.

We recommend that the installation and operation be verified by a Chartered Professional Engineer. This verification should include confirmation that the construction and pump discharge requirements meet with the design.

B.5 EXCAVATION FOR NEW UTILITY BUNKER SHED

B5.1 introduction

The following supplements a resource consent application (by others) with comment on the excavation activities with respect to the presence of loess soils (wind blown volcanic ash) in this location.

B5.2 Geotechnical Issues

The loess soils noted in this area are similar to those of the Wither Hills and these soils are well documented from the development of the Marlborough Ridge subdivision.

The areas of the Wither hill formation and predominately the Marlborough ridge has been historically documented by M Yetton- Geotechnical Consulting Limited (report dated 3 August 1996 ref – 1039) and Davidson Partners Limited (report dated 21 January 1997 ref -5663).

These past reports have highlighted specific geotechnical recommended minimum standards of construction in this loess soils area. The following discussion and recommendations are based on the historical recommendations of these past reports.

Penetrometer probes have been carried out at the site and the findings are included in the attached appendix. The results indicate that the soil bearing capacity is appropriate for light timber framed construction for Firth waffle slab foundation and specific design foundation for the utility building.

Our site assessment of the soils to this location has indicated approximately 100mm of topsoil, overlaying clay silt loams, overlaying dense silt clays.

B5.3 Construction Recommendations

We have followed The Marlborough District Council guidance procedure for development in the Marlborough Ridge subdivision. These procedures contain a number of mitigation measures that should be incorporated into this site's development. These are outlined as follows:

- Fill areas in excess on 600mm deep to be designed by a Chartered Professional Engineer familiar with the concerns of Loess soils.
- Batter slopes over 600mm high, not retained by a structure will be sloped at 2H:1V and the slope protected by geo-fabric to sustain plant growth.
- Filter cloths and Nova coil slotted agricultural drains will be laid behind all retaining walls and structure before backfilling.
- Service trenches on slope areas of the land will require backfilling with lime stabilized backfill (5%) and fitted with simple concrete cut-off dams.
- Where services trench slope exceeds 1 in 6 the pipe is to be fitted with simple concrete cut-off dams at 10m centres, elsewhere place cut of dams at 20m centres.

The above mitigation measures should be inspected throughout the course of construction and should be noted in the building consent monitoring schedule.

There is a small area between the proposed house and the utility shed, this area slopes towards the shed and, although the runoff catchment is only small, we consider that this small catchment should be drained away from the shed. Other cut slopes of the drive have similar small catchments and show signs of erosion, we clearly do not want similar occurrences to the retaining wall backfill and loess soils interface. Hence we recommend a cut of drain be located just above the proposed bank excavation to ensure no upfill runoff enters this area.

B.6 LIMITATION OF REPORT

This report has been prepared solely for the benefit for Endeavour Homes Limited with respect to our understanding of the request. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

This report is based on our interpretation of our visual examination and limited soil tests only and does not preclude the possibility of differing soil properties and/or other relevant physical features being present between the test locations or hidden from view.

Opinions and judgments expressed herein are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions. Where opinions or judgments are to be relied on they should be independently verified with appropriate legal advice.

ENGINEERING REPORT

For H & S Lensen

Engineering Assessment for Onsite Waste Disposal and Excavation Works for New Utility Building at 120 Windhawk Rise, Hawkebury, Marlborough

C APPENDICIES

1. Recommendations Site Plan.
2. Site and Soil Evaluation Sheets for Onsite Waste Disposal.

Rev No.	Revision Note:	Date:	Approved:	Checked:

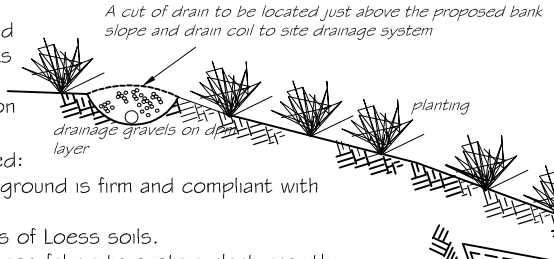
SITE DEVELOPMENT NOTES:

