3. Stormwater

3.1 Existing Stormwater Management

Prebbleton township has a very limited stormwater reticulation network. As part of the Cairnbrae Drive subdivision a 450mm RCRRJ pipe was installed with an expected capacity of approximately 120l/s. The pipeline discharges into a 675mm pipe located under Springs Road prior to discharging to an open channel which discharges to Dawsons Creek on the eastern boundary of Prebbleton Township.

A resource consent for the discharge of stormwater from the Prebbleton pipe network could not be located following a search of the ECan database. A resource consent for the discharge of stormwater into this network is therefore expected to be required.

Recent subdivisions to the north and south of the proposed rezoning site have utilised soakage to ground for stormwater management where suitable soils exist.

3.2 Options for Stormwater Disposal

3.2.1 General

Options for the disposal of stormwater from the proposed re-zoning area include:

- Pre treatment of stormwater and discharge to ground. Discharge of private roof water directly to ground without pre-treatment. (Preferred Option)
- Discharge of stormwater from roading and miscellaneous surfaces to 450mm stormwater main following stormwater treatment and flow attenuation. Discharge of private roof water to ground without pre-treatment.
- Mixture of both discharge to ground and discharge to surface water.

The Geotechnical Investigation Report (included as ***Appendix B***) indicates that sandy gravels are present at a depth of approximately 2m on the eastern portion of the site. These soil conditions would allow for the effective discharge of stormwater to ground given that sandy gravels are expected to be capable of an infiltration rate of 500mm/hr.

A resource consent from ECan will be required in order to discharge water containing contaminants to either surface water or ground. Stormwater from the development will need to be treated to remove contaminants, to enable the effects on the environment to be less than minor. Provision of flow attenuation will be required to reduce erosion, protect the receiving environment and maintain the flood carrying capacity of the streams.

It is expected that there will be some pre-treatment (e.g. swales or proprietary treatment devices) prior to additional treatment such as the use of a stormwater pond or infiltration basin as required prior to discharging to surface or groundwater.

Stormwater from roof areas is expected to be discharged to ground via individual on-site soakage areas. During large duration events stormwater from roof areas will be directed to the road.

3.2.2 Discharge of Stormwater to Ground

Discharge of stormwater to ground has been utilised in recent subdivisions to the north and south of the development area. The site has good drainage characteristics on the eastern portion of the site which would make discharge to ground feasible. One option is to construct an infiltration basin that is lined with an infiltration media, such as 150mm of topsoil in the base of the pond to provide treatment of the stormwater as it infiltrated through to the underlying sands and gravels.

In general, the first flush stormwater (stormwater from the first 15-25mm of any storm) is more polluted than stormwater runoff from later in a storm event. As a result, the first flush stormwater is generally

treated using treatment systems which provide higher levels of contaminant removal than the treatment systems required for subsequent stormwater runoff. As a result, stormwater runoff from large rainfall events, which exceed the first 15-25mm runoff threshold, can be discharged to directly to ground using rapid infiltration trenches or soak pits.

A possible location for a stormwater treatment and infiltration basin has been shown on the Preliminary Servicing Plan attached in ***Appendix C***. This would allow the developer to use the extension of Cairnbrae Drive as a secondary flowpath for stormwater. An area of land on the eastern boundary of the site was considered as a possible alternative location for the stormwater attenuation basin. This was dismissed as there is no road frontage from the development area into Norris Street and hence a secondary flow path for stormwater could not be provided from this area.

Flows in excess of the capacity of the primary system can be directed to the road as a secondary flow path.

3.2.3 Discharge of Stormwater to SDC Stormwater Reticulation

An alternative option for the disposal of stormwater to ground is the discharge of stormwater to the Prebbleton reticulated pipe network, which ultimately discharges into a surface watercourse. In order to discharge to this pipe network stormwater treatment and attenuation would be required to reduce the effect of the discharge on the receiving environment to acceptable levels.

