TAUPO DISTRICT COUNCIL

Kinloch Structure Plan

Kinloch Infrastructure Cost Estimates

June 2004
Reference 04.16237.1

HARRISON GRIERSON CONSULTANTS LIMITED

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EXECUTIVE SUMMARY

Purpose of Report

The purpose of this report is to provide Taupo District Council with infrastructure expansion concepts to cater for anticipated population growth in the Kinloch Structure Plan area and costings upon which to base Development Contributions to be paid by developers in order to fund the required additional infrastructure capacity.

Infrastructure Demand

The current Kinloch township has 610 lots of which approximately 530 are built on. It is anticipated that the total number of Household Equivalent Units (HEU) will reach 1,930 as shown in Table E1.

Table E1: Existing and Proposed Development in Kinloch		
Developer	**Lot Numbers**	**Cumulative Total**
Current Kinloch	610	610
Lisland Stages 3&4	160	
GCD	289	
LochEagles	200	1,240
Commercial/ Infill / Other	140	1,399
Future areas	531	1,930

These figures are subject to variation through the developers resource consent processes and consultation on the Structure Plan itself.

Design Criteria

The following design criteria were chosen for the Kinloch infrastructure expansion. These are based on Taupo District Council engineering standards, the Draft New Zealand Drinking Water Standards and the anticipated wastewater discharge consent conditions taking into account discussions with environment Waikato and the recent Turangi WWTP consent.

Table E2: Water and Wastewater Design Criteria	
Water Supply	
Typical Demand	1.0m³/day
Peak Demand	2.2m³/day
Min/Max Pressure	225/750kPa
Fire Hydrant Min	100kPa
Fire Flow (residential)	24l/s
Fire Flow (commercial)	50l/s
Wastewater	
Flow	1.0m³/lot
Loads	Typical Domestic Wastewater (no allowance for industrial uses)

The treated wastewater standard anticipated nutrient reduction requirements and disinfection to meet public health requirements for surface irrigation.

Table E3: Proposed Effluent Quality for Resource Consent Limits for Kinloch			
Parameter	**Units**	**Median**	**90 Percentile**
$CBOD_5$	g/m^3	10	20
Suspended Solids	g/m^3	10	20
Total Nitrogen	g/m^3	8	15
Total Nitrogen	kg/d	15	-
Ammonia	g/m^3	2.5	5
Total Phosphorus	g/m^3	2.0	4
Total Phosphorus	kg/d	4	-
PH		7	6-9
Faecal Coliforms	MPN/100ml	10	100

Wastewater disposal is land based on subsurface rapid infiltration at a maximum application rate of 9.4m^3/day to provide a conservative estimate. Further investigation as part of the resource consent provision may result in a higher loading rate.

Infrastructure Design Concept

The expansion and upgrade of the water supply system comprises the following components:

- New 3000 m^2 reservior
- New ring main and booster pump station
- Upgraded electrical supply
- Duplicate intake structure and rising main to treatment plant
- Upgraded chlorine system
- New UV and algae removal systems

(Refer Drawings appended)

The Wastewater reticulation, treatment and disposal system requires the following:

- New 200 m sewer main down Kinloch Road.

- Upgraded and expanded wastewater treatment plant including flow, balancing, installation of Membrane Bioreactors with nutrient removal, aeration upgrade, new inlet works and building extensions.
- New Treated wastewater storage pond (24 hours storage).
- New irrigation pump station.
- New irrigation rising mains to land disposal areas.
- New subsurface rapid infiltration irrigation systems.
- Upgraded electrical supply.

(Refer Drawings appended)

Infrastructure Costs

Cost estimates for the required works are summarised in the following table along with the cost per lot for development contributions.

The costs are divided into capacity increases (payable by new lots only) and level of service improvements (payable by all lots, new and existing).

The cost estimates are provisional in that they are based on the anticipated resource consent conditions. The final consent conditions and hence the actual cost of meeting these conditions will not be known with certainty until the consent processes are completed.

Table E4: Kinloch Infrastructure Cost Estimates								
	Water Intake and Treatment	**Water Retic and Reservoir**	**Wastewater Retic**	**Wastewater Treatment**	**Wastewater Irrigation P/S and Retic**	**Wastewater Disposal System**	**Wastewater Land (Land Purchase and Fees)**	**Total**
Capital Expenditure								
Capacity Increase	$302,000	$2,874,00	$353,600	$3,535,000	$2,717,000	$2,461,000	$170,000	$12,412,600
Level of Service Inc	$753,000			$1,858,000				$2,611,000
Total Capex	**$1,055,000**	**$2,874,00**	**$353,600**	**$5,393,000**	**$2,717,000**	**$2,461,000**	**$170,000**	**$15,023,600**
Cost Per Lot								
Capacity Number of Lots (New Lots Only)	1320	1320	1320	1320	1320	1320	1320	
Cost per Lot	$229	$2,177	$268	$2,678	$2,058	$1,864	$129	**$9,403**
Level of Service Number of Lots (All)	1930	1930	1930	1930	1930	1930	1930	
Cost per Lot	$390	$0	$0	$963	$0	$0	$0	**$1,353**
Total Cost per Lot	**$619**	**$2,177**	**$268**	**$3,641**	**$2,058**	**$1,864**	**$129**	**$10,756**

Resource Consents and Legal Requirements

A number of resource consents are required to provide for the expanded and upgraded infrastructure. Significant environmental and engineering investigation will be required some of these consents along with extensive consultation with interested and affected parties, including Iwi, Department of Conservation, community groups and residents.

The resource consents and legal requirements include:

- Water supply
  - A increase to the water take
  - Works in a watercourse (for land water intake structure)
  - Designations and Easements (for reservoirs, and easements pump stations and pipelines)
  - Earthworks (at treatment plant and reservoir sites)
- Waste water
  - Discharge to land (or water) of wastewater
  - Designation or Land use consent for wastewater plant site expansion
  - Easements over land (for wastewater treatment, pipelines and pump stations)
  - Discharge to air (odour) (may be part of discharge consent)

Kinloch faces an immediate issue in that the peak wastewater flow (at Christmas/New Year) is approximately the current discharge consent limit (457 m^3/d actual flow compared with the limit of 475 m^3/day). A variation to this consent is required immediately to allow for higher flows for the next 2 - 3 years while the new full discharge consent goes through the process of investigation, consultation and hearings, and new infrastructure is built.

Conclusion and Recommendations

A number of conclusions have been drawn and recommendations made as to additional investigations, design work and timing are proposed.

1.0 INTRODUCTION

The township of Kinloch is experiencing rapid growth. A number of subdivisions and other developments are proposed that will significantly increase the population. As a result Taupo District Council is preparing a structure plan for the Kinloch area to guide development in the future.

As part of undertaking this structure plan and evaluating developer contributions, Taupo District Council has engaged Harrison Grierson to evaluate infrastructure upgrade and expansion requirements for the Kinloch area.

The additional population in Kinloch will create demand for additional capacity for water supply and wastewater treatment. Expansion of the existing infrastructure will be required. The costs of the expansion will be borne by the developers and in order that appropriate costs are allocated for the infrastructure expansion, costs estimates for the expansion are required.

Quality improvements for water and wastewater treatment are also required to comply with health and environmental standards. The costs of these improvements will be shared between existing and future users.

In addition to these infrastructure expansion requirements, Taupo District Council will also be required to obtain resource consents for both the wastewater discharge and additional water take. As part of this project Harrison Grierson will prepare the necessary technical documentation and provide technical advice in support of the resource consent applications. This report includes a scoping of the likely issues involved in obtaining the necessary consents.

1.1 PURPOSE OF STUDY

The purpose of this study is to provide a concept plan and costings and scope the resource consent requirements for future water and wastewater infrastructure for Kinloch. This report is the first stage of this.

1.2 SCOPE OF REPORT

This report includes the provision of water and waste water treatment, storage and bulk reticulation as well as the expected resource consent requirements. Detailed Assessment of Environmental Effects (AEE) reports for the required resource consent are not included at this stage.

1.2.1 Water Supply

The following tasks were undertaken for the water aspects of this project:

- ***Structure Plan Review*** - Liaison with Council planning and engineering staff to clearly establish the extent of each development, the area as a whole and the responsibilities of Council and each developer.

- ***Demand Forecasting*** - In accordance with the expansion and TDC standard allowances for water demands for each of the proposed development areas were estimated.

- ***Resource Consent Application*** - Scoping of resource consent requirements and an evaluation of the additional water take requirements and any other environmental aspects associated with the resource consent application.

- ***Infrastructure Upgrade/Expansion*** - The infrastructure upgrade and expansion were quantified from the demand forecasting provided. This will include an allocation of water demand per housing lot and the expansion or planned expansion will evaluate the following

  - water take system expansion requirements
  - pumping station upgrade requirements
  - treatment plant improvements and expansion requirements
  - reservoir and system storage requirements to be provided by Council and those to be provided by developers
  - reticulation requirements.