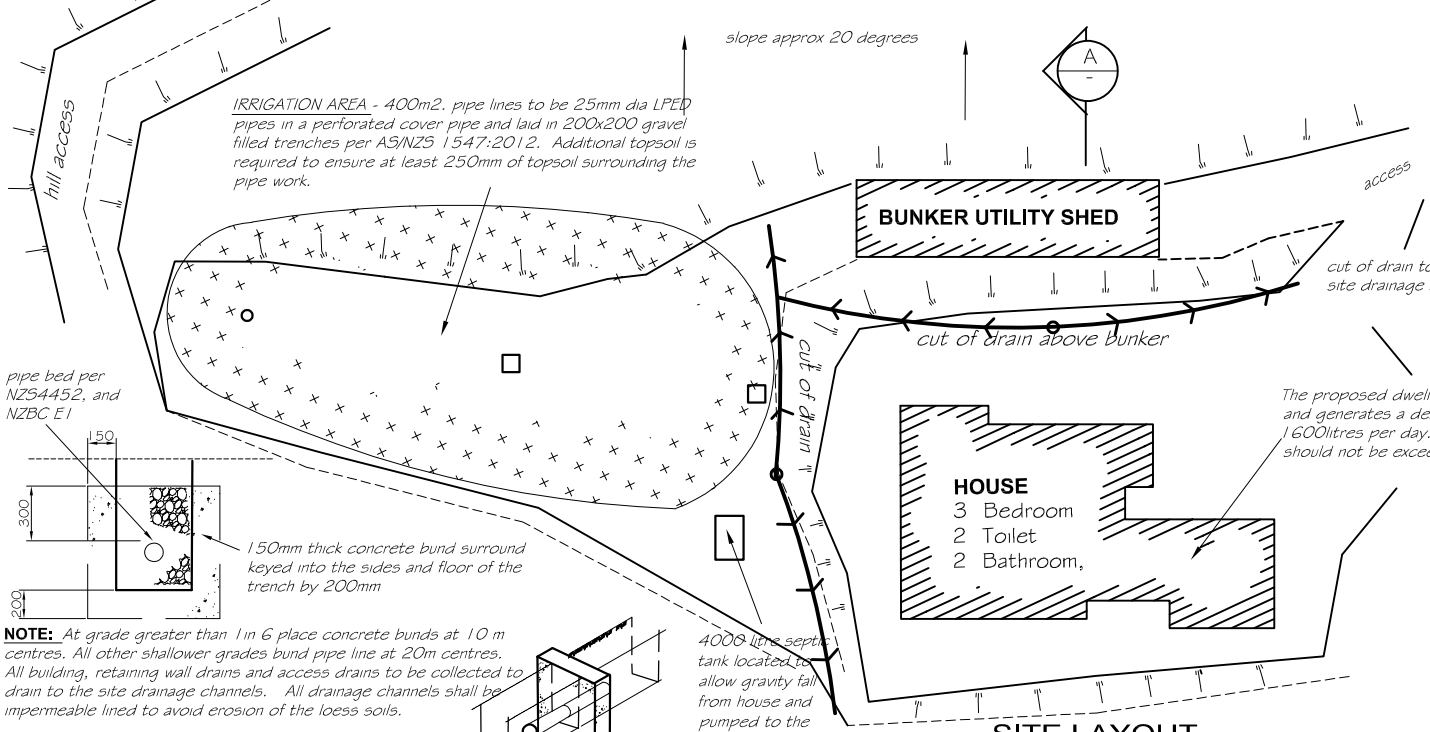
The following notes are additional to the notes on the drawing with respect to Onsite waste disposal :

- Any Uphill runoff shall be cut of with a formed shallow swale drain to ensure no runoff enters the irrigation area.
- We recommend that only registered tradesmen familiar with the construction of an LPED land application system and working to the National Plumbing and Drainage code NZS/AS 3500 should carry out all plumbing and drainage works associated with this treatment and land application system.
- We recommend that the installation and operation be verified by a Chartered Professional Engineer. This verification should include confirmation that the construction and pump discharge requirements meet with the design.

