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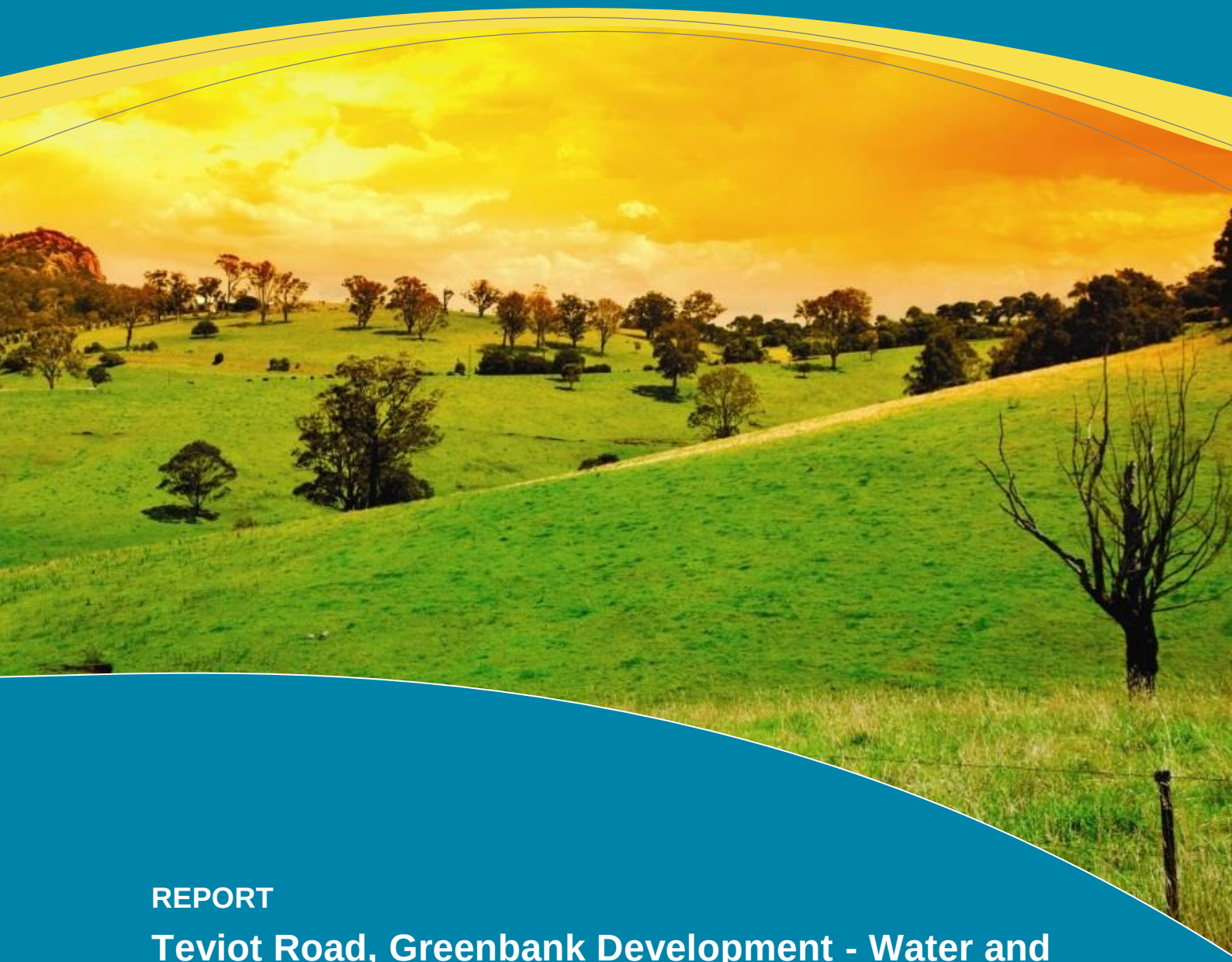

REPORT

Teviot Road, Greenbank Development - Water and Sewer Infrastructure Master Plan

Prepared for Mirvac

29/5/2017

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
0	15/03/2016		RC	PF	SOB	PF
1	31/03/2016		RC	PF	SOB	PF
2	08/11/2016		RC	PF	SOB	PF
3	20/04/2017	Changes based on EDQ Comments	RC	PF	SOB	PF
4	22/05/2017	Changes to Key Sewer Infrastructure Triggers Table 5-3 and Figure 5-3	RC	PF	SOB	PF
5	29/05/2017	Remove references to infrastructure charge offsets as requested by EDQ	RC	PF	SOB	PF

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Teviot Road, Greenbank Development - Water and Sewer Infrastructure Master Plan

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1 Introduction

Mirvac engaged MWH to undertake the assessment of water and sewer infrastructure for the Greenbank (Teviot Road) development located within the Greater Flagstone Priority Development Area (PDA). The proposed development is located on land parcels 434/RP845844, 9/S312355 and 205/RP845844.

The development is part of a major urban community under the control of Economic Development Queensland (EDQ). The development site is approximately 481 hectares and is situated in the Greenbank area of the Greater Flagstone PDA as declared under the Urban Land Development Authority (ULDA) Act (now superseded by the Economic Development Act 2012). The proposed development in the context of the Greater Flagstone UDA is shown in Figure 1-1 (source: http://www.dilgp.qld.gov.au/resources/plan/pda/greater-flagstone-development-scheme.pdf).

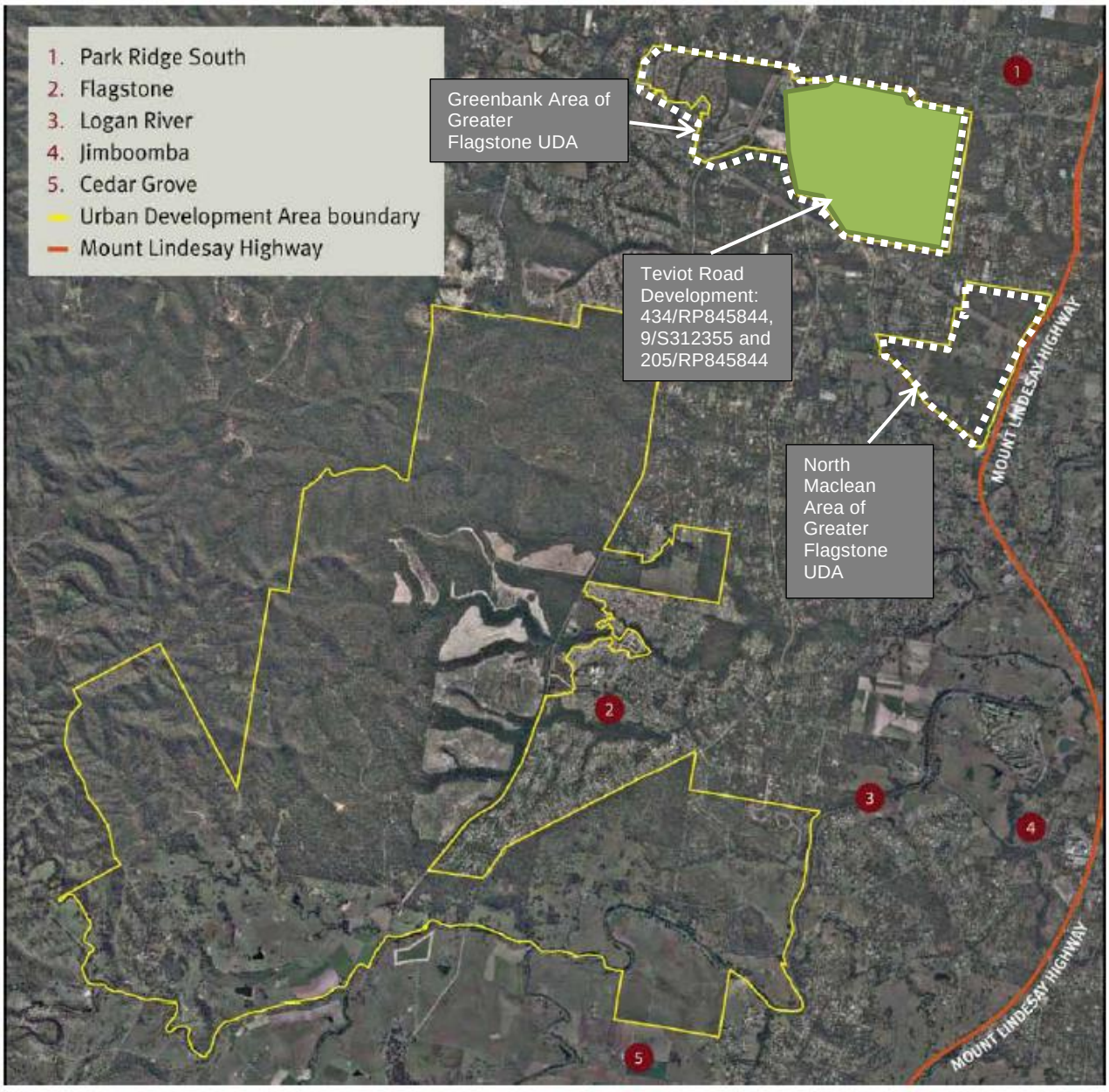

Figure 1-1: Teviot Road, Greenbank Development Area within Greater Flagstone UDA

1.1 Objectives

This report addresses the key requirements for water supply and sewerage infrastructure to serve the Teviot Road development.

1.2 Assumptions

The following assumptions and exclusions are applied in this study:

- Future water supply and sewer networks are developed based on the Logan City Council Desired Standards of Service (DSS) as outlined in Appendix B. It is noted that these standards vary from the SEQ Water Supply and Sewerage Design & Construction Code, which applies only to the design of reticulation networks.
- The strategy for potable water is based on the Master Planning Review for the Southern Regional Pipeline Water Supply Area (Logan Water Alliance, April 2015), as provided by LCC.
- Initially, potable water is to be sourced from the Spring Mountain reservoir complex for land with a nominal elevation above 50 m AHD via a pressure reducing arrangement, as advised by LCC.
- Ultimately, potable water is to be sourced mainly from the Round Mountain reservoir complex for land with a nominal elevation below 50 m AHD, as advised by LCC. Areas above a nominal elevation of 50 m AHD will be serviced by 1 of 2 options:
    - Spring Mountain and Round Mountain reservoir complexes via pressure reducing and pressure boosting arrangements, respectively.
    - Round Mountain reservoir complex via a pressure boosting arrangement.
- Sewage is assumed to be ultimately treated at “Site B” WWTP near Stockleigh in accordance with the Preferred Option 4b1 of the Logan South Wastewater Servicing Strategy Revision 3 dated 14 June 2016 (“**Logan South Wastewater Servicing Strategy**”).
- Sub-regional infrastructure includes temporary servicing solutions under the Logan South Wastewater Servicing Strategy.
- Sub-regional infrastructure will likely be designed and constructed by Logan City Council.
- Dates and growth rates have been provided for reference only, and are subject to influences outside of the developer’s control such as statutory approvals and market conditions. As such, infrastructure delivery triggers should be set by EP load, not dates.
- Prior to connection to the WWTP near Stockleigh, a temporary on-site WWTP will be constructed in the Greenbank area of the Greater Flagstone PDA with effluent disposal to land.
- The water supply and sewerage strategies outlined in this document are provided as a ‘base case’ response to the planning criteria provided by LCC. The strategies are not intended to preclude the development of innovative solutions for the Teviot Road development in the longer term, as part of the refinement process of these master plans.

2 Population Projection

2.1 Land Use Plan

The Teviot Road development site is located on 481 hectares bordering Teviot Road to the west and Greenbank Road to the south. The proposed context plan is shown in Figure 2-1.

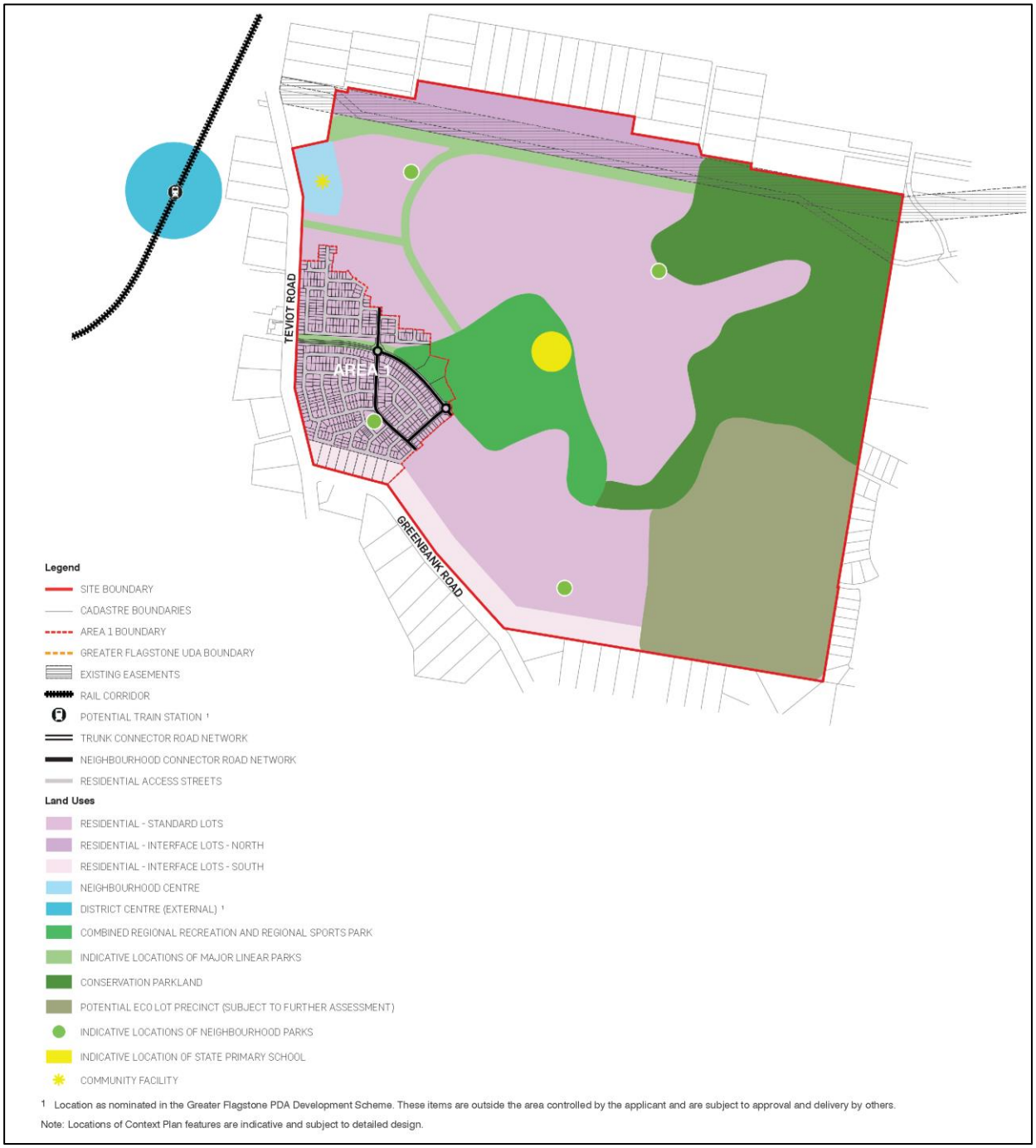

Figure 2-1: Teviot Road Context Plan

The assumed developable area of the site is 397 hectares and will consist of the land uses, areas and lot yields given in Table 2-1. The total residential yield is anticipated to be in the order of 3,350 lots. An indicative finished surface level contour plan of the site used for water and sewer planning is included in Appendix C.

Table 2-1: Teviot Road Land Use Details and Residential Lots

Land Use	Area (Ha)	Proposed Number of Residential Lots
Residential – Standard Lots	240	3,222
Residential – Eco Lots	75	75
Residential – Interface Lots – North and South	46	53
Neighbourhood Centre*	5	-
State Primary School*	7	-
Regional Sports and Recreation Park*	25	-
Total	**397**	**3,350+**

* Equivalent Population determined from GFA to EP conversion rates provided by LCC as detailed in Section 2.2.3.
+ This number does not include non-residential land use component.

2.1.1 Area 1

As part of the initial planning application, Area 1 of the Teviot Road development is being submitted for development approval. Area 1 consists of 501 standard residential lots and 9 residential interface lots. Figure 2-1 shows the Area 1 boundary within the broader context of the Teviot Road development.

Importantly, Area 1 is located in a part of the site that is predominantly clear of vegetation and intended to be excised from environmental referrals / applications (which may delay access to the balance of the site). It is intended that the development of Area 1 will commence while environmental assessment and approval is underway on the balance of the site.

The potential temporary access restriction does not have a material effect on delivery of the water infrastructure, but does influence the delivery of the sewerage infrastructure, particularly in regard to temporary infrastructure.

Refer to Section 4 and Section 5 of this report for further commentary on the water and sewer servicing requirements for Area 1.

2.2 Population Assessment

2.2.1 Logan City Council Planning Densities and Occupancy Rates

LCC advised that the following occupancy rates and non-residential planning densities are to be used for estimating the equivalent persons (EP) for the Teviot Road development:

- Residential occupancy rates:
  - 2.8 EP / Lot
- Non-residential planning densities:
  - Neighbourhood Centre: 73 EP/Ha based on Gross Floor Area (GFA)
  - School: 105 EP/Ha based on GFA
  - Sports and recreational parks: 1.05 EP/Ha based on Gross Site Area

Correspondence with LCC regarding agreed occupancy rates and non-residential planning densities is provided in Appendix A.

2.2.2 Residential Equivalent Population

The residential EP was determined by multiplying the occupancy rates by the number of dwellings (refer to Table 2-1).

Residential growth rates have been based on Mirvac's forecast sales rate which gradually ramps up to 18 lots per month (216 lots per year). This growth assumption is based on transaction evidence from surrounding developments, coupled with Teviot Road's location within the catchment.

Table 2-2 summarises the residential population and expected growth over time. The total residential population in the Teviot Road development is estimated to be 9,380 EP with build out by 2033.

The development program for Teviot Road proposes transfer of the first reconfigured land lot in December 2017. Allowing for a dwelling occupancy lag of 6 months it is estimated that by the end of 2018 there will be a residential population of 322 EP.