The above have been completed to a concept stage with clear design criteria identified and associated cost estimates provided.

1.2.2 Wastewater Treatment and Disposal

For wastewater the following tasks were undertaken:

- ***Structure Plan Review*** - Liaison with Council planning and engineering staff to clearly establish the extent of each development, the area as a whole and the responsibilities of Council and each developer.

- ***Demand Forecasting*** - In accordance with the expansion and TDC standards for wastewater flows and pollutant loads for each of the proposed development areas were estimated.

- ***Resource Consent Application*** - Scoping of resource consent requirements and identification of any ecological or other field investigations that may be required.

- ***Infrastructure Planning and Expansion***

  - *Reticulation* - A brief overview of the reticulation requirements that will need to be provided by developers. This will be established in accordance with Taupo District Council standards.

  - *Treatment Plant Expansion Requirements* - This may include a number of options for an expansion and any improvements required to meet more stringent effluent standards, associated concept design and costs estimates.

  - *Disposal System Requirements* - This will involve an evaluation of the disposal options, which will generally be land based disposal.

All of the above tasks have been completed to concept level with cost estimates provided and the information available for incorporation into the structure plan and AEE documentation as necessary. The work was carried out in close communication with Taupo District Council planning and engineering staff.

Note that developers will be responsible for providing reticulation within each subdivisions and connection to the Council mains at designated points.

2.0 INFRASTRUCTURE DEMAND

Demand for future water supply and wastewater generation have been established based on development data provided by the Taupo District Council and discussion with developers. Demand factors are based on Taupo DC engineering standards, with consideration for measured flows and pollutant loads.

2.1 CURRENT AND PROPOSED DEVELOPMENT

The current township of Kinloch consists of 610 lots of which approximately 535 have been built on. There are a number of proposed developments in the Kinloch area, the main ones expected to be completed by the end of 2004 are the Lisland (Stages 3 and 4), Kinloch Golf Resort (GCD) and LochEagles developments. There is also significant future potential for other areas to be developed. The table below shows the existing and proposed developments and the expected number of lots in each.

Table 1: Existing and Proposed Development in Kinloch

Developer	Lot Numbers	Cumulative Total
Current Kinloch	610	610
Lisland Stages 3&4	160	
GCD	289	
LochEagles	200	
Commercial/ Infill / Other	140	1399
Future Areas	531	1930

The figures for the proposed developments by Lisland, Golf Course Developments and Loch eagles are provided by the developers.

The estimate of infill is based on current rates of infill development at 2 per year. Assuming this rate coniums over the next 30 years this amounts to an additional 60 lots.

Commercial development is provided for in the LochEagles development in addition to the residential lots. A gross floor area has been estimated as 4,000m. Of this for flow calculation purposes it has been assumed that 3,200m² (806) is retail and 800m² (20%) is commercial. Using the standard figures in the Taupo District Council Development Contributions Policy (0.2 m³/100 m² this gives a household equivalent of 10 lots.

The future areas identified in the draft Structure Plan provide for a certain lot yield. This may vary depending on resource consents obtained by landowners and hence some uncertainty remains as to the ultimate number of lots in the

structure plan area. However this is considered the best available information at this time.

2.2 FLOWS AND LOADS

Water demand (flows) and wastewater flows have been determined as a first stage to estimating infrastructure requirements.

2.2.1 Future Water Demand

The forecasted total number of lots including un-consented lots are 2238. (This includes the rural water supply area of Whakaroa which is supplied from the Kinloch treatment plant).

The typical water consumption per lot is set by Taupo District Council at 1.0m³/lot/day, which results in a daily total of 2,238m³.

The peak water consumption per lot is estimated by Taupo District Council to be 2.2m³/lot/day typically lasting for two weeks per year. The additional 1.2m³/lot/day places an additional capacity (supply requirement) demand of 2,686m³/day. For two weeks, that is an additional an additional 37,604m³. This peak demand cannot be met by the buffering capacity of reservoirs as this would be impractical. The new water supply and treatment facility will therefore have to ultimately be designed to meet the peak 2.2m³/lot/day, a total of almost 5,000m³/day.

The future water treatment facility would therefore have to be designed to treat up to 2,238m³/day (94m³/hr) most of the year and have the ability to maintain a peak day flow of up to have the ability to maintain a peak day flow of up to 5,000m³ (208m³/hr) for approximately two weeks per year.

It is noted however that some of this peak capacity could be stored in reservoirs for the peak demand and through staged implementation of the plant expansion certain items of the expanded treatment capacity may be deferred for a significant period of time.

2.2.2 Future Wastewater Flows and Loads

Future flows were estimated from the number of lots (rounded up to 2000) and assuming a factor for wastewater generation of 1 m³/lot, and a peaking factor for design of 2.05. The peaking factor is based on typical flow assumptions from the literature (Metcalf and Eddy).

Future peak storm loads were estimated based on the typical ratio of averaged sustained peak flowrates to average annual flowrates from the literature (Metcalf and Eddy), from this it was determined that a four day storm period

would have the greatest flow effect on the treatment plant creating approximately an extra 500m^3/d over the four day period.

Future Loads were estimated using three different estimation process. Firstly the current load data was increased in proportion to the increase in population, secondly the loads were estimated based on population equivalents assuming four people per lot producing 250L/p/d and thirdly the loads were estimated assuming 5 people per lot producing 200L/p/d. These three estimates were then compared and to give a conservative estimate of future loads the highest value from each three was chosen for each parameter. A table of loads is detailed below, and details of the estimation is presented in Appendix 1 along with the Taupo DC data used to establish loads.

Table 2: Estimated Loads to Kinloch on Completion of Expected Development

Parameter	Load (kg/d)	Concentration at Ultimate Flow mg/l
Ultimate Flow		1930 m^3/d
COD	1,362	706
BOD_5	614	318
Suspended Solids	600	311
TKN	136	70
Ammonia	80	41
Alkalinity	400	207
Total Phosphorus	25	13

3.0 DESIGN CRITERIA

Clear design criteria are required in order to generate engineering designs and identify issues and requirements for the expansion of the Kinloch water and wastewater infrastructure. The following section sets out the criteria used in this report.

3.1 WATER TREATMENT

The drinking water quality required has been taken as that indicated by the Draft NZ Drinking Water Standards. This will require that the treatment process at Kinloch be upgraded in terms of level of treatment as well as capacity.

The anticipated future water quality standard will require that the treatment plant provide:

1. Disinfection (Bacteria and Virus inactivation)

2. Protozoa removal

3. 0.2mgl/L residual chlorine in treated water leaving the water treatment plant. Minimum contact time is 30 minutes.

In addition there is the risk of future algae blooms in Lake Taupo which can cause significant taste, odour and the possibility of toxicity problems and affect the operation of the disinfection system.

3.2 WATER RETICULATION

The water supply system will generally be designed in accordance with the "Taupo Code of Practice for Development of Land". The main exception to this is the use of $2.2m^3$/lot.day for estimating peak day demands (including household irrigation requirements) and a peaking factor of 2.6 for afternoon/ evening peak hour demands

The following design criteria were used for assisting the existing and developed water supply scheme in Kinloch:

- Domestic demand of 2.2 m^3/lot.day
- Peak hour demand factor of 2.6
- Typical minimum working pressure of 225 kPa
- Typical maximum running pressure of 750 kPa
- Minimum running pressure of 100 kPa at fire hydrants
- Fire fighting requirements of 25L/s (residential, class E); 50 L/s (commercial) while maintaining a residual pressure at other hydrants of 100 kPa
- Principal reticulation shall be networked so as to provide at least two directions of supply to any group of sites.

New reservoirs were sized to provide approximately 24hr supply to the area being served.

3.3 WASTEWATER RETICULATION

Taupo District Council engineering staff have review the capacity of the existing reticulation network and pumping stations and consider it adequate. Reticulation outside the current area will be provided by developers to Council Standards.

3.4 WASTEWATER TREATMENT

Lake Taupo is a very important environmental feature and resource. Recent policy initiatives have been launched to improve water quality in the lake. These include stricter controls on wastewater discharges.

Taupo District Council has recently been granted a resource consent for expansion of the Turangi WWTP. This resource consent includes tight effluent quality limits for the plant.

It is anticipated that the expanded Kinloch plant will be required to meet similar standards. In addition while some of the development at Kinloch may occur in large lots, (e.g. 2000 m^2 or larger) which conventionally may be treated onsite, it is assumed for this report that reticulation and treatment at the main Kinloch Plant will be required in order to meet the effluent quality stands for disposal near the lake.