The following notes are additional to the notes on the drawing with respect to the construction of the bunker utility shed:

- We have carried out penetrometers at for the proposed house area and the proposed bunker utility shed and the ground is firm and compliant with NZS3604:2011.
- Fill areas in excess on 600mm deep to be designed by a Chartered Professional Engineer familiar with the concerns of Loess soils.
- Batter slopes over 600mm high, not retained by a structure will be sloped at 2H:1V and the slope protected by geo-fabric to sustain plant growth.
- Service trenches on slopes areas of the land will require backfilling with lime stabilized backfill (5%) and where slope exceeds 1 in 6 pipe to be fitted with simple concrete cut-off dams at 10m centres, elsewhere place at 20m centres.
- The above mitigation measures should be inspected throughout the course of construction and this should be noted in the building consent monitoring schedule.



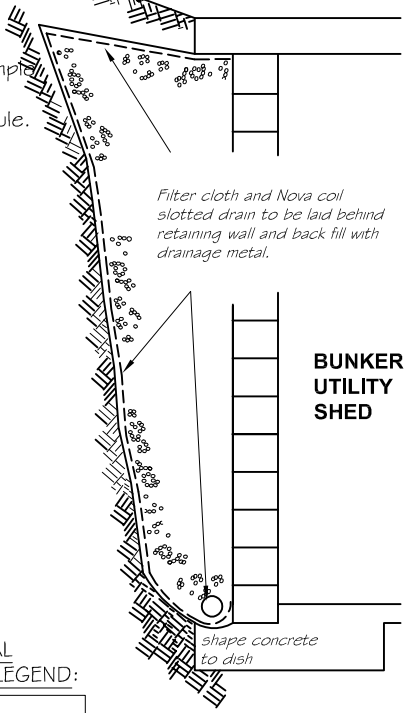


SITE LAYOUT
scale 1:500

NOTE: At grade greater than 1in 6 place concrete bunds at 10 m centres. All other shallower grades bund pipe line at 20m centres. All building, retaining wall drains and access drains to be collected to drain to the site drainage channels. All drainage channels shall be impermeable lined to avoid erosion of the loess soils.

PIPE BUND DETAIL

Perspective



SECTION A
nts

WASTE DISPOSAL INVESTIGATION LEGEND:

- Excavation
- bore investigation

Designed by:	Checked by:	Approved by/ Date-	Scale:	Revision No:
GCK	GCK	MARCH 2018	NTS	

KERRIGAN ENGINEERS LTD

Project Title: **H & S LENSEN - 120 WINDHAWK RISE, HAWKESBURY, MARLBOROUGH**

Dwg. No. 3960

Sheet Title: **SITE PLAN & ENGINEERING RECOMMENDATIONS FOR RESOURCE CONSENT**

Sht. 1 of 1

KERRIGAN ENGINEERS LTD

Graham Kerrigan
CMEngNZ (Civil & Structural)
95b Maxwell Road
P O Box 1092
Blenheim

Ph: 03 578-4085
Mobile 027 649 4299
E.mail: kerrigan.engineers@xtra.co.nz

Job 3960

31 January 2018

Operations & Maintenance requirements

This appendix suggests what might be useful in O & M Guidelines and provides basic technical information covering operation, maintenance and monitoring of on-site domestic-wastewater systems.

Advice of homeowner/occupier responsibilities

Homeowners and occupiers are legally responsible to keep their on-site wastewater system in good working order. If any of the warning signs outlined in the following are evident, the homeowner or occupier must contact the nearest local authority without delay.