Area 1 consists of 1,428 residential EP and is anticipated to be completed by 2020.

Table 2-2: Residential Population Summary

Planning Horizon	Residential EP
2018	322
2021	2,209
2026	5,233
2031	8,257
2036	9,380
Ultimate	9,380

2.2.3 Non-Residential Equivalent Population

Non-residential EP was based on GFA to EP factors contained in the Development of the Infrastructure Demand Model report (LCC 2013).

Mirvac provided preliminary timing for the non-residential uses, although actual delivery timeframes will be subject to negotiations with various stakeholders.

Table 2-3 summarises the non-residential population. The total non-residential EP for the ultimate development was calculated as 576 for both water and sewer.

Table 2-3: Adopted EP for Future Non-Residential Development

Planning Horizon	Neighbourhood Centre EP	Sport and Recreation EP	State Primary School EP	Total Non-Res EP
2018	-	-	-	-
2021	183	-	368	550
2026	183	26	368	576
2031	183	26	368	576
2036	183	26	368	576
Ultimate	183	26	368	576

2.2.4 Population and Growth Rate Summary

Combining the residential and non-residential forecasts provides a total ultimate population for the Teviot Road development of 9,956 EP for water and 9,598 EP for sewer. Forecasts at major planning horizons are provided in Table 2-4. It is intended that the *Residential – Eco Lots* and *Residential – Interface Lots (north and south)* will be serviced by local on-site treatment and not connected to the sewerage system. Details of the feasibility of on-site treatment for the larger lots is provided in Appendix E and therefore these lots are not included in the Sewerage EP numbers below.

Table 2-4: Teviot Road Population (EP) Projection

Planning Horizon	Water EP	Sewerage EP
2018	322	322
2021	2,760	2,647
2026	5,809	5,487
2031	8,833	8,511
2036	9,956	9,598
Ultimate	9,956	9,598

It is important to note that the ultimate EP and assumed growth rates differ from those adopted by EDQ / LCC. With reference to the most recent EP / growth analysis, being the Logan South Wastewater Servicing Strategy:

- The ultimate population estimate of 10,995 EP in the Logan South Wastewater Servicing Strategy is higher than the estimated 9,598 EP for sewerage (refer Table 2-4).
- The Logan South Wastewater Servicing Strategy assumes a maximum residential growth rate of 170 lots per annum for the Greenbank catchment, split 50/50 between the Teviot Downs and Mirvac development sites (i.e. a maximum growth rate of 85 lots per annum for the Mirvac site). This is around 40% of Mirvac's growth assumption of 216 lots per annum.
- It is understood that Mirvac raised concerns around the adopted growth rates, and the Logan South Wastewater Servicing Strategy was amended to include the following sentence *"It is intended that the demands on funding are reviewed on a regular basis and that best endeavours will be made by all parties to ensure that growth can be serviced"*.
- In summary, it is understood that all parties will use best endeavours to amend and update the Logan South Wastewater Servicing Strategy as required to ensure that growth can be serviced, even if actual growth rates are materially greater than those adopted in the strategy.

2.2.5 Adopted External Population

The population external to the Teviot Road development, but within the Greenbank area of the Greater Flagstone PDA, was taken from the water and wastewater network analysis of the Teviot Village Residential Development at Pub Lane, Greenbank (DEV2017/831, Calibre Consulting) as directed by EDQ. Figure 2-2 shows the location of the Greenbank catchment in respect to the overall Greater Flagstone PDA.

It is noted that the population projections of the Greenbank West (Teviot Village) area is an important input to the sizing of the regional sewerage pump station at Teviot Road which is intended to service the Greenbank catchment.

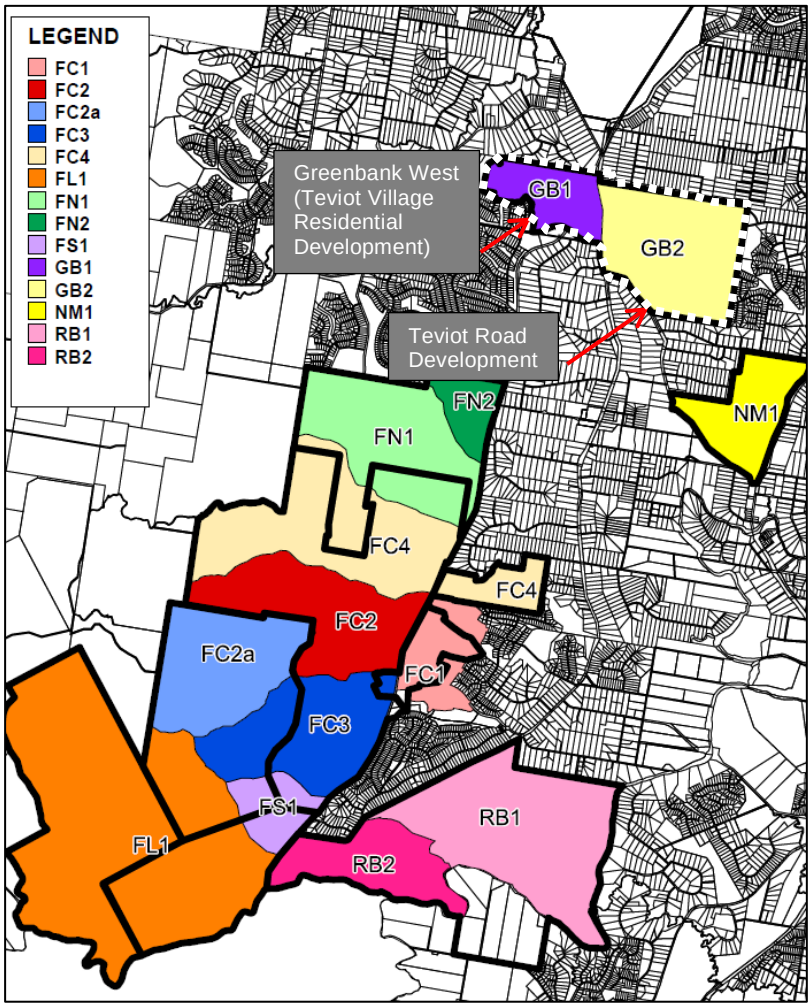

Figure 2-2: Location of Greater Flagstone PDA Catchments (source: Appendix C of the Logan South Wastewater Servicing Strategy)

Table 2-5 summarises the population projections for the Greenbank West (Teviot Village Residential Development) GB1 area.

Table 2-5: Greenbank West (Teviot Village) EP Projections

Planning Horizon	Greenbank West (Teviot Village) GB1 EP
Interim	4,000
Ultimate (with External Load)	5,886

3 Desired Standards of Service

The Desired Standards of Service (DSS) adopted for the master planning are based on the following reference strategic reports:

- Water Supply - Appendix C of Master Planning Review Southern Regional Pipeline Water Supply Area (LWA, April 2015)
- Sewerage - Appendix A of the Logan South Wastewater Servicing Strategy.

The key standards are summarised below. LCC desired standards of service can be found in Appendix B of this report.

3.1 Water Demand and Peaking Factors

In accordance with the DSS, an average day potable water demand (AD) of 165 L/EP/day was adopted for this study. In addition to this demand, an unaccounted for water allowance of 25 L/EP/day was used.

The water supply peaking factors adopted for this study and applied to the AD demand component are summarised in Table 3-1.

Table 3-1: Potable Water Demand Peaking Factors

Peaking Factor	Residential	Commercial / Education	Parks / Open Space
Mean Day Maximum Month (MDMM)	1.3	1.2	1.2
Peak Day (PD)	1.7	1.3	1.3
Peak Hour (PH)	3.1	2.0	1.7

3.2 Sewer ADWF and Peaking Factors

An average dry weather flow (ADWF) of 165 L/EP/day is adopted for this study in accordance with the DSS. As ‘Reduced Infiltration Gravity Sewers’ (RIGS) will be utilised in the proposed development, the peak weather flow (PWWF) was calculated based on 1,000 L/EP/day.

3.3 Summary of Design Outcomes and Design Standards / Resources

A summary of the design outcomes and design standards / resources utilised for the development of the IMP are outlined in Appendix D.

4 Water Supply Network

4.1 Potable Water Demand and Storage

Each residential and non-residential lot within the development will be provided with a potable water connection and all mains designed for PH demand. For the water supply network, the ultimate population and forecast growth is in accordance with Table 2-4.

Projected internal potable water demand was calculated using populations developed in Section 2 and the DSS.

A summary of the projected water demands and storage required for the Teviot Road development is given in Table 4-1.

Table 4-1: Teviot Road Development Potable Water Demand

Planning Horizon	EP	AD (ML/d)	MDMM (ML/d)	PD (ML/d)	PH (L/s)	Storage (ML) 3 x (PD-MDMM)	4 hrs MDMM Demand (ML)
2018	322	0.06	0.08	0.10	2.0	0.06	0.01
2021	2,760	0.52	0.65	0.81	16.0	0.46	0.11
2026	5,809	1.16	1.45	1.83	36.7	1.12	0.24
2031	8,833	1.74	2.18	2.75	55.5	1.72	0.36
2036	9,956	1.89	2.37	3.00	60.6	1.89	0.40
Ultimate	9,956	1.89	2.37	3.00	60.6	1.89	0.40

The development area will have an ultimate population of 9,956 EP. The total peak hour demand of the development site is 60.6 L/s. Reservoir storage calculations are based on a requirement of 3 x (PD - MDMM). The ultimate reservoir storage capacity (including emergency storage) required by the development area is 2.3 ML.

4.2 Water Supply Servicing Strategy

This section describes the water supply servicing strategy for the development including the zoning and infrastructure requirements to meet the LCC DSS.

4.2.1 Information provided by Logan City Council

In relation to the provision of water to the development, Logan City Council:

- advised that the current strategy (as shown in the Master Planning Review of the Southern Regional Pipeline Water Supply Area (LWA, April 2015)) involves supplying the entire development from the Round Mountain reservoir and installing an on-site booster pump station to service properties with elevations above a nominal elevation of 50 m AHD.
- provided MWH with specific advice on capacity constraints to the external trunk infrastructure part of the Spring Mountain WSZ to supply areas of the development above the nominal elevation of 50 m AHD.
- advised that a 300 mm diameter trunk main exists in Teviot Road and Greenbank Road on the western boundary of the development site. This main is currently supplied by the Round Mountain WSZ hydraulic grade (TWL 105 m).
- advised that the external trunk infrastructure supplying the proposed development from the Round Mountain WSZ has adequate capacity to accommodate the development's ultimate demand.
- provided MWH with boundary conditions at proposed connection points to the development to undertake an internal reticulation assessment of the proposed development.

4.2.2 Servicing Options

The development area is situated near the boundary of the Round Mountain water supply zone (WSZ) and the Spring Mountain WSZ (refer Figure 4-2). As such, an alternative option to supply the elevated areas (above 50 m AHD) from the Spring Mountain WSZ (via pressure reduction) was prepared and discussed with LCC and the option was agreed "in principle". LCC provided the capacity limitations to the existing Spring Mountain WSZ infrastructure and the external augmentation requirements to service a portion of the development from this WSZ. A benefit to servicing a portion of the development from the Spring Mountain WSZ is it reduces the size of the booster pump station required on the site and improves the Spring Mountain reservoir turnover and water quality in the zone.

For the ultimate development, two water supply options have been presented:

1. Round Mountain WSZ supply with pressure boosting from the Round Mountain WSZ similar to the strategy presented in the Master Planning Review of the Southern Regional Pipeline Water Supply Area (LWA, April 2015).
2. Spring Mountain WSZ and Round Mountain WSZ supply with pressure boosting from the Round Mountain WSZ.

Both ultimate options have been presented as each have similar construction costs and provide LCC flexibility in servicing the development and the wider Greenbank area as development progresses. The preferred option is to be confirmed and refined by LCC at a later date.

4.2.2.1 Initial Servicing Solution (common to both options)

Initially, Area 1 of the development will be supplied from the Spring Mountain WSZ with minimal external infrastructure requirements. The hydraulic capacity and external infrastructure requirements to service the development from the Spring Mountain WSZ are as follows:

- Initial 600 EP for the development site can be serviced from Spring Mountain WSZ via a PRV and the construction of a cross-connection near Pub Lane PS to allow a 300 mm diameter main on Pub Lane to be supplied by Spring Mountain WSZ instead of Round Mountain WSZ. Depending on timing of adjacent developments in Greenbank, some additional capacity may be available in the Pub Lane PS if the adjacent developments are delayed.

- Beyond 600 EP an upgrade to the Pub Lane PS pumps is required to service up to 2,560 EP of the development from Spring Mountain WSZ without substantial and expensive upgrades to trunk infrastructure such as rising mains and reservoirs.
- The proposed Spring Mountain WSZ boundary will follow the internal development front until growth reaches 2,560 EP. Figure 4-1 shows the indicative Spring Mountain WSZ to service the initial 2,560 EP.

It is recommended that the EP trigger for the timing of the upgrade to the Pub Lane PS is re-assessed at a later stage to determine if any additional capacity is available to the development, dependent on the timing of adjacent developments and potential of other non-capital solutions.

The proposed WSZ boundary changes for the initial area to be serviced by Spring Mountain are shown in Figure 4-1 and Figure 4-2. It is assumed that the Greenbank West (Teviot) area (refer Section 2.2.5) would also be included in the Spring Mountain WSZ due to its elevation and the development advice provided by LCC.

4.2.2.2 Area 1

Area 1 of the development (as shown in Figure 2-1) will be initially served by Spring Mountain WSZ with a residential population of 1,428 EP and a peak hour flow of 8.9 L/s. When Area 1 population reaches 600 EP (peak hour flow of 3.7 L/s) the Pub Lane PS may require upgrading depending on growth in adjacent developments.