The stormwater attenuation process will require the installation of a large buffering vessel such as a pond. The pond would be designed to reduce the outflow rates to a level acceptable to both SDC and ECan. The major constraint governing the rate at which this may occur is the capacity of the downstream Prebbleton stormwater pipework and ensuring the effects on the open drain are less than minor.

The pond can provide significant levels of treatment, as ponds slow stormwater flow and facilitate sedimentation which removes sediment and metals from the stormwater flow.

Flows in excess of the capacity of the system can be directed to the road as a secondary flow path.

3.2.4 Conclusion

The existing connection to the Cairnbrae subdivision is expected to be under capacity to cope with the stormwater runoff from the whole development area. As a result a large stormwater attenuation and treatment basin will be required should the developer seek to dispose of stormwater to this network.

Given the underlying ground characteristics and the topography of the site, disposal to ground can be achieved feasibly. The treatment provided using the infiltration basin removes significant levels of contaminants, therefore reducing the effects on the environment.

It is therefore recommended that the development incorporates disposal of stormwater to ground as the main means of disposal of stormwater from the development.

3.3 Estimated Stormwater Infiltration Basin Characteristics

As stated above, it is anticipated that stormwater from private roof areas will be discharged to ground via individual on-site soakage areas. As discussed in Section 3.2.1, the Geotechnical Investigation Report (included as ***Appendix B***) indicates that sandy gravels are present at a depth of approximately 2m on the eastern portion of the site. The soak pits will need to be founded in gravel soils to ensure that adequate infiltration of stormwater can occur.

Individual property on-site stormwater soak pits have been sized as per guidelines in the "New Zealand Building Code Handbook"; (Building Industry Authority, 2004). The soak pit depths should be at least 2m, but will need to penetrate approximately 0.5m into the underlying gravel layers to ensure high

infiltration rates can be achieved. It is therefore recommended that individual house soak pits be approximately 2.5m deep. Preliminary soak pit dimensions (Width x Length x Height) for a rock soak pit and a chamber soak pit are 2 x 2 x 2.5m and 1.4 x 1.4 x 2.5m respectively.

Stormwater disposal from individual roads has been reviewed to include two infiltration ponds (one in the Coffey land and one in the William Blake Ltd land).

The infiltration basins were sized using preliminary calculations to ensure that the basins have capacity to contain and infiltrate the first flush run-off from the site. The basins will be lined to ensure that the infiltration rates are controlled to between 20-50mm/hr. This will ensure that stormwater is appropriately treated prior to entering groundwater without causing long residence times which can result in boggy or unsightly areas occurring.

Treatment volumes have been estimated using the assumptions in Table 2 below.

Table 2 - Catchment Assumptions

Coffey Land, infiltration basin	
Estimated area of impervious surfaces draining to infiltration basin	1.31 Ha
Estimated area of pervious surfaces draining to infiltration basin	4.61 Ha
Runoff coefficient for impervious surfaces	0.90
Runoff coefficient for pervious surfaces	0.30
Depth of First Flush	25mm
William Blake Ltd Land, infiltration basin	
Estimated area of impervious surfaces draining to infiltration basin	1.6 Ha
Estimated area of pervious surfaces draining to infiltration basin	5.69 Ha
Runoff coefficient for impervious surfaces	0.90
Runoff coefficient for pervious surfaces	0.30
Depth of First Flush	25mm

Estimated first flush volume (Coffey Land) = Rainfall Depth x Catchment Area x Runoff Coefficient
= 0.025 x (4.61 x 0.30 +1.31 x 0.90) x 10,000
= 641 m^3

Estimated first flush volume (William Blake Ltd Land) = Rainfall Depth x Catchment Area x Runoff Coefficient
= 0.025 x (5.69 x 0.30 +1.6 x 0.90) x 10,000
= 787 m^3

It has been assumed that the basins will have a live storage depth of between 0.5-1m in depth. This is mainly limited by safety considerations and deeper basins can be utilised provided adequate fencing or other measures have been incorporated. For the purposes of this report an additional 50% of land area has been included to provide for the landscaping, batters and miscellaneous unusable area. The estimated area to be set apart for a stormwater infiltration basins have therefore been calculated at between 960 – 1,920m^2 and 1,185 – 2,370m^2 for the Coffey land and William Blake Ltd land respectively.