Design information

The proposed system for Lensen residence of 120 Windhawk Rise, Hawkesbury is:

Treatment process :	Primary treatment from 4000 litre septic tank to NZS 1546.1:2008.
Land application process :	LPED to irrigatino trenches following the requirements of AS/NZS 1547:2012.]

Based on the proposed three bedroom house and occupancy of 2 persons per room the resulting design numbers is 6 (per the requirements of MDC guidelines for new on site waste water management systems) and standard usage of 200litre/day/person equating to a daily design volume of 1200 l/day.

The soils have been assessed to 3mm/day waste loading per LPED disposal requirements to a proposed irrigation area. This loading intensity shall not be exceeded.

The land application system

Effluent from the wastewater-treatment unit receives further treatment by natural processes in the land-application system.

Irrigation systems can have a siphon or pump unit discharging effluent to the land-application system two or three times a day. This allows air to return to the soil pores as effluent soaks away between doses.

Advice to a home owner/occupier on use of the system

For the on-site wastewater system to work well, there are some good habits to encourage and some bad habits to avoid:

a. In order to reduce sludge building up in the tank:

i. scrape all dishes to remove fats, grease etc, before washing;
ii. keep all possible solids out of the system;
iii. don't use a garbage grinder unless the system has been specifically designed to carry the extra load;
iv. don't put sanitary napkins and other hygiene products into the system.

b. In order to keep the bacteria working in the tank and in the land-application area:

i. use biodegradable soaps;
ii. use a low-phosphorus detergent;
iii. use a low-sodium detergent in dispersive soil areas;
iv. use detergents in the recommended quantities;
v. don't use powerful bleaches, whiteners, nappy soakers, spot removers and disinfectants;
vi. don't put chemicals or paint down the drain.

c. Conservation of water will reduce the volume of effluent requiring disposal to the land-application area, make it last longer and improve its performance. Conservation measures include:

i. installation of water-conservation fittings;
ii. taking showers instead of baths;
iii. only washing clothes when there is a full load;
iv. only using the dishwasher when there is a full load.

d. Avoid overloading the system by spacing out water use as evenly as possible.

Advice on maintenance

a. The land-application area needs protection as follows:
i. spray or irrigation areas are not play areas for children and access should be restricted.

ii. The irrigation area utilizes the natural vegetation for evapotranspiration (take up of moisture and nutrients through plants) therefore avoid any pedestrian or other disturbance of the area.
iii. no vehicles or stock should be allowed on trenches or beds;
iv. deep rooting trees or shrubs should not be grown over absorption trenches or pipes;
v. keep the surface water diversion drains upslope of and around the land-application area clean to avoid absorption of rainwater into trenches or beds;
vi. the baffles or valves in the distribution system should be periodically (monthly or seasonally) changed to direct effluent into alternative trenches or beds, as required by the design.

b. Evapo-transpiration and irrigation areas should have their plants maintained to ensure that these areas take up nutrients with maximum efficiency.

c. Check equipment and follow the manufacturers instructions for maintaining and cleaning: pumps, siphons and secondary treatment systems filters.

Advice on operating problems

The distribution field should be inspected periodically (monthly or seasonally) for any indication of problems.

Problems can occur with systems which have not been maintained and where absorption areas have become blocked or clogged. The warning signs are obvious:
a. Absorption field is wet or soggy with wastewater ponding on the surface of the ground.
b. There is a smell of "sewage" near the septic tank or absorption area.
c. The drains and toilets run slowly.
d. The grease trap is full or blocked.

Advice of the consequences of failure

A failed septic and land-application system is a serious health and environmental hazard and can lead to:
a. Spread of infectious diseases.
b. Breeding of mosquitoes and attraction of flies and rodents.
c. Nuisance and unpleasantness.
d. Pollution and infection of waterways, beaches, streams and shellfish beds.
e. Contamination of bores, wells and groundwater.
f. Alteration of the local ecology.