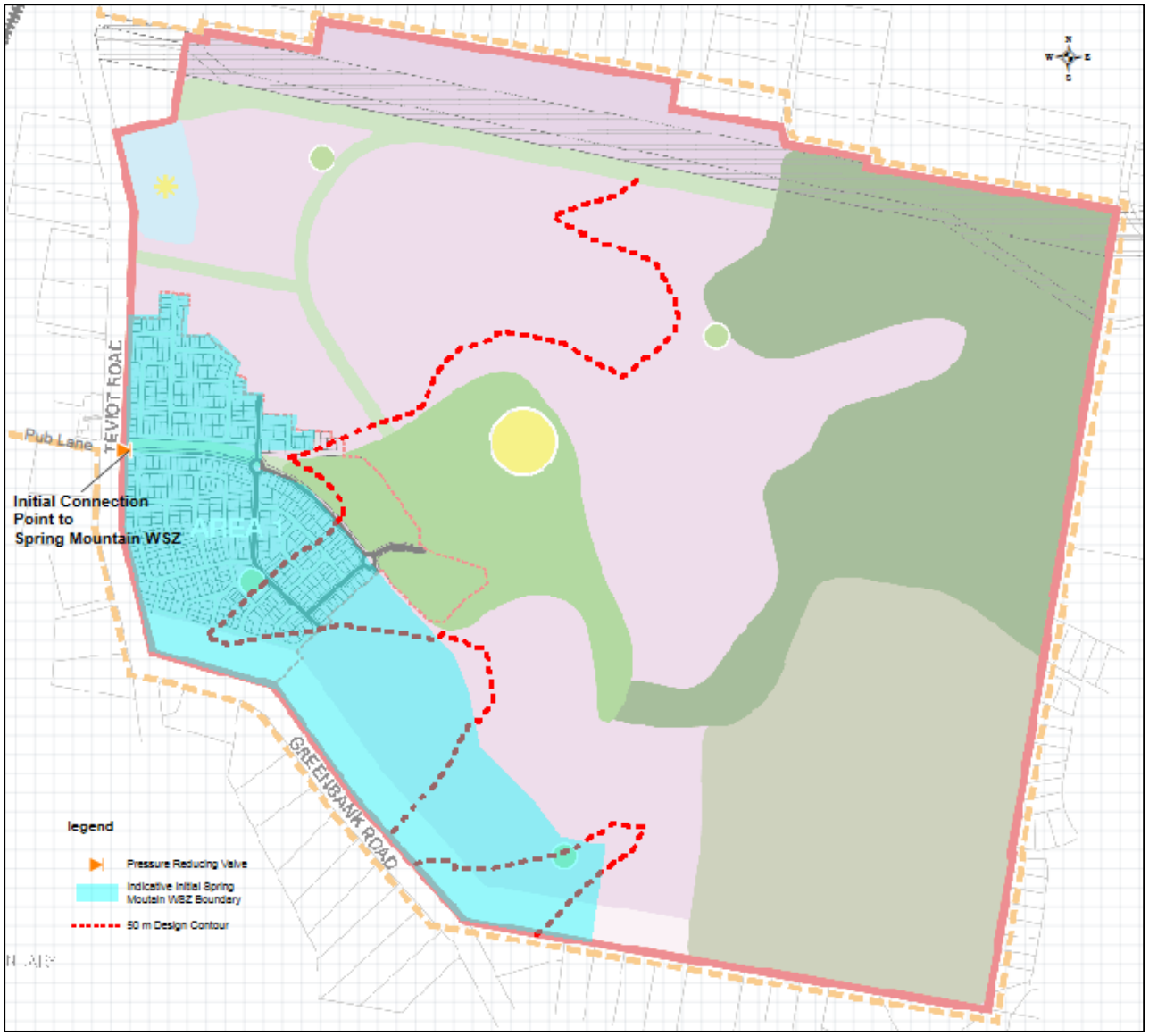

Figure 4-1: Indicative Initial Spring Mountain WSZ Boundary

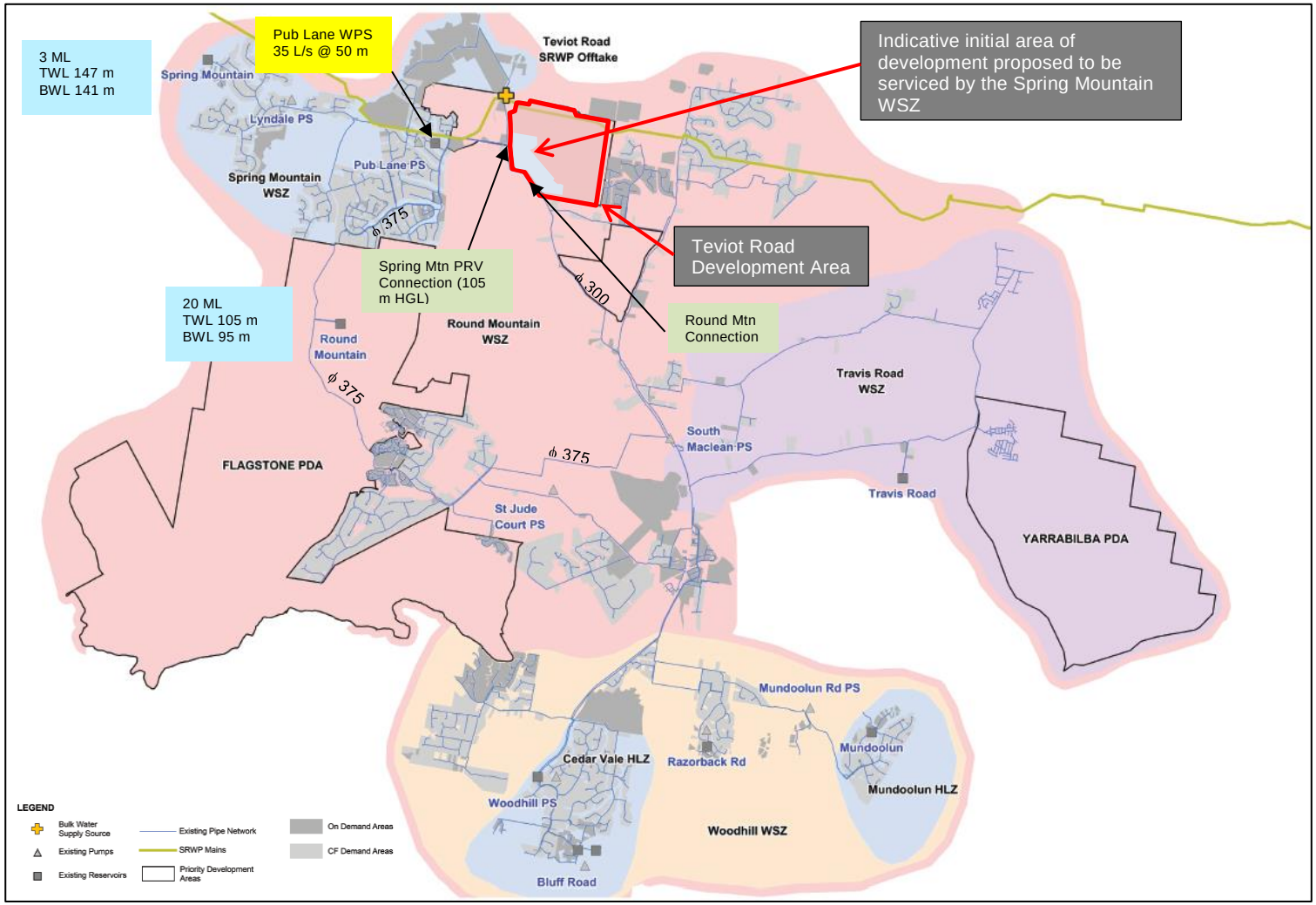

Figure 4-2: Southern Regional Pipeline Water Supply Area Infrastructure – Connection works to Teviot Road
(Source: Master Planning Review of the Southern Regional Pipeline Water Supply Area (LWA, April 2015))

4.2.2.3 Option 1 – Ultimate Round Mountain WSZ Supply

Option 1 aligns with the current servicing strategy as per the Master Planning Review of the Southern Regional Pipeline Water Supply Area (LWA, April 2015). The option allows for a pressure booster to be installed on site to supply areas with elevations notionally 50 m to 74 m AHD.

It is anticipated that 6,373 EP, approximately two-thirds of the Teviot Rd development, will be serviced by the pressure booster station fed from the Round Mountain WSZ. The pressure booster station will primarily supply residential lots with a small portion of commercial (183 EP) located in the north-west of the site.

The remaining 3,583 EP, approximately one-third of the Teviot Road development, will be served under gravity via the Round Mountain WSZ from the 300 mm diameter trunk main in Greenbank Road. The total population is primarily residential, but includes a School (368 EP) and a Sports and Recreation facility (26 EP) proposed to be located in the centre of the development.

The primary feed for the Eco Residential lots to the south east of the site will be from the Greenbank Road trunk main, however it is proposed to also connect to existing reticulation in the existing development to the east of the project site. The supply is sized for rural residential fire demand.

Figure 4-3 shows the Option 1 servicing strategy and distribution network. The boundary typically follows the 50 m contour. The final location of boundary valves will be determined as part of the Operational Works phase, when layouts are fully defined.

legend

- Pressure Reducing Valve
- Indicative Booster Pump Location
- Closed Boundary Valve
- 300 mm Diameter Water Main
- 250 mm Diameter Water Main
- 200 mm Diameter Water Main
- 150 mm Diameter Water Main
- 50 m Design Contour
- Indicative Booster Pump Zone Boundary

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Publisher: PLANNING
Publication Date: 03/11/2016
Reference: 1
Filename:
Projection: Map Grid Of Australia, Zone 56
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Teviot Road Development Greenbank

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Figure 4-3 Teviot Road Development Option 1 Ultimate Water Network Layout

4.2.2.3.1 Staging of Option 1

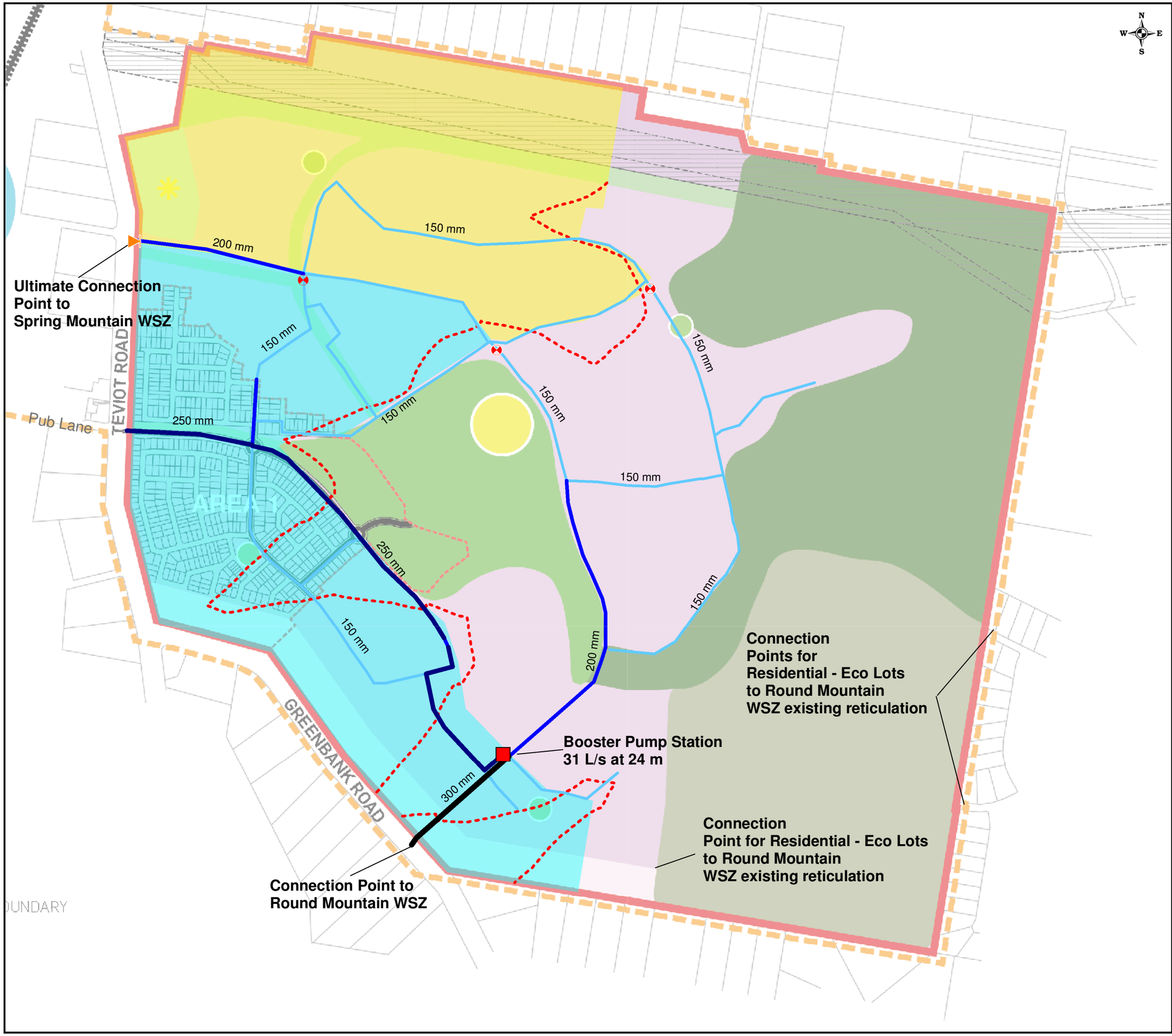
Initially, the first 2,560 EP will be served from the Spring Mountain WSZ as outlined in Section 4.2.2.1.

Before the development reaches a population of 2,560 EP a booster pump station is required to transfer supply from the Spring Mountain WSZ to the Round Mountain WSZ. The booster pump station will be sized to accommodate a population of 6,373 EP with a peak hour flow of 38.8 L/s. The pump station will be sized for residential fire flow and therefore the size of the pump station to accommodate two-thirds peak flow plus 15 L/s residential fire flow is 40.9 L/s. It is noted that the neighbourhood centre fire flow requirements (30 L/s at 12 m residual pressure) can be served from the Spring Mountain WSZ 300 mm diameter trunk main located in Teviot Road. This will reduce the design capacity of both the Spring Mountain PRV and the booster pump station as the required fire flow would be 15 L/s instead of 30 L/s. Figure 4-3 shows the indicative ultimate WSZ boundary and location of the booster pump station.

4.2.2.4 Option 2 – Ultimate Spring Mountain/ Round Mountain WSZ Supply

Figure 4-4 shows the Option 2 servicing strategy and distribution network. Ultimately, the northern area of the development will be serviced from the Spring Mountain WSZ via a new PRV located at the northern entrance of the development. Potentially the PRV and flowmeter kit used for the initial connection can be transferred to the new pit location. Figure 4-4 shows the ultimate WSZ boundaries for Option 2 and location of the new PRV and booster pump station. The boundaries typically follow the 50 m contour. However, to minimise the complexity and maximise the hydraulic capacity of the water reticulation network, some properties below the 50 m contour are included in the zone. The ultimate population proposed to be serviced within the development from each water supply zone is as follows:

- Spring Mountain WSZ – 2,560 EP
- Round Mountain WSZ gravity – 3,583 EP
- Round Mountain WSZ booster pump – 3,813 EP.



legend

- Pressure Reducing Valve
- Indicative Booster Pump Location
- 300 mm Diameter Water Main
- 250 mm Diameter Water Main
- 200 mm Diameter Water Main
- 100 mm Diameter Water Main
- 50 m Design Contour
- Indicative Spring Mountain Zone Boundary
- Indicative Booster Pump Zone Boundary

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Publisher: PLANNING
Publication Date: 03/11/2016
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Project

Teviot Road Development Greenbank

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Figure 4-4 Teviot Road Development Option 2 Ultimate Water Network Layout

4.2.2.4.1 Staging of Option 2

Initially, the first 2,560 EP will be served from the Spring Mountain WSZ as outlined in Section 4.2.2.1.

Before the development reaches a population of 2,560 EP a booster pump station is required to transfer a portion of supply from the Spring Mountain WSZ to the Round Mountain WSZ. The booster pump station will be sized to accommodate a population of 3,813 EP with a peak hour flow of 23.2 L/s. The pump station will be sized for residential fire flow and therefore the size of the pump station to accommodate two-thirds peak flow plus 15 L/s residential fire flow is 30.5 L/s. For a period of time all supply will come from the Round Mountain WSZ until development in the north occurs. This northern area will then be supplied by the Spring Mountain WSZ via a new PRV at the northern entrance of the development.

4.2.3 Distribution Network

Infrastructure was sized for both water supply options as shown in Figure 4-3 and Figure 4-4 using a H_2OMap model of the proposed network and a static simulation at peak hour demand. Pipe sizes were selected to allow all areas of the development to receive a minimum of 22 m pressure during maximum hour demand as well as optimising target and maximum pressure requirements in the pressure reduced zone supplied from the Spring Mountain WSZ.

In accordance with LCC's advice (refer Appendix A), the following boundary conditions at the trunk main connection points were adopted for network modelling:

- For Spring Mountain WSZ:
  - Minimum System Operation Head – 121 m AHD
  - Minimum Fire Flow Head – 121 m AHD (assuming 15 L/s residential)
- For Round Mountain WSZ:
  - Minimum System Operation Head – 75 m AHD
  - Minimum Fire Flow Head – 76 m AHD (assuming 30 L/s commercial/public).

The whole of site and Area 1 performance, including firefighting, was assessed by adopting the following conditions and criteria:

- Boundary conditions - as stated above
- Rural Residential (Eco Lots and Interface Lots) - fire flow of 7.5 L/s
- Residential fire flow - 15 L/s
- Non-residential fire flow - 30 L/s
- Minimum residual pressure under fire flow - 12 m at property boundary.

The proposed water supply reticulation meets the minimum operating pressure requirements under peak hour, maximum operation and firefighting scenarios. It is noted that the neighbourhood centre fire flow requirements (30 L/s at 12 m residual pressure) can be served from the Spring Mountain WSZ 300 mm diameter trunk main located in Teviot Road. This will reduce the design capacity of the Spring Mountain PRV and booster pump station as the required fire flow would be 15 L/s instead of 30 L/s.

For the Spring Mountain WSZ, the maximum nodal pressures in the pressure reduced zone will be slightly higher than the 55 m target pressure. It is noted that the proposed PRV station will require dual PRVs to ensure a level of redundancy is provided to the properties served by Spring Mountain WSZ if PRV failure occurs. The PRV design will be required to supply up to 2,560 EP under the following flow and head:

- Downstream hydraulic grade setting: 105 m AHD
- Average day flow: 5.6 L/s
- Peak hour flow: 15.6 L/s
- 2/3 peak hour flow plus fire flow (15 L/s): 25.4 L/s.

In addition, the design of the water supply reticulation allows for connectivity between the Spring Mountain WSZ and Round Mountain WSZ which further increases redundancy and flexibility of supply under contingency conditions when a PRV failure, booster pump station failure or water main break occurs. The looped connectivity of the reticulation and proposed placement of the boundary valves enables good water quality to be achieved in both the Spring Mountain WSZ and Round Mountain WSZ.

4.2.3.1 Option 1

Option 1 simplifies the ultimate supply of the development to one water supply zone (Round Mountain WSZ). However in taking this approach it increases the size of the onsite booster pump station significantly compared to Option 2 as more land above the 50 m contour requires to be serviced by pressure boosting.

4.2.3.2 Option 2

Option 2 allows for an effective implementation of district metered areas (DMA) to monitor flows for areas between 900 to 1,400 lots. To achieve this a flowmeter will be installed at the PRV chamber, at the booster pump station and at the connection point of the development on Greenbank Road with all sites connected to LCC SCADA.

4.2.4 Key Infrastructure Triggers

Infrastructure triggers are based on the Option 2 distribution layout, however it is noted that the distribution layout for Option 2 is the same for the Option 1 distribution layout.

Option 2 network assumptions are outlined below, although these assumptions are preliminary in nature and are not intended to replace the ICOP assumptions at this time.

Table 4-2 indicates the primary water supply infrastructure, as well as the EP trigger and indicative timing.

Table 4-2: Water Supply Infrastructure Triggers

ID	Infrastructure	Nominal Trigger (EP)	Year (based on Mirvac Population Projections)
TCC_001	300 mm diameter trunk cross-connection to supply development from the Spring Mountain WSZ	0	2017
TWM_001	250 mm diameter trunk main	0	2017
PRV_001	Pressure Reducing Valve (dual) for initial connection	0	2017
TPS_001	Pub Lane PS Upgrade	600*	2018
TWM_002	250 mm diameter trunk main	600^	2019
WPS_001	On Site Water Booster Pump Station	2,560	2021
TWM_003	300 mm diameter trunk main	2,560	2021
PRV_002	Pressure Reducing Valve (dual) for ultimate connection	7,396+	2028

Notes:

***** There may potentially be more spare capacity in the Pub Lane PS dependent on timing of other adjacent development fronts in Greenbank or other non-capital solutions to be explored by LCC

^ The nominal trigger may change based on the staging of the Area 1 development

+ The nominal trigger assumes that all areas fed from Round Mountain WSZ is built out first. The nominal trigger may change dependent on the development staging

Figure 4-5 shows the location of the primary infrastructure elements (highlighted red).