The table below presents the proposed effluent quality standards for the future wastewater plant on the Kinloch catchment. In considering effluent quality requirements, recent consent standards such as those required at Turangi have been considered, along with what is readily achievable through modern high rate treatment technologies. In addition consideration has also been given to the fact that the final effluent may be utilised as an irrigation resource for the new golf course. This will require a high degree of disinfection and is thus reflected in the efficient quality proposed.

Table 3: Proposed Effluent Quality for Resource Consent Limits for Kinloch			
Parameter	**Units**	**Median**	**90 Percentile**
$CBOD_5$	g/m^3	10	20
Suspended Solids	g/m^3	10	20
Total Nitrogen	g/m^3	8	15
Total Nitrogen	kg/d	15	-
Ammonia	g/m^3	2.5	5
Total Phosphorus	g/m^3	2.0	4
Total Phosphorus	kg/d	4	-
PH		7	6-9
Faecal Coliforms	MPN/100ml	10	100

3.5 WASTEWATER DISPOSAL

The wastewater disposal philosophy proposed for Kinloch involves two components. Firstly beneficial use via irrigation to the Golf Course Development will be used when weather and soil conditions allow. In periods of wet weather, or other conditions when irrigation to the golf course is not possible, sub-surface rapid infiltration will be used at various sites. This will allow for disposal of the full ultimate flow in all conditions.

Disposal of the wastewater requires that the discharge is of a very high standard a discussed above. This enables surface irrigation where available and also limits the impact of nutrients in the wastewater which may find its way into Lake Taupo via surface or groundwater.

In addition there are constraints in terms of the types of disposal available for Kinloch. Direct disposal to the lake or surface waterway leading to the lake in the Kinloch area are considered less likely to be permitted due to environmental and cultural concerns.

Discharge to land must be carefully designed to ensure that the long term application rate does not exceed the ability of the land to accept the wastewater. In addition the large volumes discharged may have effects on the hydrological patterns in the area. Hence the application rate of effluent must be carefully considered.

Soils in the Kinloch area are pumice and generally free draining, however layers of clays or other material may exist in patches which can affect drainage.

For rapid infiltration (RI) disposal a loading rate of 66 mm/week or 9.4 mm/day has been selected. This is based on Taupo District Council's existing land disposal schemes and is in line with similar systems in the region.

A higher rate may be possible however this will not be known until further detailed investigations are carried out for the resource consent application. In the event of a smaller system being installed, contributions collected in excess of that required will be refunded.

Resource consents required for the discharge of treated effluent one:

- Discharge to land (Irrigation areas) this will require ecological, geotechnical and hydrological investigations to be carried out.
- Excavation consent (treated effluent storage)

3.6 REGULATORY AND LEGAL REQUIRMENTS

Various regulatory requirements will be generated by the infrastructure expansion. These include resource consents, associated consultation and agreements from land owners, and general consultation as required under the RMA.

The following sub-sections present the likely consent and other legal requirements and associated stakeholders and other groups that will need to be consulted.

3.6.1 Water Supply

It is anticipated that the following consents will be required for the upgrade in the water supply system:

- A increase to the water take
- Works in a watercourse (for lake water intake structure)
- Designations (for reservoirs and pump stations)
- Earthworks (at treatment plant and reservoir sites)

The increase in water take from Lake Taupo for water supply purpose will require consent, possibly ecological or other environment investigation and consultation with interested parties will be required. Designations or easements for proposed reservoirs and pipeline routes may be required.

Consultation with Iwi, Doc and agreement with the Golf Course Development on reservoir site and pipe routes will be required.

3.6.2 Waste water

It is anticipated that the following consents will be required for the upgrade in the wastewater system:

- Discharge to land (or water) of wastewater
- Designation or Land use consent for wastewater plant site expansion
- Easements over land for wastewater treatment, pipelines and pump stations
- Discharge to air (odour) (may be part of discharge consent)

The expansion of the plant will involve an increase in "footprint" of the plant and this may require a land lease consent. Excavation work may also require consent.

The discharge consent will require geotechnical hydrological and ecological investigations. Consultation with a wide range of interested parties will also be required. For the purpose of this report it is assumed that the treated wastewater from the plant will be discharged to land. Discharge to water would likely entail less cost however the resource consent process would be more complex in terms of ecological assessment and consultation.

The discharge consent would likely be publicly notified and a hearing required, due to the scale of the discharge and the sensitive receiving environment.

3.6.3 Department of Conservation/Iwi

The raw water rising main and the treatment water falling main to the existing Kinloch township pass through Department of Conservation (DoC) reserve and Maori land. Discussions with DoC and Iwi will be required to allow access for additional water supply pipes and expansion of water treatment plant site and associated earthworks.

3.6.4 Private Landowners

Some pipelines, wastewater land disposal areas, reservoirs and pump stations may be located on private land. To ensure security of tenure for the infrastructure in these cases, Council will need to conclude legal arrangements or agreements such as easements, leases, convenants etc.

3.6.5 Consultation

The various resource consents will require considerable consultation with interested and potentially effected parties.

These will involve complex issues of environmental and associated ecological effects, along with aesthetics, amenity, social and cultural effects as well as economic considerations.

This consultation process will be initiated with the Structure Plan process and will continue through the specific resource consent processes where specified parties and issues are likely to be more apparent.

4.0 WATER TREATMENT

The following sub-sections present the concept for the proposed water treatment plant upgrade and expansion for Kinloch.

4.1 CURRENT TREATMENT PLANT

The current water treatment plant comprises an intake on the lake edge at the eastern end of the beach. From here lake water is pumped up to the reservoir located at 430 m elevation. Chlorine is bubbled directly into the reservoir tank to provide disinfection but there is no set contact time and contact is dependant on sufficient hydraulic retention within the reservoir tank. The capacity of the existing reservoir, pipelines and pumps are limited and the standard of treatment does not meet the draft NZ Drinking Water Guidelines.

4.2 DESIGN CONCEPT

For the proposed expansion and treatment improvements it is proposed to provide a level of treatment that is compliant with the Draft New Zealand Drinking Water Guidelines. In addition we have also considered the potential for algae blooms within the lake and have allowed for algae removal from the raw water if this becomes necessary in the future. One of the key requirements of the New Zealand Drinking Water Standard is the removal or disinfection of protozoa.

Disinfection and Protozoa Removal

Protozoa removal requires either:

1. A multi-barrier system consisting of sedimentation + filtration + chlorine disinfection.

2. Micro-filtration followed by chlorine disinfection.

3. Ultra-violet (UV) disinfection alone.

Bacteriological disinfection as measured by indicator organisms such as E Coli can be achieved by chlorine alone, but all three methods above would also reduce E Coli. As the Kinloch raw water does not require turbidity reduction, the first two methods requiring filtration are more capital intensive as well as requiring more land area and operator attention than the 3rd option of using UV to inactivate micro-organisms. It is therefore anticipated that the most economical method would be to use UV.

Proposed Disinfection System

The UV disinfection system would be in-line with the inlet pipe before entering the reservoir. Two equal, parallel UV chambers would be provided that operate on duty/standby basis. Each chamber would be designed for a water flow of 104m³/hr. The standby chamber would enter into duty during peak demand when the flow has increased to 208m³ /hr. The UV chambers and control system would be housed in a new building. A clean-in-place chemical cleaning system would be provided for UV lamp cleaning.

A budgetary quotation for the UV system has been obtained from a reputable supplier. However since the NZDWS amended water quality standard is still in the drafting stage and due to lack of data on the raw water, the design parameters that the supplier used to size the UV system for costing are based on international practice and assumed raw water quality.

After UV disinfection, chlorination is necessary to impart residual chlorine in the water before entering the supply network to prevent re-infection downstream. The existing chlorine disinfection facility consists of a 70kg chlorine gas cylinder feeding a gas chlorinator to inject chlorine into the 100,000 gallon (455m³) circular reservoir. This existing dosing facility is inadequate for two reasons:

1. The current method of injection is to dose directly into the water body through the top of the reservoir. Good chlorine disinfection practice requires rapid, thorough mixing into the inlet stream before entering the contact tank. This means installing a rapid mixing device in the inlet pipe a few metres before the reservoir. An example would be a multi-jet injection system where chlorine is dosed via multiple nozzles into the pipe so that there is thorough mixing before entering the tank.

2. The inlet and outlet of the reservoir are very close to each other. Although the inlet is placed at floor level and the outlet above water level and directed in the opposite direction to the inlet, hydraulic short-circuiting is inevitable in such an arrangement. This would shorten the contact time for some of the water stream. Relocating the inlet to the opposite end of the tank would minimise short-circuiting. Alternatively a baffle could be installed within the reservoir to further increase contact time and prevent short circuiting.