Further information

Check the yellow pages of your local phonebook, under 'septic tank services' for local provider

SITE AND SOIL EVALUATION FORM – SITE INFORMATION SHEET

Figure D3 AS/NZS 1547:2012

1.0 SITE INFORMATION

1.1 PROPERTY INFORMATION

Owner	:	*Lensen*
Location	:	120 Windhawk Rise Hawkesbury
Legal Description	:	

1.2 SITE EVALUATOR(S)

Name (principal evaluator)	:	*Graham Kerrigan*
Designation	:	*Chartered Professional Engineer*
Company	:	*Kerrigan Engineers Limited*
Address	:	*95b Maxwell Road, Blenheim*
Phone	:	*03 5784085, 027 6494299*
Fax	:	*nil*
Email	:	*kerrigan.engineers@xtra.co.nz*

2.0 ONSITE EVALUATION

2.1 Work undertaken

Details	:	*Viewed site, excavation and bores*
Date	:	*27.6.17 & 7.3.18*
Weather (on day & preceding week)	:	*Fine*
Photocopy of desktop study attached	:	*no*

2.2 Topography

Slope	:	*minor slope to west at disposal location*
Ground cover	:	*pastoral*
Geology confirm	:	*Yes~~/No,~~*
Soil landscape confirmed	:	*Yes~~/No~~*
Drainage patterns	:	*hill slope runoff to valley*
Site plan details attached	:	*Yes~~/No~~*
Clearance	:	*Okay*
Boundaries	:	*discharge contained with boundary and no environmental issues with adjoining properties.*
Allowable minimum	:	*2m per MDC requirements*
Available	:	*generally ample room*
Waterways	:	*None in proximity*
Stands of trees/shrubs	:	*none in proximity that impact*
Well, bores	:	*none*
Embankment	:	*none*
Building	:	*no dwelling in proximity*
Other	:	*none*
Site history (landuse)	:	*Pastoral*

2.3 Site exposure

Site aspect	:	*North west*
Predominant wind direction	:	*North west*
Presence of shelter belts	:	*none in proximity of impact*

Presence of topographical features or structures: *pastoral land*

2.4 **Environmental concerns** (eg: native plants intolerant of phosphorus load, high water table, swamp, waters etc): *None*

2.5 Site stability

Is expert assessment necessary?: ~~*Yes*~~*/No*

If Yes, attach stability statement and give details here of:

Author :
Designation :
Company/agency :
date of report :

2.6 Drainage controls

Depth of seasonal water-table: *No WT present*

Winter : -
Summer : -
Episodic : -

Need for cut-off drains/diversion banks: *cut of drain required*

Need for surface water collector/cut-off drains: *cut of drain required*

2.7 Availability of reserve/setback areas (show details on sketch plan)

Reserve area available for extensions: *ample area available*

% of design area :*na*

Setback distance (between site development and on-site disposal design and reserve areas) :

2.8 Photographs attached : ~~*Yes*~~*/No*

3.0 SOIL INVESTIGATION

3.1 Soil profile determination

Method : *Excavation test pits*

Other (specify) :

3.2 Reporting (attach detailed soil/report as appropriate, see soil profile information and data sheet, Figure B1): *As attached*

3.3 Estimated soil category (see E4.1 and Table E1)

Summary :

Site test	1	2	3
Soil category determining DIR/DLR	*soil category is taken from restrictive horizon layer number 2* .	*excavartion carried out at end of bed indicate similar results*	*bor carried out at end of bed indicate similar results*

Remarks :

3.4 Recommended DIR (see 5.2.3.2) *3mm/day*

3.5 Reasons for DIR recommendations : *Due to the possible dispersive nature of the receiving soils the proposed treatment should be a primary treatment system. The discharge should be LPED to irrigation trenches (200x200) to the relatively flat area to the north of the house location. The trenches should be at 1m centres and laid flat by following the hill contours. The discharge should be to the top soils layer only (following the removal of vegetation, to be later reinstated). The 200x200 gravel trenches to be laid within the topsoil layer formed from top soils and grasses as removed from the site excavations. Topsoils to be at least 250mm to the irrigation area. The irrigation area should be additionally planted with water favouring vegetation to utilise evapotranspiration potential to further minimise flow to the underlying soils.*