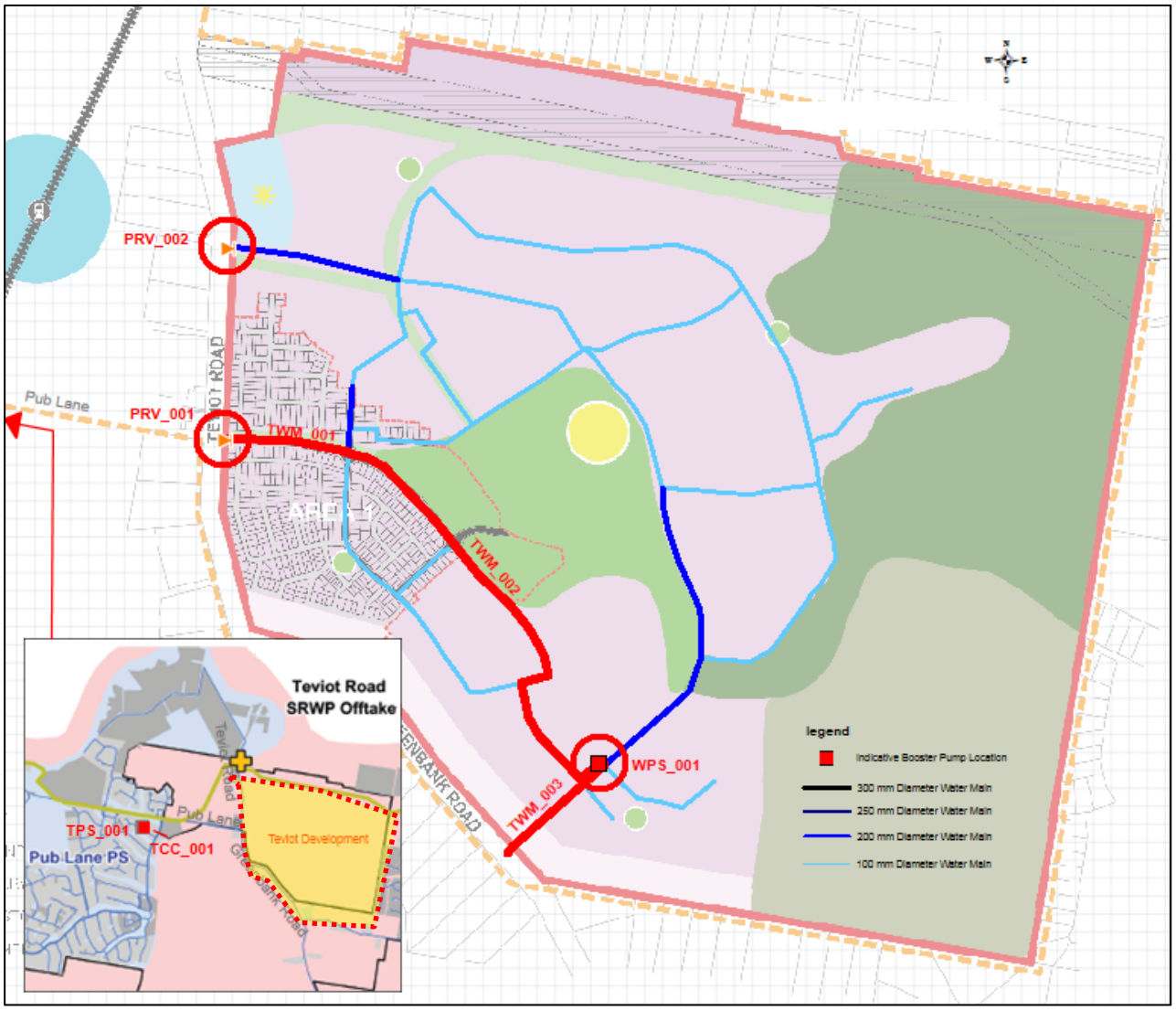

Figure 4-5: Primary Water Supply Infrastructure (Option 2)

5 Sewer Network

5.1 Sewer Design Flows

Projected sewer design flows were calculated for each development parcel in the Teviot Road Land Use Plan, using the populations developed in Section 2 and the adopted DSS.

It is intended that the *Residential – Eco Lots* and *Residential – Interface Lots (north and south)* will be serviced by local on-site treatment (i.e. lot specific treatment by septic tank or similar) and not connected to the sewerage system. Therefore these lots are not included in the sewage load calculations. Refer Appendix E for commentary on the suitability of on-site treatment for the larger lots.

The ultimate sewage population to be served is lower than the water population and is calculated to be 9,598 EP. The Average Dry Weather Flow (ADWF) and Peak Wet Weather Flow (PWWF) loadings for ultimate development are summarised in Table 5-1.

Table 5-1: Teviot Road Development Sewer Design Flows

Planning Horizon	EP	ADWF		PWWF
		ML/d	L/s	L/s
2018	322	0.05	0.6	3.7
2021	2,647	0.44	5.1	30.6
2026	5,487	0.91	10.5	63.5
2031	8,511	1.40	16.3	98.5
2036	9,598	1.58	18.3	111.1
Ultimate	9,598	1.58	18.3	111.1

5.2 Servicing Strategy

5.2.1 Logan South Wastewater Servicing Strategy

The ultimate sewer servicing solution has been prepared on the basis that sub-regional wastewater infrastructure is delivered in accordance with Option (4b1) of the Logan South Wastewater Servicing Strategy. This solution ultimately services the Greenbank Central (including the subject site) and North Maclean areas of the Greater Flagstone PDA at a future regional wastewater treatment plant (WWTP) to be constructed at “Site B” in the vicinity of Stockleigh.

The Site B WWTP is anticipated to be operational in 2021, thus Option 4b1 provides for temporary wastewater treatment infrastructure. For the subject site, temporary wastewater treatment is intended to be provided in the Greenbank Central portion of the PDA at a site which is yet to be determined. Further commentary around the temporary wastewater servicing solution has been largely excluded from this report given the lack of available detail at this stage. It is intended that this IMP will be updated to include commentary on the temporary servicing solution once a viable solution has been confirmed by LCC.

Option 4b1 is summarised in Figure 5-1.

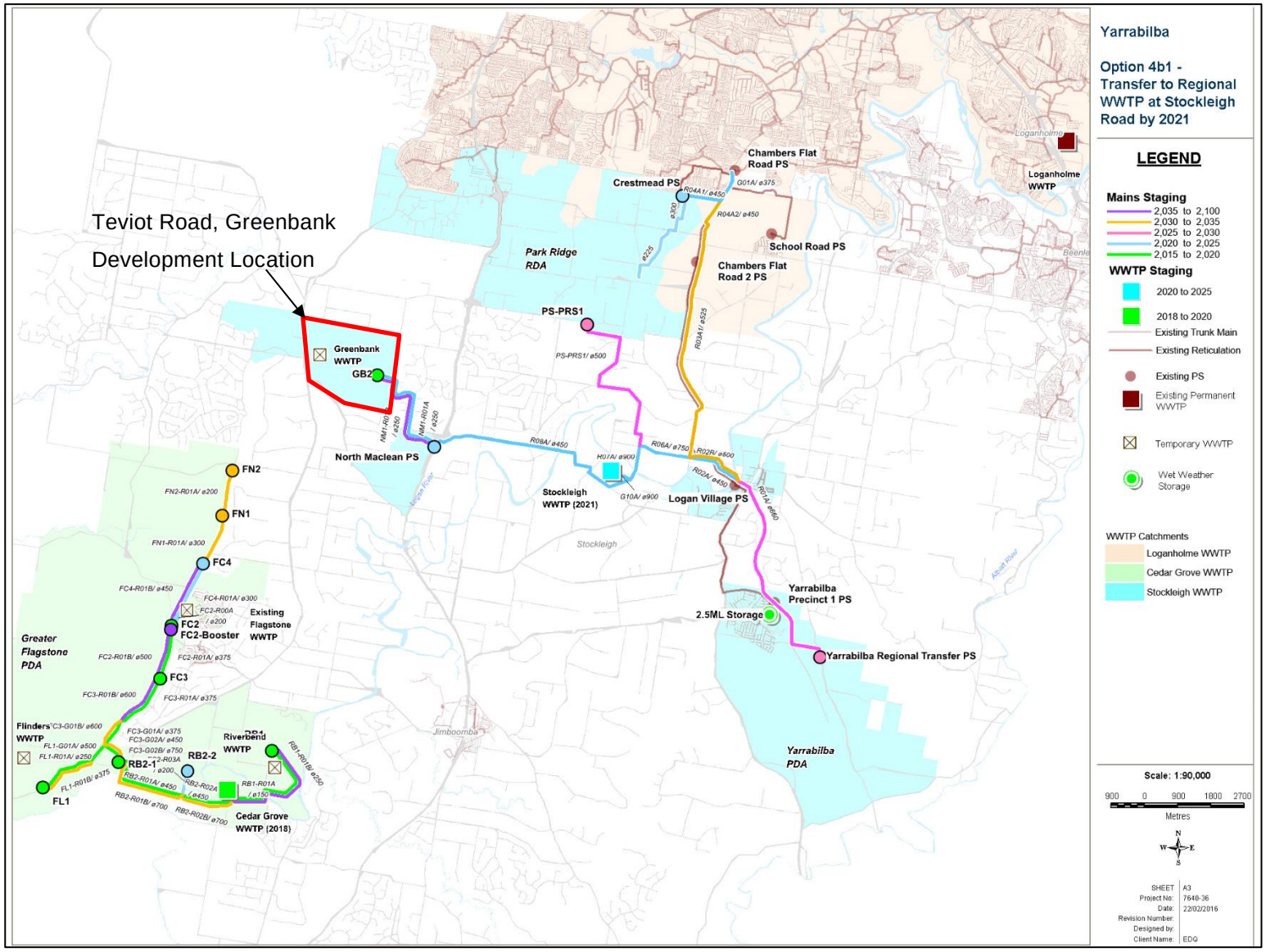

Figure 5-1: Preferred Option 4b1 – Logan South Servicing Strategy

5.2.2 Sub-Regional Infrastructure

Table 5-2 summarises the sub-regional infrastructure required to service the Mirvac site in accordance with Option 4b1 of the Logan South Wastewater Servicing Strategy.

It is understood that sub-regional infrastructure is likely to be designed and constructed by Logan City Council.

Table 5-2: Greenbank/ North Maclean Sewerage Infrastructure Required as part of the Base Strategy (taken from infrastructrue schedule for Option 4b1 in Logan South Wastewater Servcing Strategy, Cardno, May 2016)

Asset Type	Asset ID	Section	Year Req'd	Details
Lagoon (Effluent)	Greenbank Temp - Stage 1	Effluent Storage & Irrigation - Greenbank temp	2017	Lagoon Capacity 5.1ML
Wastewater Treatment Plant	Greenbank Temp - Stage 1	Treatment Plant - Greenbank	2017	WWTP Capacity ML/d Treatment
Wastewater Pump Station	GB2 - Greenbank to North Maclean	Transfer - Greenbank/North Maclean	2019	New PS - DN3.6m x depth 6.0m; 180kW installed power
Miscellaneous Works	Site B Treatment Plant Land Cost	Land Purchase - Site B	2020	Provisional sums
Gravity Main Inc. MHs	G10A	Transfer - Yarrabilba/Park Ridge/North Maclean	2021	DN900 - Gravity Main Inc. MHs
Rising Main	NM1-R01A	Transfer - Greenbank/North Maclean	2021	DN250 - Rising Main
Wastewater Pump Station	North Maclean Transfer PS	Transfer - Greenbank/North Maclean	2021	New PS - DN3.9m x depth 6.0m; 327kW installed power
Rising Main	R08A	Transfer - Greenbank/North Maclean	2021	DN450 - Rising Main
Lagoon (Effluent)	Site B WWTP Stage 1	Effluent Storage & Irrigation - Site B	2021	Lagoon Capacity 8.1ML
Wastewater Treatment Plant	Site B WWTP Stage 1	Treatment Plant - Site B	2021	WWTP Capacity 4.03293ML/d Treatment
Trenchless - Pipes	Trenchless - R08A	Transfer - Greenbank/North Maclean	2021	HDD 450mm bore, Enveloper Not required, Carrier pipe HDPE
Trenchless - Pits	Trenchless - R08A	Transfer - Greenbank/North Maclean	2021	HDD Receiving Pit 1.5m-3.0m depth
Miscellaneous Works	Logan River discharge works on Effluent Main	Logan River Discharge	2025	Provisional sums
Lagoon (Effluent)	Site B WWTP Stage 2	Effluent Storage & Irrigation - Site B	2026	Lagoon Capacity 11.9ML
Wastewater Treatment Plant	Site B WWTP Stage 2	Treatment Plant - Site B	2026	WWTP Capacity 10 ML/d Treatment
Lagoon (Effluent)	Site B WWTP Stage 3	Effluent Storage & Irrigation - Site B	2033	Lagoon Capacity 11.9ML
Wastewater Treatment Plant	Site B WWTP Stage 3	Treatment Plant - Site B	2033	WWTP Capacity 16 ML/d Treatment
Lagoon (Effluent)	Site B WWTP Stage 4	Effluent Storage & Irrigation - Site B	2043	Lagoon Capacity 11.9ML
Wastewater Treatment Plant	Site B WWTP Stage 4	Treatment Plant - Site B	2043	WWTP Capacity 22 ML/d Treatment
Rising Main	NM1-R01B	Transfer - Greenbank/North Maclean	2045	DN250 - Rising Main

5.2.3 Ultimate Trunk Collection System (Internal Infrastructure)

The proposed layout of the internal trunk sewer collection network for the ultimate development is provided in Figure 5-2.

legend

- Sewer Pump Stations
- 200 mm Diameter
- 225 mm Diameter
- 375 mm Diameter

mirvac

Publisher: PLANNING
Publication Date: 20/04/2017
Reference:
Filename:
Projection: Map Grid Of Australia, Zone 56
Horizontal Datum: Geocentric Datum of Aust 1994

Project

Teviot Road Development, Greenbank

title

Figure 5-2 Teviot Road Development Context Plan Sewer Trunk Layout

Based on the adopted growth assumptions and the topography of the proposed development, a total of 3 permanent sewerage pump stations (including sub-regional pump station GB2) are likely to be required to service the development area. The construction of these pumping stations and sewer collection system will be staged to respond to actual catchment growth.

Based on the preferred solution of the Logan South Wastewater Servicing Strategy, the key to the system is the regional pumping station (PS B also known as GB2), which will collect sewage for all of the development and in future the Greenbank West (Teviot) flows. It is proposed that PS B will transfer sewage from the site to the North Maclean transfer pump station and onwards to the “Site B” WWTP near Stockleigh as shown on Figure 5-1. Two smaller localised pump stations (PS A and PS C) may be required to collect sewage from small catchments in the north west and south east parts of the development site.

The trunk main from Area 1 and gravitating to PS B has been sized to include an additional PWWF flow of 68 L/s from future Greenbank West (Teviot Village) development.

The sizing of the proposed trunk infrastructure has been undertaken in accordance with LCC’s DSS. It should be noted that it has been assumed that the Teviot Road sewage collection system will be constructed using Reduced Infiltration Gravity Sewers (RIGS) and assuming a PWWF of 1,000 L/EP/d.

Staging of the regional collection system works is dependent on the location of the ultimate PDA/Regional WWTP and timing. In accordance with the Logan South Wastewater Servicing Strategy, early staging of the sewerage system within the development would include construction of a temporary pump station and associated rising main to the temporary WWTP, as well as the upstream 225/375 mm diameter gravity main receiving Area 1 flows.

5.3 Key Infrastructure Triggers

The network assumptions are outlined below, although these assumptions are preliminary in nature and are not intended to replace the ICOP assumptions at this time.

Triggers for the staging of infrastructure are summarised in Table 5-3, together with estimated timing assuming the adopted population forecast and EDQ’s regional projections as outlined in the Logan South Wastewater Servicing Strategy. These triggers and timings will require regular updating to account for actual population growth. The primary sewerage infrastructure within the development site is highlighted (in red) in Figure 5-3. The referenced Infrastructure IDs shown in the figure are detailed in Table 5-3.

Staging of the sewerage system as detailed in Table 5-3 contemplates tankering for the first 100 lots, followed by connection to a temporary WWTP. Figure 5-3 nominates a location for a temporary pump station which will be required to transfer effluent to the temporary WWTP. As noted earlier, it is intended that this IMP will be updated when temporary servicing solutions are better understood.

In addition, Figure 5-3 does not show the ultimate rising main infrastructure leaving the site from the regional PS B (also known as GB2). It is understood that the sub-regional rising main infrastructure will likely be designed and constructed by Logan City Council.

Table 5-3: Triggers for Internal Sewerage Infrastructure

ID	Infrastructure Description	Nominal Trigger (EP)	Indicative Year (based on Population Projections)
ULTIMATE INFRASTRUCTURE			
REG_SPS_001	Regional pump station PS B (GB2) 179 L/s with Ultimate Civil Structure	3,112	2021
TGM_001	375 mm diameter gravity main	3,112	2021
TGM_002	375 mm diameter gravity main	1,428	2020
TGM_003	375 mm diameter gravity main	0	2017
TGM_004	225 mm diameter gravity main	0	2017
LOC_SPS_001	Local pump station PS A	3,700	2023
LOC_RM_001	50 mm diameter rising main	3,700	2023
LOC_SPS_002	Local pump station PS C	9,100	2031
LOC_RM_002	50 mm diameter rising main	9,100	2031
TEMPORARY INFRASTRUCTURE (Preliminary)			
N/A	Tankering for initial 280 EP	0	2018
TMP_SPS_001	Temporary pump station to pump to temporary WWTP	280[a]	2018
TMP_RM_001	Temporary rising main from pump station to temporary WWTP	280[a]	2018
TMP_WWTP	Temporary WWTP including storage and irrigation system	280[a]	2018

Notes:
[a:] based on an approved Tankering Management Plan

Figure 5-3: Primary Sewerage Infrastructure

6 Conclusions

This report outlines strategies for providing water and sewerage services to the Teviot Road development. Based on current assumptions this water and sewer master planning study concludes that:

1. The total ultimate residential population of the Teviot Road is estimated to be 9,380 EP.
2. The total ultimate non-residential population is 576 EP.
3. The total ultimate EP of the Teviot Road development is 9,956 EP, however only 9,598 EP will be serviced with sewerage. The larger Eco Residential Lots and Interface Lots are intended to be serviced by on-site treatment. This approach is confirmed as suitable in Appendix E of this report.
4. The population of the Teviot Road Area 1 development is 1,428 EP. Area 1 is shown in Figure 2-1.
5. Water supply system:
    a. It has been demonstrated that Area 1 can be serviced with regard to water.
    b. Bulk water supply will be provided by LCC via two water supply zones - the Spring Mountain zone and the Round Mountain zone.
        i. The initial Spring Mountain water supply zone connection will be via a pressure reducing valve to be located at the entrance of the development at the intersection of Pub Lane and Teviot Road. External works are required to facilitate the supply from the Spring Mountain WSZ including a 300 mm diameter cross-connection to service the first 600 EP of the development. When Area 1 population reaches 600 EP (peak hour flow of 3.7 L/s), the Pub Lane PS (external to the site) may require upgrading depending on growth in adjacent development fronts.
        ii. The Round Mountain zone connection will be from the existing 300 mm diameter trunk main on Greenbank Road.
    c. Two ultimate water supply servicing options, representing different combinations of supply from the two existing reservoirs, have been detailed for consideration by LCC as explained in Section 4.2. Both options have been presented in the report as each has a similar construction cost and will provide LCC with the flexibility to service the development and the wider Greenbank area as development progresses. The preferred option is to be refined by LCC at a later date.
    d. Storage capacity of 2.3 ML is required to serve all lots within the development. This will be provided in some combination by the existing water supply zones.
    e. The proposed ultimate trunk water network layout options are presented in Figure 4-3 (Option 1) and Figure 4-4 (Option 2). As stated previously the preferred option is to be refined by LCC at a later date.
6. Sewerage system:
    a. Sub-regional wastewater servicing is in accordance with Option 4b1 of the Logan South Wastewater Servicing Strategy.
    b. The ultimate internal infrastructure requirements have been determined in accordance with Logan City Council's DSS and the Option 4b1 outcome.
    c. Option 4b1 requires temporary wastewater infrastructure given that the regional WWTP is not likely to be operational until around 2021. As only limited detail relating to the temporary infrastructure is available from LCC at this stage, it has been largely excluded from this document.
    d. It is intended that this infrastructure master plan will be updated once the temporary infrastructure strategy is better understood.