Algae Mitigation

Algae blooms in the lake can be handled by providing preliminary treatment (before the UV system) consisting of filtration for algae removal followed by activated carbon filters for removal of the algae exudates. These treatment units can be attached to the rising main before the UV system when needed and taken out of service when the algae bloom disappears. These filter units require

additional pressure of approximately 4 bar compared with normal operation. This additional pressure can only be supplied by having in-line booster pumps which can also be part of the add-on pre-treatment plant. An alternative process could be installed using Dissolved Air Flotation (DAF). This can be determined at the detailed design stage.

The algae removal equipment would be installed to operate only in the event of an algae bloom in the lake. This may not require installation for some time.

The design concept for the upgraded water treatment plant is appended as Drawing 16237-PFD101 and the proposed layout is shown in drawing 16237-WS101.

4.3 EXPANSION REQUIRED

Given the development proposed the existing water supply is severely limited and will require capacity expansion as well as treatment process improvements.

The current intake, pump station and rising main are sized for 30L/s or 2,600m³/day. To augment the capacity to so that an ultimate peak day total of 5,000m³/day can be achieved and the associated upgrade to the WTP to achieve the future NZDWS water quality, the following items are proposed:

1. Add a parallel suction pipe of equal size and screen of equal design to existing.

2. Add one raw water pump of similar specifications to the existing (Grundfos SP125-5-2). This will operate in parallel with one other existing pumps in a two duty/one standby mode.

3. Add a parallel rising main, 150NB from the lake edge through DOC land, to the WTP.

4. On entering the WTP area, the new and the existing rising mains combine into one new 200NB pipe.

5. Install an electro-mag flow-meter in this 200NB pipe-line for measurement and control.

6. Add a UV in-line system consisting of one duty + one duty/standby bank in parallel. Each of capacity 130 m³/hr. On average days when the demand is 1.0 m³/lot/day, the duty bank is sufficient to treat. On peak demand periods (2.2 m³/lot/day), the standby bank operates together with the duty bank to treat the increased flow.

7. Construct a small building to house the new UV plant.

8. Install a multi-jet chlorine injection system into this new 200NB inlet main after the UV.

9. Blind-off the existing 150NB inlet pipe and lay a new 200NB pipe to enter the existing 100,000 gal reservoir. Locate at the opposite end to outlet to minimise short circuiting within the tank and ensure sufficient retention time for chlorine contact, or alternatively install an internal baffle

10. Install a new residual chlorine monitor on the reservoir outlet.

The add-on pre-treatment plant is likely to consist of the following:

1. Booster Pump set - 1 duty/1 standby.

2. Pressure filters (e.g. Arkal disc filter) to 20 micron (or Dissolved Air Flotation (DAF)).

3. Pressure Carbon Filters.

4. Associated automatic valves and piping.

This add-on pre-treatment plant is only necessary when there is algal bloom in the lake and would be installed and valved as a stand by unit in parallel to the main treatment flow. Details of the water treatment plant are presented as a Process Flow Diagram and layout in the drawing section as Drawings No. 16237-PFD101 and 16237-WS101.

Some earthworks are likely to be required to provide sufficient space on the site for the additional process equipment.

4.4 COSTS

The upgrade costs for the Kinloch water intake and treatment system are shown below.

Table 4: Water Intake and Treatment Capital Expenditure	
Capital Expenditure Component	**Cost**
Capacity Increase	$262,00
Level of Service Increase	$753,000
Resource Consents	$40,000
Total	**$1,055,000**

This capital expenditure for additional capacity is primarily for the additional intake structure and pumping and upgrading of the electrical system structure. The level of service component includes the UV system and the algae removal. Refer schedule of costs in Appendix 5.

4.5 IMPLEMENTATION

Council intends to carry out the UV treatment upgrade in the short to medium term.

Initially the existing intake pump and structure will be sufficient, as demand increases however there will be a requirement to add the third intake pump and expand the associated intake structure and pump station/chamber.

The algae removal system will be installed at a later time as the likelihood of algae bloom increases.

4.6 ASSUMPTIONS AND RISKS

The following assumptions have been made as part of the concept design.

Existing reservoir and pipelines are in satisfactory condition for continued use.

Algae filtration only required during algal blooms. Not used during normal operation.

Some earthworks required for the expanded treatment plant (subject to DOC approval).

Iwi and Department of Conservation Land Easement/Agreement to add a second raw water pipeline and a second treated water pipeline across their land.

5.0 WATER RETICULATION

The following section presents the water reticulation concept for the proposed expansion at Kinloch.

5.1 DESIGN CONCEPT

The water supply design proposed is based on a new reservoir providing storage and pressure for a large proportion of the structure plan area. This will be connected to the new developments and the existing township by a new ring main through the golf course development.

In terms of water supply, Kinloch is complicated somewhat by the elevated areas of development proposed. This requires a combination of increased storage capacity to meet increased demands and to provide sufficient pressure, and booster pumping to get water to higher elevations.

The design concept proposes a new reservoir of 3000 m^3 capacity located in the golf course development at an elevation of 460 m to provide for required flows and pressures to most areas. The 3,000m^3 reservoir will ultimately provide water to Upper and Lower Golf resort development, Lisland development, and development areas 1, 2, 5 and 6 (refer figures 1 and 2). A small 300-500 m^3 reservoir to be provided by a future developer will provide water to bands 3 and 4 (Refer Figure 2). The existing reservoir will continue to provide water to the existing Kinloch township

Figures 1 and 2 and Drawing 16237-WS200 show the design concept of the network supply and system.

Additional private reservoirs and booster pumping will also be required where development is to occur at less than 10m below the TWL of the public reservoirs (to maintain a minimum pressure of approximately 100kPa required at fire hydrants) these will provided by developers.

5.2 EXPANSION REQUIRED

The figure below summarises the expansion requirements to the existing main systems for Kinloch for Stage 1 development (developments currently in resource consent stage). Refer also to plan 16237-WS200, in the drawing section. Pressure reducing valves are likely to be required at certain locations to reduce pressure in the system until demands are increased (ultimately) under the Stage 2 (future) development. Flow control valves will also be required to manage the direction of flows within the system.

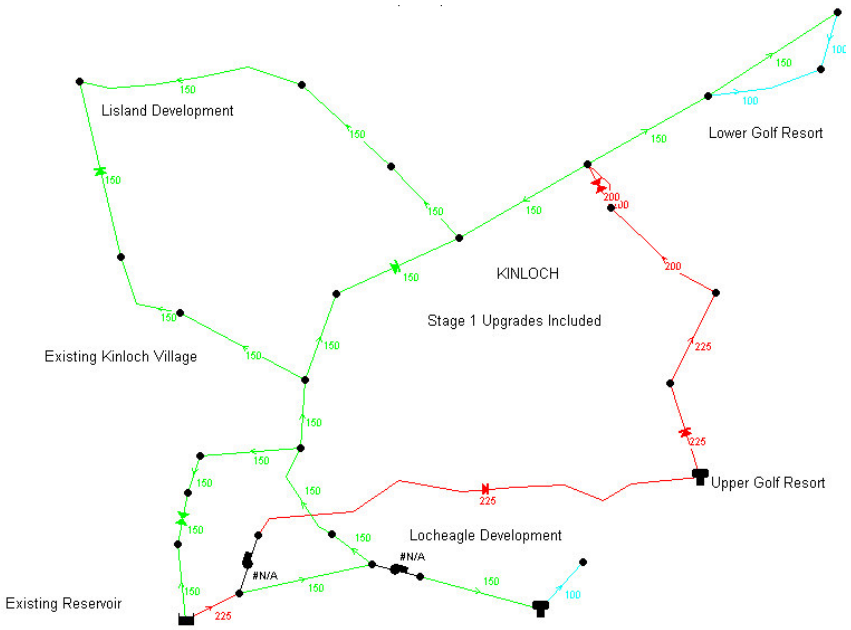


Figure 1: Stage 1 Development Principal Water Mains

The figure below summarises the expansion required for ultimate development under Stage 2.