Following the collection of the first flush volume in the infiltration basin, rapid infiltration trenches or soakage holes can be used to dispose of stormwater at a much higher rate. This is generally accepted by Environment Canterbury, provided the first flush is treated prior to discharge.

Section E1 (Surface Water) of the New Zealand Building Code states:
Except as otherwise required under the Resource Management Act 1991 for the protection of other property, surface water, resulting from an event having a 10% probability of occurring annually and

which is collected or concentrated by buildings or sitework, shall be disposed of in a way that avoids the likelihood of damage or nuisance to other property.

Preliminary calculations have been carried out to determine the rough order sizes of the proposed infiltration basins and base area of the rapid infiltration trenches required to dispose of stormwater on-site for up to a 10 year return period critical duration event. Calculations have been carried out assuming an infiltration rate of 20mm/hr through the base of the infiltration basin, which is considered conservative. The rapid infiltration trenches have been sized assuming an infiltration rate of 500mm/hr.

Table 3 - Preliminary Design of Stormwater Infiltration System

Coffey land infiltration basin		
Depth of Infiltration Basin	1.0 m	0.5 m
Base area of Infiltration Basin	641 m^2	1282 m^2
Base area of Rapid Infiltration Trenches	109 m^2	83 m^2
William Blake Ltd land infiltration basin		
Depth of Infiltration Basin	1.0 m	0.5 m
Base area of Infiltration Basin	787 m^2	1,574 m^2
Base area of Rapid Infiltration Trenches	133 m^2	102 m^2

As shown in the table above, the increase in base area of infiltration basin will decrease the base area for the infiltration trenches, given that more stormwater can be disposed to ground through the infiltration basin. Further work would be required to determine the most cost effective sizing for the stormwater system at the concept design phase of the project.

The infiltration basin would need to be located so that should the capacity of the infiltration basin and rapid infiltration trenches be exceeded, stormwater can be directed down secondary flow paths.

Topographic survey of street centrelines to the immediate east of the site has been undertaken as an addition to the site survey. The survey information shows that the topography of the township generally falls towards the southeast past Springs Road. It is therefore expected that the SDC and ECan will accept the Prebbleton roading network as a secondary flow path.

The stormwater infiltration basin finalised design is dependent on the finalised lot layout and detailed modelling which is outside of the scope of this report. The above preliminary calculations have demonstrated that the disposal to ground can be readily achieved.

A concept plan showing the possible stormwater layout using the above assumptions has been included in ***Appendix C***.

The infiltration basin in the Coffey Land has been positioned on the eastern boundary, to the western side of Cairnbrae Drive. The secondary flow path for this infiltration basin is southeast down Cairnbrae Drive.

The infiltration basin in the William Blake Ltd land has been positioned along the eastern border of the proposed road. This location has been chosen so the proposed road can be used as a secondary flowpath for stormwater flows exceeding the infiltration basin capacity, and this area is outside the proposed zone of high density housing located on the other side of the road. If the infiltration basin was positioned further southeast of the location shown in Appendix C, the secondary flowpath would pass through existing properties into Norris Street. It is not practical to create an easement through these existing properties for the secondary flow path, so if the basin was positioned in this location it would be necessary to pump flow exceeding the basin capacity up to the proposed road which would act as the secondary flowpath for stormwater.

3.4 Estimated Contaminant Loadings

Contaminant loadings for the roading stormwater runoff have been estimated using the Auckland Regional Council's TP10 document.

Following treatment using grassed swales with a nine minute retention time, the stormwater is expected to have the following contaminant loadings:

Contaminant	Expected Loading Following Swale Treatment
Sediment	16.3g/m3
Zinc	0.124g/m3
Copper	0.033g/m3
Total Petroleum Hydrocarbons	0.624g/m3

3.5 Conclusions

The area proposed for re-zoning is well suited to ground soakage as the primary method of stormwater removal and this method has been successfully implemented to the north and south of the development area.