Appendix A Correspondence with LCC – Occupancy Rates and Planning Densities

Roger Crozier

From: Leslie, Tracey <TraceyLeslie@logan.qld.gov.au>
Sent: Wednesday, 26 August 2015 10:22 AM
To: Roger Crozier
Cc: 'mark.clancy@mirvac.com'; Paul Flint; Veeren, Sandy; Nishendra Attygalla
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)
Attachments: Categories of Development Types and Conversion Rates.docx; GB_Contour Map.jpg

Hi Roger,

Apologies for the delay in responding to your request. Please find below our review of the information provided.

Review of Non-Res Conversions

The conversion factors used by Logan City Council for non-residential development are:

- School: 105 EP/Ha based on GFA
- Neighbourhood Centre: 73 EP/Ha based on GFA
- Sports and recreational parks: 1.05 EP/Ha based on Gross Site Area

I have attached the tables from our *Development of the Infrastructure Demand Model 2013* report for your reference.

We calculate an ultimate non-res demand of approx. 470 EP with the assumption of 50% of the site area being the GFA. This is not too far off your calculation and will not have a significant impact on boundary conditions.

Boundary Condition Assessment

The following table indicates the boundary conditions derived from our hydraulic model. From 2021 onwards both the residential and non-residential demands have been split between supply point 1 and supply point 2. As non–residential demand comes under the commercial demand category, 30 l/s of fire flow has to be provided from 2021 onwards. We have assumed a slightly higher commercial demand for this analysis, however this can be revised if you can provide the proposed EP based on the conversion rates above.

Year	Res Demand (EP)	Com Demand (EP)	Boundary Conditions for Development			
			System Operation Head		Fire Flow Head	
			Point 1	Point 2	Point 1	Point 2
2016	594	-	80m	-	78m (15 l/s)	-
2021	2836	535	78m	76m	78m (30 l/s)	76m (30 l/s)
2036	9164	550	78.5m	78m	78m (30 l/s)	78m (30 l/s)
2051	9240	550	76.5m	75m	76.5m (30 l/s)	75.7m (30 l/s)

According to the above boundary condition assessment, the following boundary conditions can be provided for this development:

- Point 1 boundary condition under system operation (hydraulic head) – 76.5m
- Point 2 boundary condition under system operation (hydraulic head) – 75 m
- Point 1 boundary condition under fire flow (hydraulic head) – 76.5m
- Point 2 boundary condition under fire flow (hydraulic head) – 75.7m

Note: Pump supply will be required for any development above 55m elevation. The elevation map for the development is attached with this email.

Capacity of DN300 main

There is no requirement in upgrading the DN300 main. The 2021 demand of this development has some impact on the pressure in elevated areas of Pub Lane. However this area has been identified in our Master Planning study as requiring upgrade to meet our DSS.

Let me know if you would like us to revise the boundary conditions based on the revised non-res demand conversions.

Kind regards,

Tracey Leslie | Senior Water Infrastructure Engineer | Water Infrastructure Branch | **Logan City Council**
Phone: 07 3412 9679 | PO Box 3226 Logan City DC Qld 4114 | traceyleslie@logan.qld.gov.au
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From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Thursday, 20 August 2015 4:43 PM
To: Veeren, Sandy
Cc: 'mark.clancy@mirvac.com'; Paul Flint; Leslie, Tracey
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Sandy/ Tracey

We're in the middle of project scoping for the water supply assessment for the proposed development site at Greenbank.

Can you please provide us with confirmation that the existing 300 mm trunk main which will service the site will not be required to be augmented due to the ultimate development demand?

Many thanks
Roger

From: Veeren, Sandy [mailto:SandyVeeren@logan.qld.gov.au]
Sent: Wednesday, 19 August 2015 6:48 PM
To: Roger Crozier
Cc: Ferero, Nicholas; 'mark.clancy@mirvac.com'; Paul Flint; Leslie, Tracey
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi Roger,
I have asked Tracey Leslie to undertake this task and provide a response back to you.

Regards

Sandy Veeren | Water Infrastructure Planning Program Leader | Water Infrastructure Branch | **Logan City Council**
Phone: 07 3412 4613 | Mobile: 0478 650 839 | PO Box 3226 Logan City DC Qld 4114 |
sandyveeren@logan.qld.gov.au
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From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Tuesday, 18 August 2015 1:37 PM
To: Veeren, Sandy

Cc: Ferero, Nicholas; 'mark.clancy@mirvac.com'; Paul Flint
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi Sandy

Thanks for your response to my email regarding the Greenbank development. Please find attached Mirvac's settlement profile (with indicative timings of the non-residential component). The ultimate delivery timing for the non-residential uses is subject to negotiation and detailed programming. Please treat this information as commercial-in-confidence.

I have converted the number of lots in the settlement profile to an Equivalent Population for the residential component and completed similar for the non-residential component (refer table below). I have used 2.8 EP/Lot for residential and applied conversion assumptions for non-residential demand which I need your review/ input.

Planning Horizon	Residential EP	Non-Residential EP	Non-Res Comments	Total EP
2017 (start)	594			594
2021	2,836	424	Primary School & Neighbourhood Centre and Regional Rec Park (10 ha)	3,260
2031	9,164	13	Regional Sports Park (15 ha)	9,177
Ultimate	9,240	437		9,677

The non-residential demand has been calculated based on the following assumptions:

- School at approximately 750 pupils at 0.03 ET per pupil/staff member = 63 EP (at this stage Logan in the SEQ code does not provide advice on conversion rates for schools. I've adopted Gold Coast Water's rate for primary schools which is 0.03 ET per Pupil / staff member. If LCC do have conversion rates for primary schools please advise and we'll amend the non-res component.
- Neighbourhood Centre at 4.2 ha at 30 ET/ha = 353 EP.
- Sports park and recreational park at 25 ha at 0.3 ET/ha = 21 EP (at this stage Logan in the SEQ code does not provide advice conversion rates for open space. SEQ Guidelines states "Subject to assessment by the local government"). In this case I've used Gold Coast Water's rate which is 0.3 ET/ha. If LCC do have conversion rates for open space please advise and we'll amend the non-res component.

If you are happy with what has been calculated can you please provide boundary conditions for the water supply analysis based on the two supply connection points (located on Teviot and Greenbank roads) attached. We require both service pressure and fire flow boundary conditions in hydraulic grade (m AHD) format to complete the internal water supply assessment.

If you have queries on the numbers provided please don't hesitate to contact me.

Many thanks
Roger

MWH
BUILDING A BETTER WORLD
Roger Crozier
Team Leader – Water and Wastewater Networks
Water Group - QLD

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Web: www.mwhglobal.com.au

From: Veeren, Sandy [mailto:SandyVeeren@logan.qld.gov.au]
Sent: Thursday, 30 July 2015 3:54 PM
To: Roger Crozier
Cc: Ferero, Nicholas
Subject: RE: Greenbank Development - Greater Flagstone PDA

Hi Roger,
As discussed, I recommend that Mirvac contact EDQ to discuss the work which about to commence in relation to the wastewater strategy.

Concerning water supply we have previously provided advice to Mirvac in meeting as follows:

- Connection to the site is available from the 300mm water main in Teviot Road and Greenbank Road.
- The site will be fed from the Round Mountain reservoir
- The existing infrastructure is able to service land below RL 70 (subject to detailed verification)
- Land above RL 70 will require pumping
- Our Logan South planning used 2.8 EP/dwelling.

If you provide a table showing EP vs time we can provide boundary conditions for your water supply analysis.

Regards

Sandy Veeren | Water Infrastructure Planning Program Leader | Water Infrastructure Branch | **Logan City Council**
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From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Tuesday, 28 July 2015 2:55 PM
To: Veeren, Sandy
Subject: Greenbank Development - Greater Flagstone PDA

Hi Sandy

MWH have recently been appointed Mirvac's consultant engineer for Lot 434 on RP845844, Lot 205 on RP845844 and Lot 9 on Crown Plan S312355 (~3,000 Lot development) situated in the north of the Greater Flagstone Priority Development Area. We are producing IMPs for Water, Sewer, Roads and Stormwater.

Could you please call me at your earliest convenience to discuss servicing the proposed development in regards to water and sewer. MWH would like to request the latest water and sewer servicing strategy reports for South Logan and further discuss with Logan Water the following items:

- Water Supply
  - Current planning strategy
  - Boundary conditions and supply points (what existing trunk infrastructure available)

- Local demands surrounding site and what demand has been allowed for in the latest servicing strategy
- Confirm service standards (assumption is line with SEQ Guidelines for Logan Water)

- Sewer
  - Current planning strategy and proposed discharge points
    - Short Term Options
    - Long Term Options
  - Temporary WWTP requirements including initial thoughts on:
    - LCC requirements (it is understood that a temporary WWTP may be handed over to LCC for operation)
    - Buffer distances
    - Disposal/ Re-Use
  - Use of Reduced Infiltration Gravity Sewers (RIGS) to influence reduction in Peak Wet Weather Flow (PWWF)

If you can please contact me on 0458 710 007 to set up an initial meeting, that would be much appreciated.

Regards,

MWH
BUILDING A BETTER WORLD

Roger Crozier
Team Leader – Water and Wastewater Networks
Water Group - QLD

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Categories of Development Types and Relevant Density Unit

PLANNING SCHEME USE	LGIP DEVELOPMENT TYPE	IDM DEVELOPMENT TYPE	IDM DENSITY UNIT
Dual occupancy, multiple dwelling, dwelling unit	Attached dwelling	**Attached dwelling**	Persons
Dwelling house	Detached dwelling	**Detached dwelling**	Persons
Caretaker's accommodation, community residence, relocatable home park, retirement facility	Other Dwelling	**Other dwelling**	Persons
Detention facility, hostel, residential care facility	Other bed	**Other bed**	GFA
Hotel (accommodation only), tourist park, short term accommodation	Short term accommodation	**Visitor accommodation**	GFA
Office, sales office	Commercial	**Commercial**	GFA
Club, community care centre, community use, crematorium, emergency services, function facility, funeral parlour, place of worship	Community	**Community**	GFA
High impact industry, medium impact industry	General / Heavy industry	**Heavy industry**	GFA
Hospital	Health	**Health**	GFA
Outdoor sport and recreation, major sport and recreation and entertainment facility, motor sport, park	Outdoor sport and recreation	**Sport and recreation**	Gross Area
Adult store, brothel, food & drink outlet, health care services, hotel other than short term accommodation, indoor sport and recreation, night club entertainment facility, service industry, service station, shop, shopping centre, theatre, veterinary services.	Retail and service	**Retail**	GFA
Educational establishment, child care centre	Education	**Education**	GFA
Agricultural supplies store, bulk landscape supplies, garden centre, hardware and trade supplies, outdoor sales, showroom, wholesale nursery	Retail showroom	**Showroom**	GFA
		Plant nursery	Gross Area
Car wash, low impact industry, port services, research and technology industry, transport depot, utility installation, waterfront and marine industry, warehouse	Light Industry	**Light Industry**	GFA
Animal husbandry, animal keeping, aquaculture, cemetery, cropping, extractive industry, intensive animal industry, intensive horticulture, parking station, permanent plantation, renewable energy facility, rural industry, tourist attraction, winery	Other (rural/transient)	**Other Rural**	Actual water meter reading

Non-Residential Conversion Rates – Water

IDM DEVELOPMENT TYPE	AVERAGE WATER CONSUMPTION METHOD ADOPTED	CONVERSION RATES - WATER		RETURN TO SEWER (%)
		GROSS SITE AREA WATER EP/HA (DENSITY GROSS)	GROSS FLOOR AREA WATER EP/HA (DENSITY GFA)	
Commercial	GFA, 5th-95th %ile	-	55.9	0.9
Community	GFA, 5th-95th %ile	-	73.0	0.9
Education	GFA, 5th-95th %ile	-	105.3	0.8
Health	GFA, 5th-95th %ile	-	226.5	0.9
Heavy Industry (1)	50% above Light Industrial	-	56.6	0.8
Light Industry	GFA, 5th-95th %ile	-	37.8	0.8
Sport and Recreation	Gross, 10th-90th %ile	1.05	-	0.9
Other Rural (2)	Based on Water Meter Consumption	-	-	-
Plant Nursery	Gross, 10th-90th %ile	6.74	-	0.1
Retail	GFA, 5th-95th %ile	-	97.6	0.9
Showroom	GFA, 5th-95th %ile	-	110.8	0.9
Visitor Accommodation	GFA, 5th-95th %ile	-	233.9	0.9
Other Beds (3)	As per Visitor accommodation	-	233.9	0.9

Note:

1. Insufficient data and highly variable – assumes Heavy Industry is 50% greater than Light industry.
2. This development type applies to development associated with rural premises that are supplied with water. Existing water meter readings have been used to establish EP's
3. Insufficient data exists to calculate a conversion rate. It is assumed that density for 'Other beds" is similar to short term accommodation.

Non-Residential Conversion Rates – Wastewater

IDM DEVELOPMENT TYPE	AVERAGE WATER CONSUMPTION METHOD ADOPTED	CONVERSION RATES - WASTEWATER	
		GROSS SITE AREA WASTEWATER EP/HA (DENSITY_GROSS)	GROSS FLOOR AREA WASTEWATER EP/HA (DENSITY_GFA)
Commercial	GFA, 5th-95th %ile	-	50.3
Community	GFA, 5th-95th %ile	-	65.7
Education	GFA, 5th-95th %ile	-	94.7
Health	GFA, 5th-95th %ile	-	203.8
Heavy Industry (1)	50% above Light Industrial	-	45.3
Light Industry	GFA, 5th-95th %ile	-	30.2
Sport and Recreation	Gross, 10th-90th %ile	0.94	-
Other Rural	-	-	-
Plant Nursery	Gross, 10th-90th %ile	0.67	-
Retail	GFA, 5th-95th %ile	-	87.8
Showroom	GFA, 5th-95th %ile	-	99.7
Visitor Accommodation	GFA, 5th-95th %ile	-	210.5
Other Beds (2)	As per Visitor accommodation	-	210.5

Note:

1. Insufficient data and highly variable – assumes Heavy Industry is 50% greater than Light industry
2. Insufficient data exists to calculate conversion rate. It is assumed that density for "Other beds" is similar to short term accommodation.

Roger Crozier

From: Jeremy Thomas <jeremy.thomas@loganwia.com.au>
Sent: Tuesday, 8 December 2015 3:34 PM
To: Roger Crozier
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi Roger,

For the elevated 600 lots boundary conditions from the northern 300mm at the junction of Pub Lane and Teviot Rd will be 50m (120m head) pressure under normal operating conditions and 25m pressure (95m head) under fire flow (15L/s).

Regards
Jeremy

From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Monday, 7 December 2015 2:54 PM
To: Jeremy Thomas <jeremy.thomas@loganwia.com.au>
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hey JT

Hope you're doing well mate, looking forward to the Christmas break?

Hey, any luck on the boundary conditions for the Mirvac development site based on being served off the Spring Mountain WSZ?

Cheers
Rog

From: Jeremy Thomas [mailto:jeremy.thomas@loganwia.com.au]
Sent: Wednesday, 4 November 2015 1:11 PM
To: Roger Crozier
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Indeed.in back to back meetings all day until 2.30. Will call later.

Sent from my Windows Phone

From: Roger Crozier
Sent: 4/11/2015 12:50
To: Jeremy Thomas
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hey Jermey

Any progress on the proof of concept (?), just want to update Mirvac on any progress

Cheers
Roger

From: Jeremy Thomas [mailto:jeremy.thomas@loganwia.com.au]
Sent: Thursday, 29 October 2015 2:31 PM
To: Roger Crozier
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hey Roger,

We're snowed under …but I've negotiated with Dieter to steal his resource for a couple of hours tomorrow for a proof of concept.

Will let you know as soon as it's complete.

Please also let Henry know we've got some issues with the ClearSCADA data processing for Yarrabilba that I'm still working on…

Cheers

Jeremy

From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Thursday, 29 October 2015 2:26 PM
To: Jeremy Thomas <jeremy.thomas@loganwia.com.au>
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi JT

How's the potential option of moving Mirvac's land into Spring Mountain WSZ coming along? Any preliminary outcomes as yet?

Rog

From: Jeremy Thomas [mailto:jeremy.thomas@loganwia.com.au]
Sent: Tuesday, 27 October 2015 8:32 AM
To: Roger Crozier
Subject: FW: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi Roger

I've appended some comments below and I'll call to discuss.

Jeremy

From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Thursday, 22 October 2015 9:19 AM
To: Veeren, Sandy
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Sandy

Just had questions around servicing Mirvac's development for water and sewer:

1. Can you provide us permission to use the latest Logan Water Alliance water and sewer strategy documents provided to us for other development occurring in the Yarrabilba PDA? Specifically,
   - Master Planning for Southern Regional Pipeline Water Supply Area (April 2015)
   - LOGANHOLME WASTEWATER CATCHMENT MASTER PLANNING REVIEW Part 1 (June 2015); And

- REVISION OF LOGAN SOUTH WASTEWATER SERVICING STRATEGY (January 2014)
- Latest Cost Unit Rates for Logan

2. How is the shopping centre on Pub Lane currently served being approximately RL 70 m? Is this through the Spring Mountain WSZ?