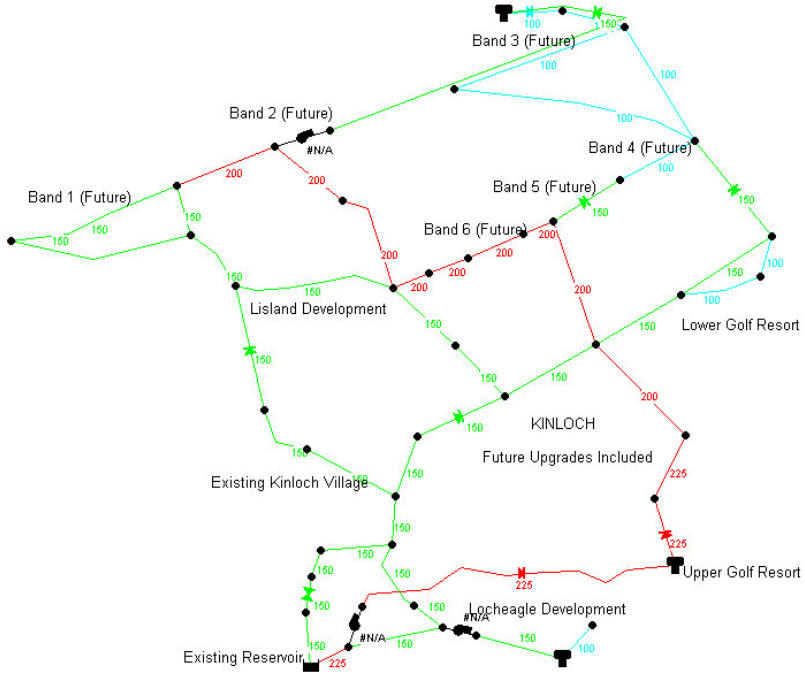


Figure 2: Stage 2 Development Principal Water Mains

The establishment of the 3000 m³ and the 300 m³ reservoirs will enable fire flow residual pressures to be met in most areas, with the exception of those areas immediately adjacent to the reservoirs (if no higher reservoirs are provided) and some parts of Band 2 due to the high elevations in the area. Emergency boosting in those situations may be required.

It is expected that the Stage 2 reticulation, reservoir and pumping stations will be provided by developers and these are not costed in this report, nor are they included in the development contributions.

5.3 COSTS

The following capital costs have been estimated for the work proposed. All of the proposed works is to provide for additional capacity for the new developments, no change in the level of service is proposed.

Table 5: Water Supply Reticulation Cost Estimates	
Capital Expenditure Component	**Cost**
Capacity Increase	$2,874,000
Level of Service	-
TOTAL	**$2,874,00**

The capital costs comprise the new 3000 m^2 reservoir , the ring main, and the booster pumping station to supply the new reservoir. The costs for each component are included in the cost schedule in Appendix 5.

5.4 IMPLEMENTATION

The 3000 m^2 reservoir, ring main and boosters pumping station will be installed in the short term to supply the developments already consented. Reticulation, storage and booster pumping above areas sewed by the proposed reservoir, and in the future development areas will be provided by developers.

5.5 ASSUMPTIONS

The assessment of development scenarios has been based upon limited information in terms of development layout and elevations. There is a risk that the system may require remodelling as development design progresses in more detail to ensure that specific fire flow requirements are able to be met in all areas.

The reservoirs are proposed to be located at high elevations. The exact location of the reservoirs has not been reviewed, however, and due to the steep nature of parts of the proposed developments there may be some geotechnical issues that need to be addressed, and depending upon the outcome of preliminary engineering investigations, alternatives may need to be considered.

6.0 WASTEWATER RETICULATION

Expansion of the wastewater reticulation system is required to provide for areas outside the current sewerage catchment.

6.1 NEW RETICULATION

6.1.1 Sewer Mains

A new sewer main along Kinloch Road will be required to serve new connections at the northern end (Refer Drawing 16237-WW200).

6.1.2 Internal Reticulation

Developers are required to provide all the internal sewer reticulation within the development areas to engineering standards specified by the Council.

The reticulation provided by the developer will connect to the Council's reticulation network at points specified by Council.

6.2 EXISTING COUNCIL RETICULATION

Council's engineering staff have advised that the existing sewer network and pumping stations have adequate capacity to accept the flows currently proposed.

Additions from future areas to the West of Kinloch may require upgrading of pipe mains depending on the connection point. This can be addressed at the time as part of the specific development proposal.

6.3 COSTS

The following capital cost has been estimated for the work proposed (new gravity main along Kinloch Road). All the proposed work is to provide for additional capacity for new development. No change in level of service is proposed.

Table 6: Wastewater Reticulation Cost Estimates	
Capital Cost Component	**Cost**
Capacity Increase	$353,600
Level of Service Increase	-
TOTAL	**$353,600**

6.4 IMPLEMENTATION

The new sewer main will be installed in the short term in conjunction with planned developments along Kinloch Road.

6.5 ASSUMPTIONS

A conservative pipe size has been allowed to provide for all anticipated future connections with the structure plan area.

7.0 WASTEWATER TREATMENT

Currently Taupo District Council operate a Sequential Batch Reactor (SBR) treatment process at Kinloch and several other plants in the district. The current upgrade of Turangi involves installation of Membrane Bioreactor (MBR) technology which achieves higher standard of effluent quality compared to SBR, without requiring additional filtration or disinfection.

Previous cost estimates for expansion of the Kinloch WWTP (Harrison Grierson Strategy Study 2002) have compared conventional technologies comprising SBR treatment with added sand-filtration and UV disinfection, with MBR technology. The costs for these two options have been within 10% of each other. Because of this, and the recent choice of MBR for the Turangi plant for this study only MBR technology is costed as indicative of the costs of achieving the required effluent quality. Taupo District will be able to evaluate different technologies in more detail prior to the detailed design stage.

7.1 DESIGN CONCEPT

7.1.1 Existing Treatment Plant

The existing Kinloch plant includes inlet screen and grit removal, two SBR treatment tanks, a waste activated sludge (WAS) tank, treated effluent storage, and disposal pump station to feed the current irrigation area.

7.1.2 Design Criteria

The proposed wastewater treatment plant is based on a set of design criteria. This provides a firm basis for estimating the cost and identifying potential constraints.

The inputs to the plant are set out in section 2.2.2. These are based on the expected ultimate flow of 1930 m^3/day and typical domestic wastewater loads. Commercial and retail development has been included in the population figures in terms of Household Equivalent Units (HEU) since the type of wastewater is

essentially the same. No allowance for significant non-domestic loads has been made.

The output criteria are set out in section 3.4 and include strict controls on nutrients (nitrogen and phosphorus) to reduce effects on Lake Taupo in line with Environment Waikato and Taupo District Council policies.

Additional safeguards to any public health risks include the provision of a storage pond for treated wastewater with capacity for 24 hour flow at peak periods. This allows for the wastewater to be retained out the plant, and not irrigated if a major treatment upset results in wastewater at less than the required standard.

The wastewater disposal loading rate was discussed in section 3.5. The chosen rate of 9.4mm/day for sub surface rapid infiltration is deliberately conservative in order that sufficient land area is identified and conservative costings are generated. If as a result of the resource consent process less are is required, costs may be lower.

7.1.3 Proposed Treatment Plant

The design concept for the expanded plant is illustrated in Drawing 16237-PFD100 appended. It is comprised of a Membrane Bioreactor (MBR) which involves aerobic biological treatment plus filtration of the effluent which provide solids removal and disinfection of the treated wastewater to the required standard.

The proposed MBR process will be designed with enhanced nutrient removal for nitrogen and phosphorus and provide for both the expansion in capacity and the improvements in effluent quality required. The existing plant will be modified and expanded with most of the existing infrastructure able to be used as part of the plant expansion/upgrade. The process is described in more detail in Section 7.2

7.2 EXPANSION REQUIRED

The current resource consent provides for the discharge of 475m³/day discharged to ground soakage. The peak load during the holiday periods 2003/2004 was 457m³/day. Hence there is almost no spare capacity during this period for additional discharges.

The treatment plant itself consists of two Sequential Batch reactors (SBRs) which can be operated to allow for wide variations in flow over time. The existing plant is considered capable of treating flows of up to 662m³/day, however there are a number of limitations on certain process equipment items such as the blowers and aeration systems which would need upgrading to

achieve this (Refer HG 2001 Process Review Report). It should be noted that the current effluent quality in terms of bacteriological and nutrient levels may not be suitable for the increased requirements expected at the higher future flows.

The upgrade of the plant will require a major expansion and given that large storage capacities may be required, especially for the final effluent, this will require an increase in the land area for the plant. As the proposed development occurs over time there is good potential for staging of the plant expansion to minimise large lump sum capex.

The proposed process includes:

- New inlet screen and grit removal to provide additional capacity (for the longer term developments).
- The existing SBR tanks will be used as influent buffer capacity and partially converted into a pump station for the new MBR process.
- Another influent pond will be created to cope with any extreme flow events.
- A new anoxic tank with carbon dosing for nitrogen removal.
- New process tanks as Membrane Bioreactor (MBR) tanks with aerated treatment and filtration for solids removal and disinfection, and alum dosing for phosphorus removal.
- A permeate tank added to provide the capabilities for reuse of the treated effluent as service water.
- A new treated effluent pond will be installed to provide 24 hours storage in the event of problems with the disposal areas or in the event that a process problem affects effluent quality.
- An expanded treated effluent pump station will pump the permeate to the disposal areas.

Process details for the above plant are presented on Drawing 16237-PFD100 in the drawings section of this report and a concept layout is shown as Drawing 16237-WW100.

7.3 COSTS

Capital costs are divided into capacity and level of service components as shown in the table below.