As with all ground soakage systems, the efficiency can decrease over time. However, by adopting a conservative approach to the design of the systems, ensuring that there are adequate options for future upgrading and making allowance for secondary flows, ground soakage systems can provide a cost-effective long-term solution to stormwater disposal.

Adequate measures would need to be implemented to ensure the effects of the discharge on the underlying groundwater or receiving surface water are reduced to an acceptable level using suitable treatment and attenuation devices as required. The discharge will require a resource consent from ECan to discharge to ground or surface water given that it must be considered as a Discretionary Activity.

4. Water Supply

4.1 Outline Development Plan Servicing

Existing 150mm diameter water mains are located on Blakes Road and Cairnbrae Drive. An existing 100mm diameter water main is located in William Street.

Deficiencies in the existing Prebbleton water supply network mean that the network must be upgraded in order to provide the additional capacity required to service the proposed development. SDC have requested that a $10m^2$ utility lot be located at the Blakes Road end of the development for water supply purposes. This has been included in the Preliminary Servicing Plan in ***Appendix C***.

It is expected that this additional bore could be brought on-line relatively quickly following the SDC obtaining the required development contributions.

4.2 Required Demand

The proposed plan change includes re-zoning the area to cater for approximately 210 residential properties.

The Christchurch City Council Infrastructure Design Standard (CCC IDS) (Draft 2007) sets the following minimum design criteria for the design of sewerage reticulation.

Table 4 - Water Design Requirements

Total Additional Lots	210 Lots
Peak Living Zone Design Flow Rates	0.175 litres/second/connection

The peak expected domestic demand is therefore:
Peak Demand *=210 Lots x 0.175 l/s/connection*
=36.75 l/s

The water supply reticulation should comply with the New Zealand Fire Service Fire Fighting Water Supplies Code of Practice (SNZ PAS 4509:2003) for fire fighting flows, residual fire pressure and the spacing of hydrants. Residential housing without sprinkler systems is classified as W3 under the code of practice. Water demand for fire fighting is 25l/s as can be seen in Table 3.

Table 5 - New Zealand Fire Service Water Requirements

Water supply classification	Water flow required within a radial distance of 135m (l/s)	Additional water flow required within a radial distance of 270m (l/s)	Water Storage		Maximum number of fire hydrants to provide flow
			Time (min)	Volume (m3)	
W3	12.5	12.5	30	45	2

The total peak demand can be estimated using the following formula:
Peak $Demand_{Total}$ $= Demand_{Fire\ Flow} + 0.5 \times Peak\ Demand_{Domestic}$
=25l/s + 0.5 x 36.75l/s
=43.4l/s.

In order to comply with the Fire Service Code of Practice the principal mains within the development must have a minimum size of 100mm diameter.

4.3 Conclusions

The adjacent existing water reticulation system allows the proposed development to be serviced easily for good connection points for the proposed residential development area.

The SDC have identified that additional capacity will be required in order to service the development.

The SDC have identified a possible suitable location for an additional bore, being at the intersection of Shands and Blakes Roads. It is expected that this bore could be brought on-line relatively quickly to cope with any additional potable water demand caused by the development.

5. Summary

This report assesses the feasibility of providing services for the 210 lot residential development of 18.8586 ha of rural land west of Prebbleton township

The majority of the development can be serviced by gravity sewerage reticulation provided by the extension of the existing SDC sewer reticulation. Some sites on the east of the development may require private pumping systems into the gravity reticulation depending on final detailed design.

The site is well suited to ground soakage as a method for disposal of stormwater. Suitable long term solutions can be provided to dispose of stormwater on-site without placing the downstream limited stormwater network under increased pressure.

Capacity deficiencies within the existing Prebbleton water supply network have been identified by the SDC although a suitable location for an additional bore at the intersection of Shands and Blakes Road has been identified. This proposed bore is expected to meet the needs of the development.