This centre is serviced via Round Mountain. They have their own private pump set. Please note that both the 300mm mains on Pub Lane are now on Round Mountain supply and are cross connected at the Pub Lane PS site and on Pub Lane approximately 200m west of the shopping centre connection. These mains also receive supply via the Teviot Rd SRWP connection with an average head of around 95m (varying from 90-110m). A contingency pressure managed connection from the Pub Lane Pump outlet-Spring Mountain WSZ to the 300mm main connecting to the SRWP at Teviot Road and supply north to the Greenbank Army Training(GBTA) Centre also exists.

3. We understand that at ultimate a WPS booster pump station will be required to serve areas higher than 55 m AHD as the site will be ultimately supplied by Round Mountain Reservoir Head. Application 1 of the Mirvac development will be the western portion (highest land) adjacent to Teviot Road and Greenbank Roads. Is there potential (spare capacity) in the short (to medium) term to serve the high level area in Mirvac's land (Greenbank area) by the Spring Mountain WSZ? This potentially delays the timing of which the WPS booster pump station is required.

I understand that the master plan indicates a local booster for 2031. Out IDM indicates development in this area around 2026 (there was no master planning review for the interim planning horizon). There certainly may be an opportunity to extend the Spring Mountain supply via the PRV connection mentioned above and using one of the Pub Lane 300mm mains to extend the WSZ for the high level areas of the development and the GBTA. The impacts of this scenario would need to be assessed through some more detailed planning.

4. If the Spring Mountain WSZ approach is possible, how many additional EP's from Mirvac's development could be served by Spring Mountain WSZ before triggering pipeline augmentations (if any) and reservoir spare capacity issues in the Spring Mountain WSZ? If this solution is feasible to delay the WPS, how would the first stages of Mirvac's land connect to the Spring Mountain WSZ i.e. what additional infrastructure would be required to be built by Mirvac to connect?

The infrastructure requirements would more likely be focussed on additional pipework at Pub Lane (short but definitely rock to navigate), and pump upgrade timing. The local issues with capacity in the Spring Mountain WSZ are generally confined to peak hour demand on the single inlet/outlet main, a dedicated intel outlet arrangement has been explored and dismissed based on cost due to the large amount of rock along the alignment. Local development west of Tall Timber Rd through to Tulley Rd (IDM timing 2026) is anticipated to provide relief in the long term, however in the interim, operational controls to maintain Pub Lane pump operation during peak hours will suffice (by providing both a pump supply and support from the reservoir). The impacts on the wider trunk network would also need to be explored as well as the additional operational complexity required to provide full support from the Teviot Rd SRWP connection (in the event of an incident /maintenance at the Pub Lane SRWP connection).

5. Has there been any monitoring of flows and pressures in the Round Mountain WSZ and Spring Mountains WSZ to confirm the desired standards of service for constant flow properties?

Logan Currently has pressure and flow monitoring at a number of key sites in the SRWP supply area (all reservoir, PS and meter sites). Five new meter sites have recently been added to allow DMA (traditional and virtual) monitoring of this area. In addition the Logan PLMP Stage 3 design and delivery is now underway which includes the pressure management in the Spring Mountain & New Beith areas (as well as the rest of the SRWP supply area) which will include critical point monitoring of DSS levels.

I will give you a call to discuss.

Many thanks

MWH
BUILDING A BETTER WORLD
Roger Crozier
Team Leader – Water and Wastewater Networks
Water Group - QLD

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QLD 4101

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Mob: +61 (0) 458 710 007
Eml: roger.crozier@mwhglobal.com
Web: www.mwhglobal.com.au

From: Veeren, Sandy [mailto:SandyVeeren@logan.qld.gov.au]
Sent: Monday, 31 August 2015 11:45 AM
To: Roger Crozier
Cc: Leslie, Tracey; WaterDA; Ferero, Nicholas; Nishendra Attygalla
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi Roger,
The information provided is correct meaning that land above approximately 55m AHD will not be able to be serviced from the Round Mountain reservoir zone. Depending on your staging, there may be a solution in place for the elevated land in time, however if you intend to develop the elevated land early then you would need to provide a temporary water pumping station.

Regards

Sandy Veeren | Acting Water Infrastructure Manager | Water Infrastructure Branch | **Logan City Council**
Phone: 07 3412 4613 | Mobile: 0478 650 839 | PO Box 3226 Logan City DC Qld 4114 |
sandyveeren@logan.qld.gov.au
www.logan.qld.gov.au | facebook.com/logancitycouncil | twitter.com/logancc

Logan City: Building Our Communities, Our Businesses and Our Pride

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From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Monday, 31 August 2015 8:38 AM
To: Veeren, Sandy <SandyVeeren@logan.qld.gov.au>
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi Sandy

How'd you go with the hydraulic boundary conditions from last week? We have a constraints meeting for the internal Structure Plan on Wednesday with Mirvac. If you can please provide an answer by today or tomorrow morning that would be much appreciated.

Many thanks
Roger

From: Veeren, Sandy [mailto:SandyVeeren@logan.qld.gov.au]
Sent: Wednesday, 26 August 2015 11:04 AM
To: Leslie, Tracey; Roger Crozier
Cc: 'mark.clancy@mirvac.com'; Paul Flint; Nishendra Attygalla
Subject: RE: Greenbank Development - Greater Flagstone PDA (Commercial-In-Confidence)

Hi Roger,

From:	Jeremy Thomas
To:	Roger Crozier
Cc:	O"Brien, Daniel; kumaraherath@logan.qld.gov.au; Sandy Veeren (LCC); Nishendra Attygalla
Subject:	RE: Mirvac"s Greenbank Development - Water Supply
Date:	Wednesday, 22 June 2016 10:18:34 AM
Attachments:	image001.jpg image002.png image003.png image004.png image005.png image006.jpg 22062016093730-0001.pdf

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Hi Roger,

I've appended some responses below.

Kind Regards
Jeremy

From: Roger Crozier [mailto:Roger.D.Crozier@mwhglobal.com]
Sent: Wednesday, 22 June 2016 9:04 AM
To: Jeremy Thomas <jeremy.thomas@loganwia.com.au>
Cc: O'Brien, Daniel <DanielO'Brien@logan.qld.gov.au>; kumaraherath@logan.qld.gov.au; Sandy Veeren (LCC) <sandyveeren@logan.qld.gov.au>; Nishendra Attygalla <Nishendra.Attygalla@loganwia.com.au>
Subject: RE: Mirvac's Greenbank Development - Water Supply

Hi Jeremy

Thanks for your email regarding water supply servicing of Mirvac's development.

Had some questions in regards to the assessment and some questions might be required to be answered by Daniel or yourself:

- Can we please be provided with the cross-connection details required near Pub Lane PS? We have asked for this a number of times and haven't received any details as yet.

I've marked up a GIS plan (attached) indicating the general location/nature of the cross connection requirement. Subject to more detailed assessment and constraints this connection could of course move and new boundary valves located but you'll get the general idea.

- In terms of the Pub Lane PS upgrades, will Mirvac's 600 EP trigger this upgrade? Or is the upgrade already being planned by LCC/ LWA if it's required in 2018?

There are competing development demands on the remaining capacity at the pump station. At his stage the pump upgrade timing will be dependent on the timing / staging of the initial 600EP and the other development timing and final density. This is best discussed with Daniel and team. The pump station has been recently upgraded and the next stage was not planned until approx. 2031 to meet forecast growth, and therefore it is not currently included in the short term capital works.

- Do the lower hydraulic boundary conditions consider fire flow demand? In the first submission of the infrastructure master plan (IMP) we used 95 m AHD from Spring Mountain WSZ assuming 15 L/s residential fire flow.

Our boundary conditions have assumed a 15L/s fire flow demand for Mirvac.

- From your conclusions when you say only approximately a quarter of the demand (2560 EP) can be served from the Spring Mtn WSZ do you mean approximately 640 EP?

No we mean approximately 2560EP (ultimately).

- Will this assessment be going in as an addendum to the current Logan South water supply strategy? If so what's the timing on the addendum? We've been asked by EDQ based on the first RFI to redo the IMP based on the updated South Logan water strategy.

I'll discuss with Sandy the implication of the EDQ request, but at this stage we will likely be adopting the planning outcomes of this analysis and the Seqwater discussion into our IDM, model and assumptions and disseminate this information to other relevant water business stakeholders. There is currently no plan to add an addendum to our master planning document and the Logan South strategy is likely to evolve further as part of the imminent Logan South Project as more information from developers becomes available. Internal memorandums documenting the outcomes of this analysis and in line with the advice provided may be prepared. A new water strategy document will be developed as part of that program.

Many thanks
Roger

Roger Crozier
Team Leader, Water Group

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roger.crozier@mwhglobal.com
www.mwhglobal.com

From: Jeremy Thomas [mailto:jeremy.thomas@loganwia.com.au]
Sent: Monday, 20 June 2016 2:11 PM
To: Roger Crozier <Roger.D.Crozier@mwhglobal.com>
Cc: O'Brien, Daniel <DanielO'Brien@logan.qld.gov.au>; kumaraherath@logan.qld.gov.au; Sandy Veeren (LCC) <sandyveeren@logan.qld.gov.au>; Nishendra Attygalla <Nishendra.Attygalla@loganwia.com.au>
Subject: Mirvac's Greenbank Development - Water Supply

Hi Roger,

Further to the previous advice given, we've completed a review of the servicing strategy and hydraulic modelling assessment for the Mirvac Development with the increased density to determine the impact on the network and our ability to service.

The following assumptions have been made

- Development above approximately 55m AHD in the Mirvac will be considered as elevated and can be supported from the Spring Mountain Res/Pub Lane PS network. Lower elevated areas can be supplied from Round Mountain reservoir head.
- The following EP forecast has been adopted:

Development Category	2018	2021	2026	2036
Mirvac (Elevated)	641 EP	2000 EP	2000 EP	2560 EP
Mirvac (Lower)	0 EP	1070 EP	4112 EP	7665 EP

- A cross connection is required near the Pub Lane pump station to transfer one of the 300mm mains to the Spring Mountain network to enable the elevated are to be serviced.
- Upgrades to the Pub Lane PS will also be required, the timing of which is to be determined following confirmation and timing of additional loads on the station and other impacting developments (approximately 2018 based on current forecasts).
- The following boundary conditions indicate the hydraulic head near the approximate connecting points (Exact connecting points TBC)

Year	Mirvac Elevated (m)	Mirvac Lower (m)
2018	138	82
2021	129	78
2026	121	82
2036	121	76

To summarise, there is capacity within the network to meet the higher density of this development in elevated areas beyond the 600 EP initially confirmed, however only approximately a quarter of the demand (2560 EP) can be met from the Spring Mountain/ Pub Lane Elevated Zone without significant and costly network upgrades. The remaining demand will have to be met via the Round Mountain supply area.

I apologise for the time to get this analysis to you. Wider potential grid supply changes/ issues that significantly impacted on this development had to be assessed and resolved to enable Council to provide this advice. If you have any queries or I can assist further, please feel free to give me a call. This advice is limited to the technical assessment and all discussions and communication should be addressed to the Water Development Service Team at Council who

are happy to meet with you to discuss the finer details etc.

Kind Regards

Jeremy Thomas
Project Manager
P: 07 3412 9667 | F: 07 3412 9649 | M: 0406 803 497

LOGAN WATER INFRASTRUCTURE ALLIANCE
Logan City Council, Downer, Cardno and WSP|Parsons Brinckerhoff
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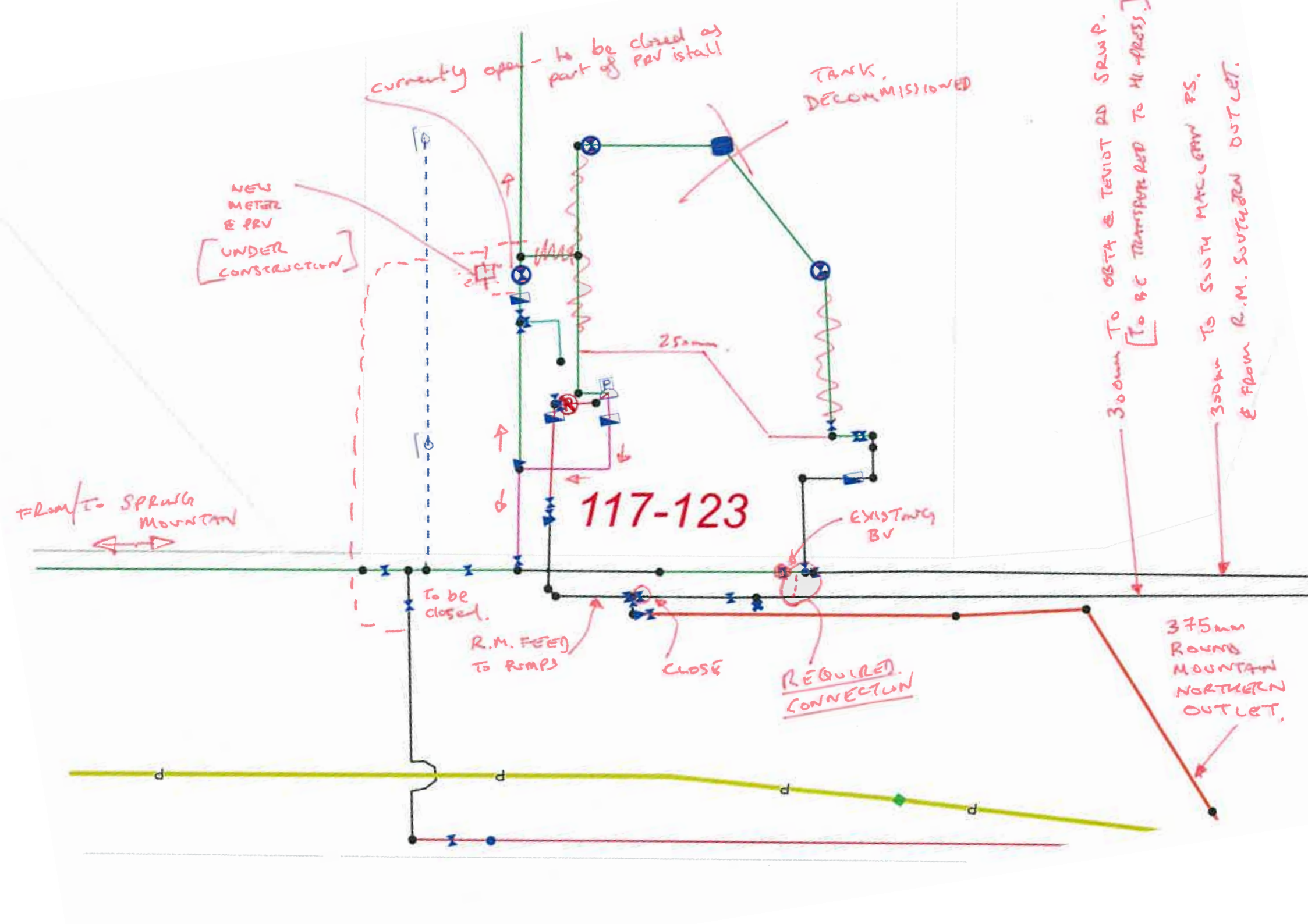

currently open - to be closed as part of PRV install
TANK DECOMMISSIONED
NEW METER & PRV
[UNDER CONSTRUCTION]
250mm
117-123
FROM/TO SPRING MOUNTAIN
EXISTING BV
To be closed.
R.M. FEED TO RUMPS
CLOSE
REQUIRED CONNECTION
375mm ROUND MOUNTAIN NORTHERN OUTLET.
300mm TO OSTA & TEVIOT RD SR&WP. [To BE TRANSFERRED TO HI PRESS.]
350mm TO SOUTH MACLEAN PS. & FROM R.M. SOUTHERN OUTLET.

Appendix B Logan Water Alliance Desired Standards of Service

WATER NETWORK DSS				
Parameter	**Criteria**			
Water demand				
Average Day Demand (ADD)	On demand areas - 190 L/EP/d. Based on 165 L/EP/d residential consumption + allowance for leakage/losses (25 L/EP/d).			
	Constant flow areas - 150 L/EP/d. Based on 120 L/EP/d residential consumption + allowance for leakage/losses (30L/EP/d).			
Peaking factors	**Category**	**MDMM/AD**	**MD/AD**	**PH/AD**
Guidance Note: Peaking factors are to be applied to the residential component of demand, i.e. 165 & 120 L/EP/d. Leakage /loss levels will remain constant throughout all demand categories and should only be appended after any peaking escalation has occurred.	Residential detached	1.3	1.7	3.1
	Residential attached	1.3	1.6	2.6
	Rural residential	1.3	1.7	CF services 70L/hr/property
	Commercial	1.2	1.3	2.0
	Industry	1.2	1.3	1.7
	Parks / Open space	1.2	1.3	1.7
System planning				
Bulk supply and reticulation	3 days of MDMM. Reservoirs to have a net positive inflow and capable of continuous operation and not fall below the emergency level. 3 days of MD. Reservoirs should not fall below the emergency level. 5 days of AD. Reservoirs should fill from empty to full.			
Service pressures				
Minimum operating pressure at PH	On demand areas – 22m at the property boundary based on reservoir at minimum operating level (MOL). MOL defined as 15% of storage height or top of emergency storage.			
	Constant flow areas – 10m at the property boundary based on reservoir at minimum operating level (MOL) MOL defined as 15% of storage height or top of emergency storage.			
Maximum operating pressure	80 m at the property boundary based on the reservoir at TWL			
Target maximum operating pressure	55 m at the property boundary based on the reservoir level at TWL			

Fire fighting		
System pressure	On demand areas	12 m minimum at property boundary
	Constant flow areas	no fire service provided
Fire flow	Constant flow areas	no fire service provided
	Rural Residential	7.5 L/s for 2 hrs
	Rural Commercial / Industrial	15 L/s for 2 hrs
	Residential	15 L/s for 2 hrs
	Commercial & Industrial	30 L/s for 4 hrs
	Special risk / hazard	to be advised by Logan City Council (LCC)
Background demand	2/3 PH (as per DEWS requirements)	
Reservoir level	Minimum Operating Level (MOL)	
Water quality		
Drinking water quality	Drinking water to comply with the NHMRC Australian Drinking Water Guidelines	
Reservoir storage		
Ground level storage capacity	3 (MD - MDMM) + (Greater of emergency storage/fire fighting reserve) Emergency Storage = 4 hr MDMM demand in zone or 0.5 ML whichever is greater. *Fire Fighting* reserve = ***> 4800EP:*** • rural residential 108 kL • industry 540 kL • otherwise 216 kL **< 4800 EP:** • rural residential 54 kL • industry 432 kL • otherwise 108 kL	
Elevated storage capacity Guidance Note: In-line pressure booster pumping without high-level storage shall be considered where satisfactory pressures can be provided by gravity flow during low	6 (PH - 1/12 MDMM) + minimum fire fighting reserve. *Fire Fighting reserve =* ***> 4800EP:*** • rural residential 108 kL • industry 540 kL • otherwise 216 kL	

demand periods or booster failure can be mitigated to an acceptable level (risk assessment required) and where there is no other feasible means of providing adequate pressure.	**< 4800 EP:** • rural residential 54 kL • industry 432 kL • otherwise 108 kL
Pumping capacity	
Pump supplying a ground level reservoir	MDMM over 20 hrs
Pump supplying an elevated reservoir	(6PH – operating volume) / (6 x 3600)
Standby pump capacity	To match duty, except where more than one duty pump or as determined by risk assessment.
Reticulation booster pumps/pumped system	PH + fire flow
Pipeline assessment & design	
Main capacity	Raw water mains & trunk feeding ground level reservoir : MDMM for a gravity supply and MDMM over 20hrs for a pumped supply Trunk Mains feeding elevated reservoir: capacity of pumps: Reticulation Mains: PH + fire flow.
Mains size Guidance Note: New CF areas are not permitted by LCC.	Constant flow areas - where mains terminate in short runs such as cu- de-sacs minimum sizes that may be acceptable are: DN 63 up to 150 m from main DN 80 up to 350 m from main
	On demand areas - minimum reticulation main 100mm in residential areas and 150mm in commercial and industrial areas.