Table 7: Wastewater Treatment	
Capital Expenditure Component	**Cost**
Capacity Increase	$3,535,000
Level of Service Increase	$1,858,000
TOTAL	**$5,393,000**

The currently relatively high level of treatment results in capacity increase requiring the majority of capital expenditure, however the requirement for additional nutrient, removal and disinfection requires significant ' level ofservice' expenditure as well.

For details refer Cost Schedule in Appendix 6.

7.4 IMPLEMENTATION

Implementation can be staged over time, however there will be a requirement for a significant initial capital outlay of up to • required to provide the additional capacity and treatment quality for Stage 1 (currently consented developments and the existing lots). This is required to get the existing wastewater flow up to the quality of the proposed new standards.

Final decisions on the treatment technology, plant layout, and the implementation programme will require additional engineering analysis beyond the concept design stage used in this study for costing purposes.

7.5 ASSUMPTIONS AND RISKS

The following assumptions have been made for this study. MBR plant with pre- and post treatment storage for wet weather or other contingencies.

- Reuse of existing facilities as far as possible.
- Consent standards, in particular effluent quality are based on initial discussions and the requirements of Environment Waikato and the golf course development.
- Sufficient power to the site.
- Telemetry adequate for expanded plant.
- Geotechnical and environmental studies do not identify additional constraints.

8.0 WASTEWATER DISPOSAL

8.1 DISPOSAL OPTIONS

There are two main disposal options that have been considered, disposal to land via surface irrigation and disposal by rapid infiltration using subsurface drippers. Subsurface drippers have been selected rather than infiltration basins so that they can be used in the available golf course areas.

As discussed in an earlier section discharge to water via a rock filter or other infiltration system located adjacent to a waterway such as the Whangamata stream is technically feasible. Public perceptions and cultural aspirations may however limit its appeal and Taupo District Council have expressed reservations about this option. While this will need to be considered as part of the statutory requirements for the AEE and resource consent application it is not considered further in this report.

The broad philosophy proposed is to obtain beneficial use of the wastewater via surface irrigation onto the golf course development. This provides for irrigation over a wide area. A high level of effluent quality is proposed to allow for irrigation onto public areas. In times of wet weather when surface irrigation on the golf course is not required, or in the unlikely event that effluent quality is not up to standard can alternative methods of disposal will be required.

Subsurface rapid infiltration of the treated effluent into the ground at various locations around Kinloch is proposed as the second method of disposal.

Rapid infiltration into the free - draining soils in the Kinloch area allows the area required for disposal to be minimised by using high loading rates.

For the purposes of this study a loading rate of 9.4 mm/day has been chosen. This is consistent with other schemes in the area including the existing Taupo Land Disposal System. A higher rate may be provided, reducing the land area required, however this will require significant additional ecological, geotechnical and hydrological analysis. This work will be done as part of the resource consent application for discharge to land.

Taupo District Council's experience is that subsurface RI would not be limited by wet weather and hence will provide all year round disposal as required.

The potential irrigation areas are discussed in the subsections below. Refer to Figure 3 in Section 8.2 and drawing 16237-WW100 appended for the general size and location of these areas.

8.1.1 Kinloch WWTP land disposal - Rapid Infiltration

There is approximately 7 Ha of available land around the Kinloch Wastewater Treatment Plant. 3.9 Ha of this land is to be sold to Council by Lisland Properties Ltd as part of Stage 4 of the Lisland Holyoaks subdivision. Part of this area will be required for the expanded treatment plant and the remainder will be used for effluent disposal (Refer Drawing 16237-WW101). It is proposed that the flat areas of this land comprising approximately 2.2 Ha will be developed for rapid infiltration This land area adjacent to the plant has potential for disposal of 206m³/day at the proposed loading rate.

Currently Council uses part of the area for land disposal of effluent via a carbon bed and soakage trench system. This carbon bed was installed during 2002.

8.1.2 Kinloch Golf Course Development (GDC)

The golf course will irrigate extensively to maintain the fairways and greens. The primary source for this will be a bore operated by (GDC) and used to top up a storage lake on the resort site. (Refer drawing 2001-192-500). Treated wastewater can be used instead of bore water provided that certain effluent quality criteria can be met. The effluent standard proposed meets the public health requirements for irrigation on salad food crops (LTC 2000). Irrigation can also occur at night further reducing any public health risks. Low nitrogen and phosphorus will mean that the golf course nutrient budget requirements will not be disrupted by the effluent allowing for easier management.

Initial discussions with the golf course resort have shown that there is potential to reuse significant quantities of treated wastewater for irrigation provided that effluent quality standards can be met.

The Golf Resort provides the potential for disposal of approximately 1,900m³/day in the summer and up to 800m³/day in the winter. Wet weather and other factors will limit the irrigation on the golf resort land at times.

In summer the golf resort could irrigate almost all of the ultimate flow assuming that quality standards for the effluent quality are maintained. During the AEE stage further discussions will be required to ensure that the plant is designed to meet the appropriate standards and the methods to be used for application of the wastewater.

8.1.3 Golf Resort Rapid Infiltration

The golf course development have indicated that two areas on the golf resort site are available for rapid infiltration. These comprise 4 Ha and 1 Ha respectively (Refer Drawing 16237-WW200). These would be designed to use subsurface drippers in the ground to create a rapid infiltration system.

These areas combine have the potential for disposal of up to 471m³ /day based on proposed loading rate.

8.1.4 LochEagles Irrigation

LochEagles propose to plant and maintain green areas as part of the subdivision. The areas proposed are predominantly sloping areas not suitable for house lots. LochEagles propose to irrigate the planted areas to ensure tree survival. This irrigation system could be used for disposal of effluent.

The area available is approximately 3.5 Ha of sloping land (refer Drawing No. 02364-01 and LochEagles Figure 1 appended). This area has the potential for the disposal of up to 53m³/day in the summer and a lesser volume in the winter. A lower loading rate is assumed for this land due to its sloping nature.

The use of the LochEagles land for irrigation is limited by the small size of the reserve areas, the slope of the land and the distance from the Kinloch wastewater treatment plant. Maintenance will be limited due to the subsurface drippers. The slope of the land limits the irrigation application rates. Irrigation would also be likely to be affected by wet weather due to the relatively large stormwater catchment uphill.

For this reason irrigation of wastewater on the LochEagles land has not been examined in detail and is not considered viable for the purposes of the infrastructure study.

8.1.5 Kinloch Golf Course (KGC)

A further option is the land that comprises the existing Kinloch 10 Hole Golf Course (KGC). The owners are not involved in any developments on their land and hence are not required to vest land in Council as part of the subdivision process. However the land is suitable for irrigation, and the owners are interested in providing for irrigation on the property, and so the golf course has been included in this study.

The existing golf course in Kinloch comprises 10 holes and is owned by Kinloch Golf Course Ltd. The golf course currently has limited irrigation on its greens using pop-up sprinklers. The course is used by locals and holidaymakers and the operator charges low fees for access. Water for irrigation is sourced from the Kinloch water supply system and irrigation is currently limited due to the cost of water. The golf course recently sold land to the Kinloch Golf Resort company(GCD) and as part of this sale a covenant has been placed in the certificate of title such that the land cannot be developed for housing and must remain as open space. This potentially provides some certainty as to availability of the land for effluent disposal.

Discussion with the owners regarding irrigation of treated effluent on the golf course was carried out. While surface irrigation would be possible using pop-up sprinklers similar to the exiting green irrigation system the owners have indicated that they would prefer subsurface irrigation for reasons of potential public perceptions of health risks from the effluent. Increased maintenance costs for mowing etc are also expected for surface irrigation that may be avoided with subsurface irrigation. Hence infiltration using subsurface drippers has been investigated.

The total area of the golf course is approximately 14 Ha. Of this it has been assumed that approximately 10 Ha would be available for subsurface irrigation. This excludes treed areas, buffer zones to boundaries, and areas of significant slope.

While the land would not need to be purchased, Kinloch Golf Course Limited has stated that an annual rental cost will be charged for use of the land. There will also be infrastructure installation costs.

8.1.6 Land Available From Future Subdivisions

The draft Structure Plan provides for areas of land to be subdivided beyond the boundaries of the currently proposed developments discussed above. In the event that this occurs land may be required to be vested in Council to provide additional area for wastewater disposal.

It is assumed that this will provide sufficient area to accommodate the additional population expected as a result of these subdivisions, hence reducing the area of land required for disposal to that required for the flows generated by the subdivisions currently being processed is limited to those areas and potential infill and commercial development.

8.1.7 Summary of Land Disposal Options

The table below summarises the land disposal options for Kinloch. Areas and flows stated are based on the flow assumption and loading rates assumed. These may vary in the resource consent process or as a result of negotiations with land owners.