4.0 GENERAL COMMENTS

4.1 Groundwater quality issues: *none applicable*

4.2 Type of land-application system considered best suited to site and why: *as above*

4.3 Overall evaluation of minimum land-application area for site: *as above*

4.4 Results of consultation with other interested parties: *Not required*

4.5 Other comments, for example special precautions which may be needed: :

SITE AND SOIL EVALUATION FORM – EXCAVATION LOG

Figure B1 AS/NZS 1547:2012

Client: _____LENSEN_____ **Job:** _____3960_____ **Excavation Number:** _____1_____ **Logged By:** ____G KERRIGAN_____

Address: _____ 120 WINDHAWK RISE, HAWKESBURY _____ **Surface Level: R L :** _____NA _____

Date of inspection: _____27 June 2017 and 7 March 2018_____

Slope: _minor slope to east to a small portion of the bed area_____ **Land form element:** _____hill ridge line _____ **Surface conditions:** _Pastoral _____
Indicative drainage: ___hill slope drainage to valleys_____
Surface stones: _____none relevant_____ **Ground cover:** _____ grass – pastoral land _____ **Watertable depth:** _____none found _____
Land surface notes: _____Minor evidence of Loess soil to existing minor road side cuttings _____ **Parent material:** _____Colluvial deposits _____

Layer	Lower Depth (mm)	Horizon	Moisture Conditions (See note 2)	Colour (Moist)	Field texture	Coarse Fragments % volume	Structure (see Note 3)	Modified Emersion	Sample Taken (Y/N)	Consistency (see Note 4)	Soil Category	Other assessment
1	100-150	topsoil	dry	brown	Top soil loam		Single grained	na	no	loose	3	Pastoral grass,
2	350	clay silt loams	dry	Light, orange brown	clay silt loams		minor structure		no	firm	4	
3	600	dense silt clays	dry	Light yellow brown	silty clays dense		dense		no	firm	5	fine silts, site indicates evidence of loess erosion.
4	not determined	hard pan clay loam	dry							very firm	5	

NOTES:
1 **Use another form of >5 layers of major horizons.**
2 **Dry, moist, very moist, saturated.**
3 **Apedal (no peds) Either single grain or massive.**
Pedal (observable peds) Weak, moderate or strong.
4 **Strength – loose, very weak, weak, firm, very firm, strong, very strong, rigid.**
Stickiness (when wet) – non, slightly, moderately, very.

Notes/comments/observations:

Layer 1 – Given the underlying limiting horizon of loess soils of layer 3 and poor permeability of layer 2 we consider the discharge should be to the upper surface layer of topsoil. The construction of the proposed irrigation area will entail the removal of the vegetation layer, and build up of the bed areas to at least 250mm deep, the removed vegetation layer should be reinstated upon the formed gravel irrigation trenches.

Layer 2 & 3 – Underlying soils are fine silt and the property indicates evidence of minor loess soils erosion.

Overall soil category assigned: _____**5** (restricted by limiting horizon of layer 3)_____

Maximum depth of system: ___Due to the possible dispersive nature of the receiving soils the proposed treatment system should be septic tank treatment to irrigation (200x200) trenches. The discharge should be LPED to trenches to the relatively flat area to the north of the house location. The trenches should be 0.2x0.2m and at 1m centres and laid flat by following the hill contours. The discharge should be to the topsoils layer only (following the removal of vegetation, to be later reinstated). The gravels to be laid upon the topsoil layer and reinstated with top soils and grasses as removed from the site excavations to create a minimum of 250mm of topsoil to the irrigation area. The trench bed should be additionally planted with water favouring vegetation to utilise evapotranspiration potential to further minimise flow to the underlying soils _____

Soil appears favourable for (list system types): _____LPED irrigation of primary waste_____ **Checked By:** _____GCKERRIGAN_____7.3.18_____