Friction default value

Existing Infrastructure	Future Infrastructure
Colebrook White k values (mm)	The design shall be conducted to achieve less than the following head losses: (a) 5 m head/km for ≤DN 150 (CIOD) or ≤DN 180 (ISO). (b) 3 m head/km for ≥DN 200 (CIOD) or ≥DN 250 (ISO). Head loss shall be calculated using computer models or hydraulic formulas.

Pipe Material	Pipeline Age (years)		
	< 10	10 to 25	> 25
Asbestos Cement	0.15	0.3	0.3
Plastic (UPVC, MDPE, Hobas, etc)	0.06	0.06	0.15
MSCL/DICL	0.3	0.3	0.6
CICL	0.3	0.3	0.6

Maximum velocity	2.5 m/s At peak hour for trunk mains and at peak hour including fire flow for reticulation.

WASTEWATER NETWORK DSS	
Parameter	**Criteria**
Sewage load	
ADWF	165 L/EP/day
PDWF	Use actual flow data; or $d \times 165$ L/EP/d or; $d \times 0.00191 \times EP$ L/s *Where:* $d = 0.01(\log A)^4 - 0.19(\log A)^3 + 1.4(\log A)^2 - 4.66 \log A + 7.57$ *d = dry weather peaking factor* *A = gross plan area of development catchment, in hectares* *Refer to WSAA Sewerage Code of Australia; Part 1 Planning and Design*
Containment standard for assessment of existing networks	Network to contain a 1 year ARI storm event, for critical storm duration. This is an overflow containment standard rather than a conveyance standard. For those catchments that fail the standard, mitigation measures such as I/I reduction and wet weather storage should be considered in addition to any capacity increases.
PWWF	Residential 1300 L/EP/d
	For Common Effluent Discharge PWWF = 660 L/EP/d
	Commercial 1300 L/EP/d
	Light Industrial 1000 L/EP/d
	Heavy Industrial 840 L/EP/d

Gravity sewer design	
Flow equation	Colebrook White to be used for all applications – design and modelling
Pipe roughness general	Colebrook White k = 1.5mm
Maximum velocity @ PWWF	3 m/s
Depth of flow @ PWWF - Existing	Up to 1m below MH surface level and no spillage through overflow structures
Depth of flow @ PWWF - Proposed/ new sewers	100% of pipe depth
Depth of flow @ PDWF – Existing and new sewers	Maximum 60% of pipe depth
Slime Stripping	It is desirable where gradients permit to achieve slime stripping. A wall shear of 3.85 Pa is required to achieve slime stripping.

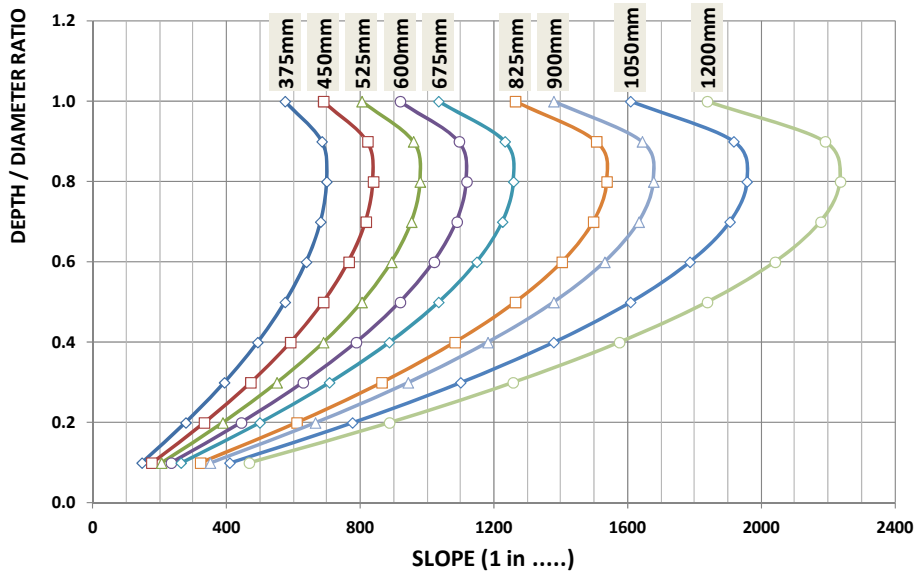
Minimum grades for self cleansing

Diameter (mm)	Grades (mm, 1 in X)
150	180 (80 in last section between last manholes or to an end)
225	300
300	400
375 - 1200	Minimum Grades are to be based on achieving Self Cleansing Shear Stress of 1.6 Pa at PDWF, refer formula and figure below.

$$S_{min} = \frac{\tau}{\rho . g . R_p}$$

Where:

S_{min}	=	Minimum Grade		
τ	=	Self Cleansing Shear Stress	=	1.6 Pa
τ	=	Slime Stripping Shear Stress	=	3.85 Pa
ρ	=	Density of Water	=	1000 kg/m^3
g	=	Gravitational constant	=	9.8 m^2/s
R_p	=	Hydraulic Radius Partial Full Pipe (m) = Wetted Perimeter / Cross sectional flow area		



Note: Depth/Diameter ratio is based on flow conditions at PDWF

Sewerage pump stations	
Wet well operating requirements	V (kL) = 0.9 x pump rate (L/s) / N Where N is the acceptable number of starts per hour Pump Rate (L/s) = capacity of the largest duty pump N = 12 for motors <= 15 kW N = 8 for motors 15kW - 200 kW N = 5 for motors > 200 kW Control levels shall be based on Table 5.1 of WSA04-2005. The minimum depth between duty start and duty off is 100mm and ideally should be 300mm or greater.
Emergency storage	Emergency storage volume requirement to be based on containment of 2 hours of PDWF. Where actual measured flow data is available, then volume should be based on containing 2 hrs measured PDWF provided it takes into account any future growth. Except where otherwise specified to meet the requirements of the overflow risk assessment If there is an overflow pipe - storage in the system is measured between the high level alarm and overflow pipe invert level. If there is no overflow pipe - storage is measured between the high level alarm and 300mm below the lowest upstream manhole or top of wet well.
Pump capacity	If PWWF <20L/s, then 2 pumps (duty/standby arrangement) shall be provided, with each pump being capable of delivering PWWF. If PWWF >20L/s and <200L/s, then 2 pumps (duty/duty assist arrangement) shall be provided, with each pump being sized such that the two pumps running in parallel are capable of delivering PWWF. The minimum single pump capacity shall be not less than the calculated PDWF, where PDWF is a minimum of 2.5xADWF. If calculated PDWF has a peaking factor <2.5xADWF then 2.5 shall be used. If PWWF >200L/s, then minimum of 3 pumps (duty/duty assist/duty assist/…. arrangement) shall be provided. The minimum single pump capacity shall be not less than the calculated PDWF, where PDWF is a minimum of 2.5xADWF. If calculated PDWF has a peaking factor <2.5xADWF then 2.5 shall be used. All pumps operating shall be capable of delivering PWWF with each pump being sized in consultation with LCC.
Pump operation	VSD shall only be used, subject to special approval from Logan City Council. If approved by Logan City Council, the VSD operating regime shall be selected to ensure sufficient self-cleansing velocities, and shall meet the pump supplier's requirements.
NPSH	***Refer Clause 6.4 of WSA04-2005***

Rising mains	
Flow equation	Colebrook White to be used for all applications
Friction mains	For preliminary design a Colebrook White Roughness (k) of 0.6 mm is to be used. For detailed design, roughness shall be based on velocity and pipe roughness at end of pump design life. However, pumps should be able to operate (not necessarily meet design flow) for Colebrook White roughness's between manufacturers specified roughness for new pipes and 0.6 mm
Minimum velocity	Minimum Velocity to be based on achieving an absolute minimum Self Cleansing Shear Stress of 1.6 Pa at Single Pump Flow. However it is desirable to achieve a Slime Stripping Shear Stress of 3.85 Pa. The wall shear is to be calculated using the following equation: **$\tau = \rho.g.(D/4) \times (HL/L)$** Where: τ = Wall Shear Stress (minimum of 1.6 Pa required for self cleansing) HL =Frictional loss over main length of L based on Colebrook White (m) L =Length of main (m) ρ = Density of Water = 1000 kg/m³ g =Gravitational constant = 9.8 m²/s D =Internal Diameter of Pipe (m)
Maximum velocity	3.0 m/s proposed systems Manufacturer's specifications for new systems
Max detention time	Maximum time of detention in pressure main and SPS wet well is 6 hours [2 hours in wet well and 4 hours in rising main] (based on daily average flows) to minimise potential for odour / hydrogen sulphide generation. Where high retention times are likely to occur, odour / sulphide control measures will be required to the satisfaction of Logan City Council. ***(Refer WSA 07-2007-1.1 section 3.15)***
Reduced infiltration gravity sewers (RIGS)	
As per gravity sewers except	Not permitted without Logan City Council approval
PWWF	Reticulation system to be designed for 1000 L/EP/day Trunk systems to be designed for minimum 1300 L/EP/day
Total PS Capacity	1300L/EP/d
Low pressure sewers / vacuum pumps	
Low pressure sewers / vacuum pumps	Are not preferred and will only be allowed subject to approval from Logan City Council.
Private pump stations and rising mains	
	Private pump stations and rising mains are permitted for single users only and no connection or sharing will be permitted without approval from Logan City Council
Common effluent discharge	
Common effluent discharge (CED)	Not permitted without approval from Logan City Council.

Appendix C Contour Map of Development

legend

mirvac

Publisher: PLANNING
Publication Date: 31/10/2016
Reference: 1
Filename:
Projection: Map Grid Of Australia, Zone 56
Horizontal Datum: Geocentric Datum of Aust 1994

Project

Teviot Road Development, Greenbank

title

Teviot Road Development
Indicative Finished Surface Levels Map

Appendix D Design Outcomes & Design Standards / Resources

Element	Design Outcome
Sewer – Residential	▪ All standard residential lots are to be provided with a sewerage connection. ▪ Balance parcels and super lots are not required to be provided with a sewerage connection however it must be demonstrated that they can be suitably serviced prior to subsequent subdivision ▪ Eco Lots and Interface Lots are to be serviced by an onsite sewerage treatment solution. ▪ On site sewerage treatment areas are permitted outside of the building envelope ▪ The internal sewer reticulation infrastructure has been sized based on the amended Peak Wet Weather Flow standard of 1,000 L/EP/d for greenfield development sites
Water – Residential	▪ All standard residential lots are to be provided with a potable water connection. ▪ Balance parcels and super lots are not required to be provided with a potable water connection however it must be demonstrated that they can be suitably serviced prior to subsequent subdivision ▪ Eco Lots and Interface Lots are to be connected to a potable water connection. Future dwellings on eco and interface lots are also required to have rainwater tanks. ▪ The internal water network is designed to satisfy Logan Water's desired standards of service requirements.
Sewer – Non-Residential	▪ All non-residential land uses are to be provided with a sewerage connection. ▪ Non-residential land uses Equivalent Person (EP) sewage generation must be serviced by the waste water collection system. ▪ The internal sewer network is designed to accommodate the non-residential land uses and is sized on the PWWF standard of 1,000 L/EP/d for Greenfield development sites.
Water – Non-Residential	▪ All non-residential are to be provided with a potable water connection. ▪ Non-residential land uses EP water demand must be serviced by the potable water network. ▪ The internal water network is designed to accommodate the non-residential land uses and satisfy Logan Water's desired standards of service requirements.
Notes: *- Development outcomes are acceptable where in accordance with the design outcomes above, or part thereof.* *- Alternate design outcomes may be proposed and deemed acceptable.*	

Design Standards / Resources
Logan Water Desired Standards of Service – Water Supply (Logan Water, received 19/02/2016)
Logan Water Desired Standards of Service – Sewerage (Logan Water, received 19/02/2016)

SEQ Water Supply and Sewerage Design and Construction Code (Version 1, July 2013)
WSA 02-2002 Sewerage Code of Australia (Second Edition, 2002)
WSA 04-2005 Sewerage Pump Station Code of Australia (Second Edition, Version 2.1, 2005)
WSA 03-2002 Water Supply Code of Australia (Second Edition, 2002)
Notes: *- The Design Standards / Resources above are considered acceptable Standards / Resources.* *- Development outcomes in accordance with the Design Standards / Resources, or part thereof, are considered acceptable outcomes.* *- Alternate Standards / Resources may be proposed and deemed acceptable.*

Appendix E Larger Lots Onsite Sewage Treatment Feasibility Technical Note

GREENBANK ONSITE SEWERAGE SUITABILITY ASSESSMENT

Prepared for Mirvac

November 2016

QUALITY STATEMENT

PROJECT MANAGER		PROJECT TECHNICAL LEAD
Paul Flint		Dr Dean Lanyon
PREPARED BY		
Dr Dean Lanyon	…….....	…04/11/2016
CHECKED BY		
Roger Crozier	…….....	…04/11/2016
REVIEWED BY		
Paul Flint	…….....	…04/11/2016
APPROVED FOR ISSUE BY		
Paul Flint	…….....	…04/11/2016

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
A	04/11/16	Draft	DL	RC	PF	PF
B	05/11/16	Final	DL	RC	PF	PF

Mirvac

Greenbank Onsite Sewerage Suitability Assessment

CONTENTS

LIST OF TABLES

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APPENDICES

1 Introduction

The proposed Mirvac Greenbank (Teviot Road) development area is located within the Greater Flagstone Priority Development Area (PDA) on land parcels 434/RP845844, 9/S312355 and 205/RP845844 as shown in Figure 1. While the majority of the development will be serviced by network sewerage infrastructure, Mirvac propose to provide approximately 128 eco-lots and interface lots which will be serviced by local on-site treatment (i.e. lot specific treatment by septic tank or similar).

On-site Sewage Facilities (OSSF) consist of wastewater systems situated within property boundaries that treat the sewage generated from the property, and the land application area of the treated effluent. OSSF include all types of wastewater treatment and land application, such as septic tanks, aerated wastewater treatment systems, biofilter systems, composting toilets, and activated sludge systems. These systems are required in areas not serviced by sewerage infrastructure. Effective on-site treatment and land application achieves:

- Protection of public health and safety;
- Maintenance and enhancement of environmental quality; and
- Maintenance and enhancement of community amenity.

MWH now part of Stantec have been engaged by Mirvac to prepare an Onsite Sewage Assessment (OSA) to assess the suitability of the proposed interface and eco lots within the Greenbank development site for on-site effluent disposal. Location of the interface and eco lots within the Greenbank development site, referred to as OSSF North and OSSF South, are shown in Appendix A.

This OSA report addresses the requirements under the standard 'AS/NZ 1547:2012 On-site domestic wastewater management' for the proposed interface and eco lot areas.