Table 8: Kinloch Land Disposal Options			
Land Parcel	**Available Area (Ha)**	**Potential Flow (m^3/day)**	**Comment**
Land around Treatment plant	2.2	186	
GCD	5	423	
KGC	10	790	9.3 Ha required
LochEagles Reserve	3.5	95	Lower loading rate due to slope
Future	6.4	531	Area sufficient to provide for future flows
Total (RI)	23.6	1930	Exclude LochEagles
GCD Surface Irrigation	40	1900 (800)	Summer/(Winter)

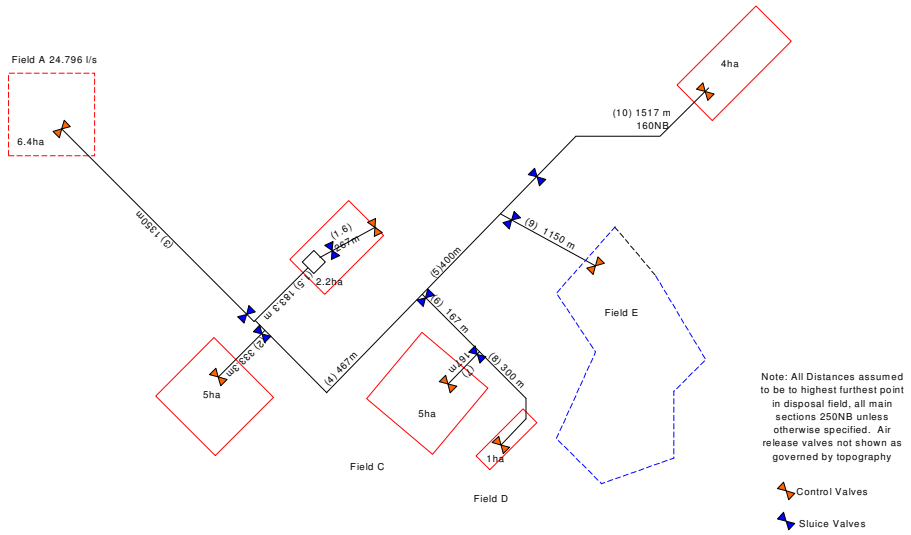
Area x 9.4 mm/day x 0.9 (10% Allowance for buffers etc)

Additional land outside the Structure Plan area could be investigated of any one of the above options become unavailable, or if Council prefer for operational reasons to have fewer, larger land areas.

8.2 DESIGN CONCEPT

The Rapid Infiltration system will consist of subsurface pressure compensating drippers. These will provide an even flow into the soil. The drippers will be installed below the surface and the area re instated to allow use of the land. Large areas can be installed. The treated effluent will be pumped to the various disposal areas by a dedicated pump station with associated control valves and telemetry.

**Kinloch WWTP New Effluent Pump Station &
Rising Main Cost Estimate Layout Schematic**



8.3 EXPANSION REQUIRED

8.3.1 Disposal areas

The area required for effluent disposal based on a loading rate of 9.4 mm^2/day, and allowing for some buffer area, access routes etc is 120 m^2/lot. This equates to a total area of 23 Ha required. 6.4 Ha would be provided by developers in the future structure plan areas, with the remaining 16.6 Ha located in the land around the wastewater treatment plant, the GCD land, and leased area of the KGC.

8.3.2 Pumping and Reticulation

A new pump station and reticulation for treated effluent will be installed.

The pump station and rising main system costed consisted of the following elements:

- Two Flygt CP3231/705 125kw 430mm impeller Submersible wastewater pumps
- Two Flygt CT3231/705 125kw 430mm inline wastewater pumps
- The appropriate control systems and telemetry
- A Wet well composed of a 4m x 3.5m precast concrete box section, 3.5m deep with a precast base slab

- A Chamber composed of 6m x 5.5m concrete block walls, 2.8m deep with a concrete base slab

- A PE80 Rising Main of varying dimensions (315mm to 160mm) with all the appropriate fittings, of total length 6100m

- Control valves for each of the disposal fields

8.3.3 Land Disposal Control and Management

The proposed land disposal system includes a number of separate land areas located at some distance from each other. In addition, in the case of the Golf Course Development (GCD), strict treated wastewater standards are required to allow for surface irrigation or public areas. For these reasons management of the land disposal system will be complex.

A monitoring and notification system will be required to provide assurance to the golf course that the treated wastewater meets the required standard. In the rare event that it does not meet the standard. Likewise the GCD will require a system whereby they can choose to limit the volume, or not accept the treated effluent at all of weather or soil condition or other factors warrant.

At times when the surface irrigation is unavailable the various/rapid infiltration areas will be used. This will require control valves and flow monitoring to ensure appropriate flows reach each part of the system.

Significant costs in terms of control valves and associated telemetry have been allowed for to provide the level of control required. As noted in an earlier section, Council may prefer for operational reasons to reduce the number of land disposal areas. This however will require identification and possibly purchase of suitable land at reasonable cost.

8.4 DISPOSAL SYSTEM COSTS

The table below sets out the costs of the components of the land disposal system.

Table 9: Disposal System Costs	
Capital Expenditure Component	**Cost***
Irrigation Pump Station	$570,000
Reticulation and Controls	$2,147,000
Land Purchase**	$170,000
Irrigation Equipment	$2,461,000
TOTAL	**$5,348,000**

* Cost includes contingency and engineering

** Still Subject to negotiation

The costs above do not include land costs as most of this will be provided by developers or on a lease arrangement. Negotiations are currently underway for purchase of the land around the treatment plant. This land will also provide additional area for the expansion of the treatment plant itself, and also formalise the buffer zone around the plant provided in the Transitional District Plan.

8.5 IMPLEMENTATION

The area of irrigation installed can be matched to the number of lots developed. The pump station and other section costs would be accrued at Stage 1, resulting in a higher proportion of the cost in Stage 1 than Stage 2.

Capacity for the initial flows and short-term growth will need to installed immediately. Over time the system will be progressively expanded to keep pace with the increasing flows as population grows.

The surface irrigation connection to GDC will be installed at such time as the GCD are able to accept the wastewater and the treatment plant has been upgraded to supply treated effluent to the required standard.

8.6 ASSUMPTIONS AND RISKS

Land disposal has been assumed as the most likely means of wastewater disposal. Discharge to water has not been costed due to the anticipated environmental and cultural concerns. These however must be assessed as options during the resource consent process and if found to be viable may significantly change the cost for disposal.

It is assumed that resource consents can be obtained for the proposed irrigation and rapid infiltration (RI) systems. Initial enquires indicate that similar RI

systems exist in the Waikato Region however this must be confirmed in the resource consent process.

Security of access to land - assume suitable easements, contractual arrangements, etc are obtained to provide sufficient security for Council and to satisfy EW consent requirements.

A single area for disposal would be cheaper to construct and operate however obtaining land in a single area is a key issue. This could be found outside the structure plan area. However some land is required for buffer area around the treatment plant and this can also be used for sub-surface disposal thus reducing land requirements elsewhere.

A more comprehensive evaluation of the land requirements, sub-surface and soakage characteristics and proposed areas will be undertaken as part of the resource consent application.

9.0 DEVELOPMENT CONTRIBUTIONS

Council and developers regard transparency and equity in the cost allocations as important issues. This section describes the factors considered in the allocation of the infrastructure costs to the various parties, including the existing users.

9.1 CONSIDERATIONS

9.1.1 Equity Among Contributors

Equity between developers is required in terms of development contributions. However depending on the particular circumstances of each development some contribute land suitable for use for infrastructure purposes and some may not. Different forms of land tenure may also be involved such as easements, leases and other contractual arrangements.

The costs in this report are based on the following assumptions:

Where land is vested in Council the land is counted as contribution towards land requirements and if land is contributed in excess of the minimum requirement the additional land is acquired at some agreed value. The costs of the additional land will be allocated to new and existing users as appropriate.

Where land is used but not vested in Council, security of tenure shall be protected by way of easement or other suitable mechanism. This is counted as a full contribution to the infrastructure requirements.

Where no land is to used for infrastructure purposes a financial contribution will be required.

Where land from other parties (not subject to development contributions) is leased or otherwise obtained, a contractual arrangement will be entered into to ensure security of tenure and fair and reasonable costs for use of the land. Theses costs will be included in the costs of the infrastructure and allocated among the existing users and new developments as appropriate.

9.1.2 Variation in Distance and Elevation

The development proposals for Kinloch vary in the location, distance from the treatment plants and elevation of properties. This could lead to differing costs if each development was to be considered in isolation.

In this report no distinction has been made between different developments in terms of distance from treatment plants, length of reticulation and elevation. This simplifies the calculation of contributions and also reflects the nature of water and sewerage systems in that they are managed as systems rather than

individual branches (eg, larger reservoirs and water reticulation ring mains provide increased security of supply for all users).

9.1.3 Costs for Existing Users

As discussed earlier in this report the works required for Kinloch include both expansion of capacity and an increase in the level treatment for both drinking water and wastewater treatment. New users are required to meet the new treatment standards and existing users are also required to meet the new standards.

For the purpose of allocation of costs increase in expansion of capacity are allocated to new developments only. Increases in the level of treatment are allocated across both existing users and new developments equally on a per lot basis.

9.1.4 Cross Benefits Between Existing Users and New Developments

New developments in some cases benefit from the use of existing infrastructure ie. The existing water and wastewater treatment and reticulation facilities.

Existing users will also benefit from the expansion of the infrastructure, eg. the proposed new ring main which will provide additional security of supply to existing users as well a supplying new developments.

For simplicity these cross benefits have been assumed to be approximately equal and therefore not included in the calculation of costs and the allocation of contributions.

9.1.5 Engineering Feasibility

The feasibility of use of potential land contributions has been considered to determine whether land or financial contributions are required. For instance some land proposed by developers for use for wastewater disposal is small in size, distant from the treatment plant or not particularly suitable for high rate irrigation.

9.1.6 Capital and Operating Costs

Development contributions have been calculated on the basis of capital costs. Operating costs are assumed to be met by rates.

9.2 INFRASTRUCTURE CAPITAL COSTS - SUMMARY

Table 10: Kinloch Infrastructure Cost Estimated								
	Water Intake and Treatment	**Water Retic and Reservoir**	**Wastewater Retic**	**Wastewater Treatment**	**Wastewater Irrigation P/S and Retic**	**Wastewater Disposal System**	**Wastewater Land (Land Purchase and Fees)**	**Total**
Capital Expenditure								
Capacity Increase	$302,000	$2,874,00	$353,600	$3,535,000	$2,717,000	$2,461,000	$170,000	$12,412,600
Level of Service Inc	$753,000			$1,858,000				$2,611,000
Total Capex	**$1,055,000**	**$2,874,00**	**$353,600**	**$5,393,000**	**$2,717,000**	**$2,461,000**	**$170,000**	**$15,023,600**
Cost Per Lot								
Capacity Number of Lots (New Lots Only)	1320	1320	1320	1320	1320	1320	1320	
Cost per Lot	$229	$2,177	$268	$2,678	$2,058	$1,864	$129	**$9,403**
Level of Service Number of Lots (All)	1930	1930	1930	1930	1930	1930	1930	
Cost per Lot	$390	$0	$0	$963	$0	$0	$0	**$1,353**
Total Cost per Lot	**$619**	**$2,177**	**$268**	**$3,641**	**$2,058**	**$1,864**	**$129**	**$10,756**

The lot numbers upon which the cost per lot figures are based contain some uncertainty due to possible changes in future lot yields that may be made as a result of submission on the draft structure plan. To assess the possible effect of changes in the lot yield a sensitivity analysis was carried out. For a variation in the number of new lots of 20 - 35 % the Development Contribution varied by approximately 10%. The cost summary sheets for these are attached in Appendix 4.

The level of treatment required for the wastewater is also subject to some uncertainty until such time as the new resource consent for discharge of the ultimate wastewater flow is obtained. The estimates are based on concrete design criteria as discussed earlier in this report and these have been conservatively derived on the bases of the information available.

Likewise the costings are based on concept design and may vary up or down as more detailed investigations proceed.

10.0 RESOURCE CONSENT REQUIREMENTS

As noted in earlier sections new resource consents will be required to allow the planned infrastructure to proceed.

The key consents are discussed in more detail below.

10.1 WASTE SUPPLY

Several resource consents will be required for the planned expansion of the water supply section.

10.1.1 Water Take

The projected water demand is more than twice the current water take. A new resource consent from Environment Waikato will be required to provide for this additional volume. The water is sourced from the lake which has ample volume. Some consultation and ecological related to the intake structure may be required.

10.1.2 Additional Intake Structure

At such time as the existing intake structure reaches its flow capacity an additional intake structure will be required.

Construction of a structure on the bed of a lake of river may require consent from Environment Waikato. If so consultation regarding potential environmental effects with various interested parties may be required, and Environment Waikato will need to be satisfied that the temporary (construction) and ongoing effects will be minor.

10.1.3 Water Treatment Site Excavation

Excavation at the water treatment plant site will likely be required to accommodate the additional treatment equipment. This may require consent depending on the volume of earthworks to be carried out and the site conditions.

The new reservoir many also require significant earthworks and resume consent prior to construction.

10.2 WASTEWATER TREATMENT AND DISPOSAL

A range of consents will be required for the upgrading and expansion of the wastewater treatment plant and the disposal system.

10.2.1 Variation of Current Consents

The wastewater flow during the two weeks Christmas - New Years peak is approaching the resource consent limit. Hence, to provide for the continuing addition of new connections to the system a variation of the current consent is required in the short term to provide for the extra flow. This will provide time for a full comprehensive resource consent to be sought for the proposed upgrade and expanded treatment plant and disposal system.

Environment Waikato has indicated that such a variation could be granted however conditions regarding the total nitrogen discharged (in line with current mass load but much lower than the current allowed connotations) and expansion of the existing land disposal area will be required.

10.2.2 Full Comprehensive Consent

In order to provide for the long term wastewater needs of Kinloch a major new consent will be required for the discharge of wastewater.

As previously discussed discharge to local waterways is not considered a likely option so land disposal, both surface and subsurface is proposed.

The discharge consent will require detailed investigation into the soils in the chosen locations, the ecological effects, particularly in relation to nutrient impacts on the lake, hydrological impacts on groundwater flows, as well as covering public health, management, maintenance and monitoring of the system and agreements with land owners where disposal is not on Council owned land.

The investigations are expected to take quite a number of months to complete.

Consultations with a wide range of interested and affected parties will also be required as part of the process. This is desirable in order to identify potential issues related to the consent, and also reduce the number of potential submitters at any resource consent hearing that may be required through the consultation discussions.

10.3 PROGRAMME

A detailed programme for the resource consent investigation and engineering study should be prepared to progress the issues discussed.

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 CONCLUSIONS

- Feasible infrastructure expansion and upgrading concepts have been generated and assessed for Kinloch
- Costs for water supply and reticulation and wastewater treatment and disposal contributions for new developments and existing users have been estimated based on the design concepts.
- Costs for existing users and new developments have been apportioned using clear criteria
- A mix of contributions in terms of land and money are proposed to meet the demand for construction works and additional land for treatment plants and wastewater disposal.
- Equity between new developments, and between existing users and new developments have been addressed in a transparent manner.
- Alternative options for land disposal may be available to simplify the disposal system and reduce overall cost however these require further investigation in terms of land availability and cost.
- Resource consent issues have been identified and require immediate action to provide for the ongoing growth of Kinloch.

11.2 RECOMMENDATIONS

It is recommended that Council:

- Carry out valuations on land proposed for infrastructure use to provide a firm basis for land costs included in these estimates
- Commence negotiations with landowners and investigate land outside the structure plan area for disposal
- Commence applications for variation of the wastewater resource consent as soon as possible to increase the allowable flow.
- Develop a programme for the infrastructure expansion including resource consent investigations, consultation, engineering studies and detailed design.
- Discuss resource consent issues in detail with Environment Waikato

12.0 REFERENCES

Harrison Grierson 2001 Kinloch Wastewater Treatment Plant Process Review

Harrison Grierson 2002 Taupo Strategy Study Kinloch Stage 2 Report

LTC 2000 New Zealand Guidelines for Utilisation of Sewerage Effluent Land Part Two: Issues for Design and Management. L. J Whitehouse, H.Wang and M.D Tomer (ads) Land Treatment Collective/Forest Research

Metcalf And Eddy 1991 Wastewater Engineering Treatment, Disposal and Reuse (Third Edition) McGraw-Hill, Singapore

Ministry of Health, Draft New Zealand Drinking Water Standards (May 2004 version)

APPENDIX 1

Population, Flows and Loads

APPENDIX 2

Existing Wastewater Discharge Resource Consent

APPENDIX 3

Turangi Wastewater Resource Consent

APPENDIX 4

Cost Summary

APPENDIX 5

Water Supply Cost Schedules

APPENDIX 6

Wastewater Cost Schedules

DRAWINGS

Draft Structure Plan Map

Concept Plan for Water Treatment and Reticulation (16237-WS200)

Concept Plan for Wastewater Treatment and Disposal (16237-WW200)

Water Treatment Layout (16237-WS102)

Water Treatment Process Flow Diagram (16237-PFD101)

Wastewater Site Layout (16237-WW101)
Wastewater Treatment Plant Layout (16237-WW100)

Wastewater Treatment Process Flow Diagram (16237-PFD100)

Golf Resort Development Plans (2001-192-200, 2001-192-500)

Lisland Subdivision Stage 4 Plan (CO2)

Loch Eagles Subdivision Plans (02364-01, 02364-19)