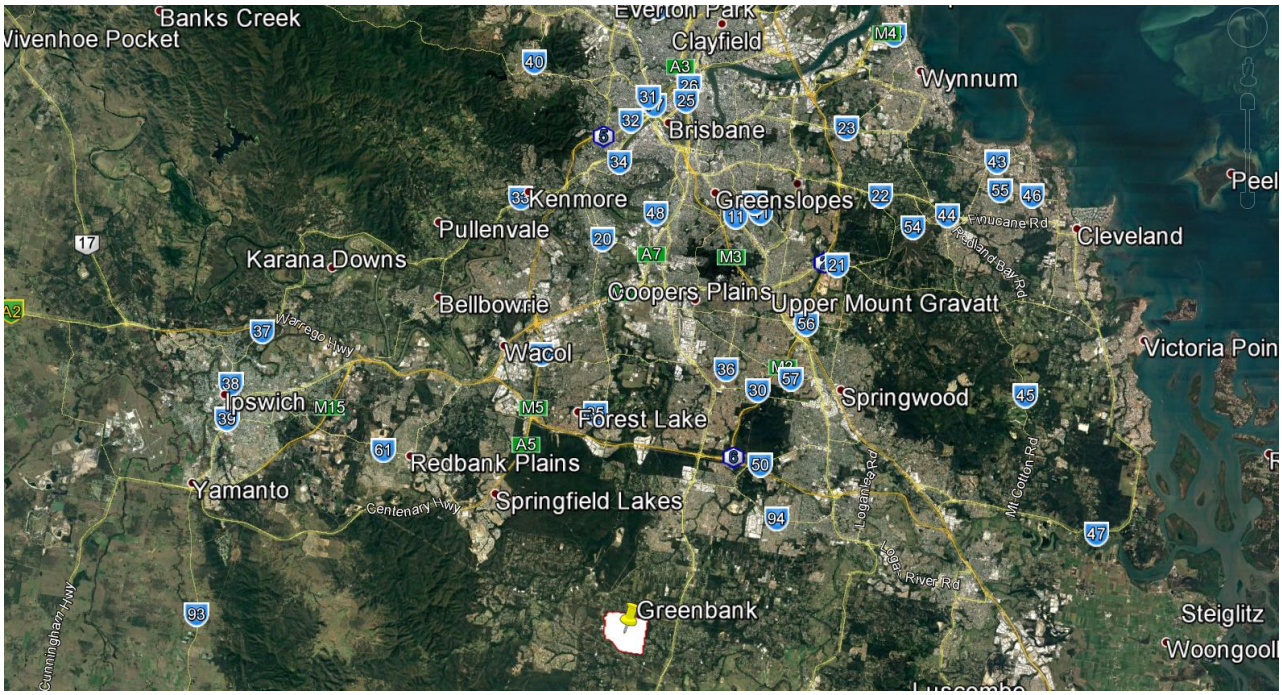


Figure 1: Location of the Greenbank development site relative to the greater Brisbane area

2 Legislative Requirements

The Queensland Plumbing and Water Code (the Code) specifies the requirements for onsite sewerage disposal and treatment systems that have a peak design capacity of 20 equivalent persons (EP) or less. The Code defines performance criteria for the following:

- Onsite wastewater management systems
- Greywater use facilities
- Land application systems (including setback distances)
- Water meters for new premises
- Chief executive approvals (of treatment systems)

In consideration of an application for on-site treatment and disposal facilities, the local government is required to assess whether the application triggers referral for an Environmentally Relevant Activity (ERA) under the *Environmental Protect (Water) Policy 1997* (EP Policy). Disposal of on-site wastes becomes the ERA of sewage treatment when daily flows exceed 4,000 litres. ERA requires approvals from the Department of Environment and Heritage Protection, either as a concurrence agency or assessment manager.

The individual interface and eco lots proposed do not exceed the daily flow limits therefore will not require referral to the Environmental Protection Agency.

Under Sections 31(2) of the EP Policy, which relates to depositing prescribed contaminants in waters, it is an offence to deposit or release sewage and sewage residues, whether treated or untreated, and any other matter containing faecal coliforms or faecal streptococci, including, for example;

- Waste water pumped out from a septic tank, or
- Solid or liquid waste from an on-site sewerage facility; into waters, or a roadside gutter or stormwater drainage, or at another place, and in a way, so that the contaminants could reasonably be expected to wash, blow, fall or otherwise move into waters, a roadside gutter or stormwater drainage.

Relevant Australian Standards for the treatment of on-site effluent include the following:

- AS/NZS 1547:2012 'On-site domestic wastewater management';
- AS/NZS 1546:2008 'On-site domestic wastewater treatment units';
- AS3500 – National Plumbing and Drainage Code; and
- Department of Infrastructure and Planning 'Queensland Plumbing and Wastewater Code' April 2010 (the Code).

This report was prepared in accordance with the requirements of the standards set out in these documents. The intent of the report is to determine the suitability of the proposed interface and eco lots for on-site effluent disposal. The assessment is not designed to be specific to each lot but rather an assessment for the proposed area in general highlighting any constraints and restrictions that will need to be considered for a site specific OSSF.

3 Site and Soil Evaluation

An initial desktop analysis was undertaken of the soil, topography and drainage lines to ascertain the likely variation in soil and landscape properties. The soils were reported[1] to be a Chromosol or Sodosol through the entire development site. The landscape was gently undulating which was intersected with drainage lines of varying degrees reporting to Logan river some 5 kilometres from the development site. The desktop analysis did not identify any soil and landscape issues that would prevent the use of OSSF. The desktop analysis was followed by a field and soil profile inspection. Twenty four inspection sites were identified to cover the expected variation in landscape and soil properties across the site. The expected variation in soil profile conditions was such that the entire development site could be evaluated and represent the assessment for the proposed OSSF sites (see Appendix A for soil observation locations). The site was inspected during October 2016.

[1] ASRIS (Australian Soil Resource Information System) http://www.asris.csiro.au/

3.1 Site Assessment

The landform for the entire site is classified as very gentle to gentle low hills/rises with crests that generally fall from west to east. The ridges are bisected by unnamed drainage features which flow west to east eventually reporting to Logan River approximately 3 kilometres east. Little to no erosion was observed on site.

Broadly the vegetation in the study area can be divided into two classes; 1) cleared open grassland dominated by grass and exotic weeds and 2) dry Sclerophyll woodlands with a mixture of regrowth, mature regrowth and remnant areas. The woodlands cover 50-70% of the canopy with 30-50% of ground cover. The occurrence of Sclerophyll woodlands is often associated with soils of low fertility.

Within the proposed OSSF North and South areas, the natural surface slope is always under 10% which represents no risk for subsurface on-site disposal systems, with most of the area under 6% suggesting surface application systems could be considered (see Appendix A). Specific site observations for each proposed OSSF area are shown in Table 1. The observations do not preclude the use of OSSF on the proposed sites.

Table 1: Summary of the site evaluation of the proposed OSSF sites

Site Factor	OSSF North	OSSF South
Slope	< 10%	< 10%
Drainage	Minor drainage lines only	Minor drainage lines only
Waterlogging	Nil	Nil
Erosion and land slip	Nil	Nil
Surface boulders and outcrops	Nil	Nil
Vegetation	Sclerophyll Woodlands	Sclerophyll Woodlands
Water course	Logan river 5km east	Logan river 3km east
Water bores	Nil	Nil
Water Table	> 1.5m	> 1.5m
Weathered rock	0.55 to >1.2m (1.12 av)	0.55 to >1.2m (0.97 av)
Flooding	Nil (> 1:100)	Nil (> 1:100)
Other specific factors	Nil	Nil

3.2 Soil Assessment

The OSSF north area was dominated by Chromosols and reflects the results from the desktop study. The topsoil was dominated by sandy loam of week crumb structure that ranged in depth between 400-550 mm. There was evidence of restricted drainage due to the presence of a partially bleach A2 horizon above a mottled B horizon. The B horizon consisted of a moderately structured medium sandy clay.

The soil conditions of the OSSF south area was very similar to the OSSF north but with slightly shallower soil profiles. The topsoil was dominated by a sandy loam of week crumb structure that ranged in depth between 400-550 mm. There was evidence of restricted drainage due to the presence of a partially bleach A2 horizon above a mottled B horizon. The B horizon consisted of a moderately structured medium sandy clay.

The surface soil across the development site were very acidic and of low fertility with subsoil acidity also evident. The subsoils were non dispersive with an Emerson classes of 5 recorded. Permeability results suggests the subsoils are of low permeability with conductivities < 0.06 m/d. The surface soils would benefit from the addition of lime to lift soil fertility. Further, during OSSF installation, consideration should be given to the incorporation of gypsum and lime into subsoil to lift the soil pH and improve subsoil permeability. The clay subsoils have an average P sorption Index (PSI) of 65 mg/kg giving the

soils a high soil P sorption capacity[2]. Hence, the phosphorus loading on the soils and expected lifespan of the OSSF will not require an increase in land application area above the designed treated effluent loading rate.

A summary of the soil conditions and soil categorisation for OSSF installation are provided in Table 2. Both proposed areas for OSSF installations have the potential for subsurface lateral flow due to low permeability of the subsoils. Hence, a lower design loading/irrigation rate should be considered as well as locating the OSSF in a relatively flat area, where possible. Nevertheless, the soil conditions do not preclude the use of OSSF in the proposed areas.

Table 2: Summary of the soil evaluation of the proposed OSSF sites

Site Factor	OSSF North		OSSF South	
	Topsoil	Subsoil	Topsoil	Subsoil
Depth (cm)	40 – 55 (47 av)	55 – 120 (112 av)	17-62 (40 av)	55 -120 (97 av)
Colour	Light brown	Yellow Brown/Orange	Light brown	Yellow Brown/Orange
Soil texture	Sandy loam	Medium sandy clay	Sandy loam	Medium sandy clay
Coarse Fragments	0-20%	2-10%	0-50%	5-30%
Soil Structure	Weak crumb	Mod/strong polyhedral	Weak crumb	Mod/strong polyhedral
Emerson Class	3-8	5	3-8	5
Reactivity	Nil	Little	Nil	Little
Water table	Nil	Nil	Nil	Nil
Surface condition	Dry	-	Dry	-
Permeability (m/d)	1.0	< 0.06	1.0	< 0.06
Other soil specific factors	Nil	Nil	Nil	Nil
Soil Category	2	6	2	6

4 System Sizing and Setbacks

4.1 Initial Assessment

4.1.1 Estimation of Daily Flows

For this assessment it is assumed that each lot will contain 4 Equivalent Persons (EP) in a single dwelling. According to AS/NZS 1547:2012 the typical domestic design flow allowances for Australia is 150 L/person/day. Hence, the estimated daily flow is **600 L/dwelling/day.** The estimated daily flow standard of 600 L/person/d is a slightly conservative unit load compared to the Average Dry Weather Flow (ADWF) of 462 L/dwelling/day Logan City Council (LCC) uses to size network sewerage infrastructure.

4.1.2 Required Area for Effluent Disposal

The design loading or irrigation rates (DLR/DIR) are a function of the land application method. For this assessment, a conservative approach has been applied using an evapo-transpiration absorption (ETA) system with a defined DIR of 5 mm/day (see Appendix C). However, given the lower permeability of the subsoil (Soil Category 6), a water balance is used to determine the long term application rate (LTAR).

[2] Moody PW and Bolland MDA, 1999, Phosphorus, In: Soil Analysis and Interpretation Manual, CSIRO Publishing, Collingwood, Victoria.

Using climate data for the site[3] the average daily water demand for an ETA system with a grass cover is 1.3 mm/day for the Greenbank development area. Hence, the required land application area can be determined as per AS/NZS 1547:2012 as follows:

DIR (designed irrigation rate) = 1.3 mm/day

Q (designed daily flow) = 600 L/day

A (Area required) = 462 m^2

Hence, hydraulically, the maximum land application area that would be suitable for the OSSF sites could be constructed using a 21.5 m x 21.5 m parcel of land (~0.05 hectares) within each lot. The exact sizing and lifespan of the system will depend on the treatment method and land application system. Setback requirements from the land application area will also need to be accommodated within each lot.

4.2 Impact of Wastewater Treatment and Land Applications Options

Options considered for OSSF wastewater treatment include:

1. Septic tanks;
2. Aerated wastewater treatment system (AWTS); and
3. Biological filter.

Options for land application include:

1. Absorption trenches and beds;
2. Evapotranspiration-absorption and seepage-beds/trenches (ETA);
3. Surface spray irrigation;
4. Subsurface drip irrigation;
5. Subsurface low pressure emitting dripper lines (LPED); and
6. Mounds.

Each of these treatment and land application options, in combination, impact of the land application area requirements and setback distances. Examples of each land application system is provided in Appendix D. The land application area is also impacted by the expected number of EP per lot. These impacts have been outlined in the following sections.

4.2.1 Land Application Area Requirements

Given the soil category rating (6), which requires the design loading and irrigation rate to be determined by a water balance method, the land application area will be largely governed by the number residents on each allotment and type of vegetation cover. However, when trenches are used as a land application method the design area is based on the permeability of the subsoil. The land area required is outlined in Table 3.

Table 3: Land application area (m^2) requirements based on the number of residents and vegetation covering

EP	Trenches (DLR 0.6 mm/d)	Grass (DIR 1.3 mm/d)	Trees (DIR 2.0 mm/d)
2	500	231	150
2.5	625	288	188
3	750	346	225
4	1000	462	300
5	1250	577	375
6	1500	692	450

[3] Based on SILO data drill (-27.75 153.00) https://www.longpaddock.qld.gov.au/silo/

4.2.2 Setback Distance Requirements

Setback requirements are a function of the site and soil characteristics, effluent treatment method and the type of land application method. The requirements for setbacks and impact of various factors are outlined in Appendix B. The site and soil evaluations of both OSSF areas allows the required setback requirements to be estimated depending on the type of system installed. Table 4 provides an outline of the required setbacks based on different treatment system and application methods and AS/NZS 1547:2012. Setback will also need to consider local government regulations.

Some of the required setbacks are not an issue for the Greenbank development irrespective of treatment and disposal method of site effluent. The closest registered groundwater bore is 150 metres from the proposed interface and eco lot area (see Appendix A) which is greater than the maximum setback distance of 50 metres. Further, whilst there are drainage lines through the proposed interface and eco lot area (see Appendix A) these do not constitute waterways or surface water bodies. The closest surface water is the Logan River some 3 km from the Greenbank development site, far in excess of the maximum setback distance of 100 metres.

5 Summary and Recommendations

In summary the site and soil evaluation of the proposed OSSF sites within the Greenbank development area demonstrates no critical limitation that would preclude the use of an on-site effluent land application system.

It is recommended that the appropriate setback conditions will need to be considered depending on the treatment system and land application method and position within each lot (slope and position in landscape). The required land application area will be governed by the number of dwelling occupants, treatment system and type of vegetation cover.

Table 4: Indicative setback distances (metres) as a function of disposal systems and discharge method

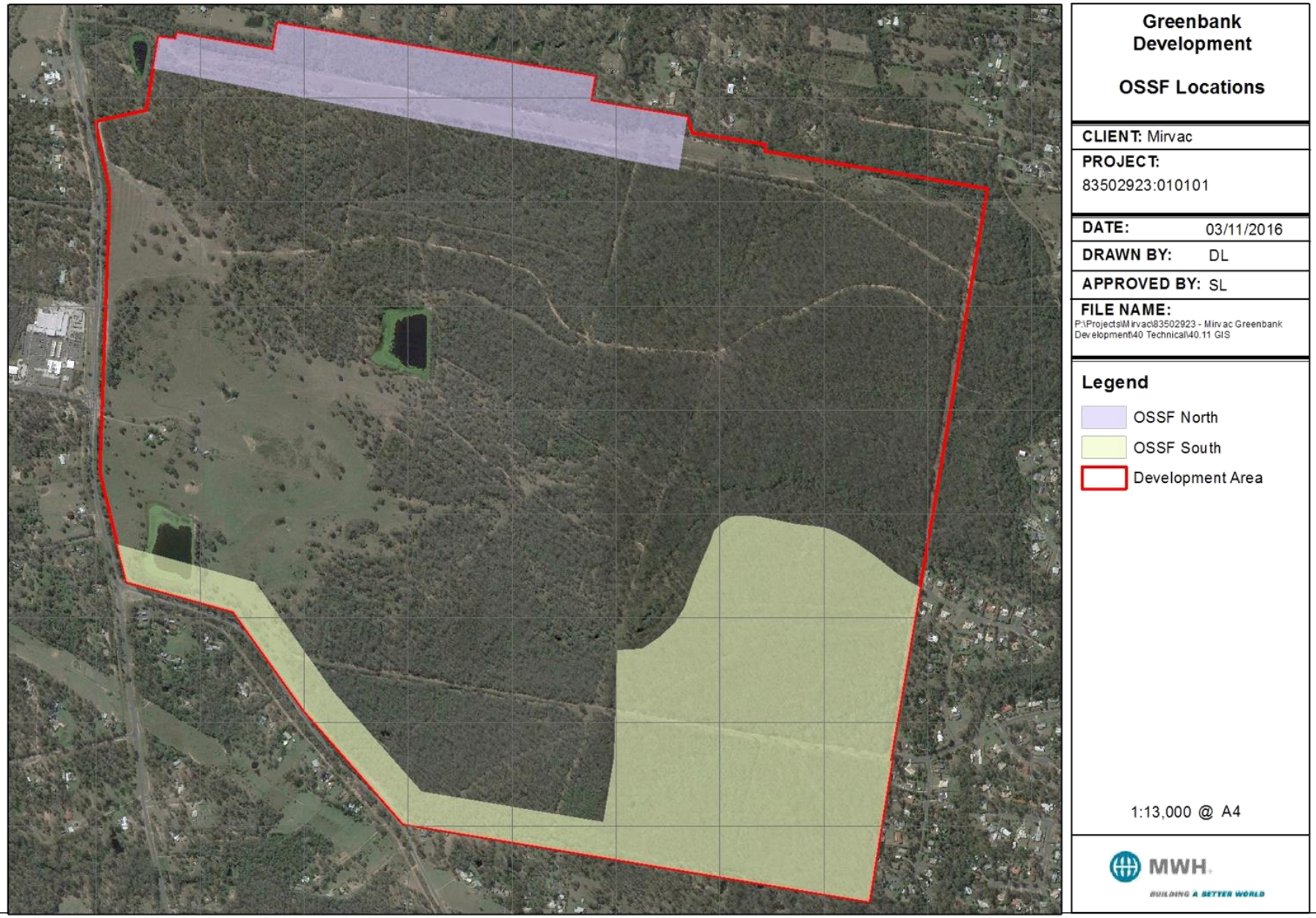
Treatment	Example OSSF Type	Indicative Class of Recycled Water	Discharge Method	Property Boundary	Dwellings	Surface water	Bores	Recreational areas	In-ground water tanks	Groundwater	Hardpan Bedrock
Primary	**Septic Tank**	-	Subsurface	30	6	100	40	12	12	1.5	1.0
			Surface*	-	-	-	-	-	-	-	-
Secondary	**AWTS, Biological Filter, aerobic sand filter**	D	Subsurface	20	5	70	30	12	12	1.2	0.8
			Surface	40	8	80	45	15	15	1.5	1.0
Tertiary (with disinfection)	**AWTS, Biological Filter, aerobic sand filter**	B-C	Subsurface	10	4	50	20	10	10	1	0.5
			Surface	30	6	70	40	12	12	1.2	0.8
		A	Subsurface	1.5	2	30	15	5	5	0.8	0.5
			Surface	20	4	50	30	10	10	1	0.6

*Not recommended

Appendices

Appendix A Maps

1. Location of OSSF within development site
2. Soil and landscape observation points within the development site
3. Natural surface elevation across the development site
4. Slope analysis of the natural surface within the development site
5. Natural drainage lines within the development site
6. Registered Groundwater Bores (source: QldGlobe)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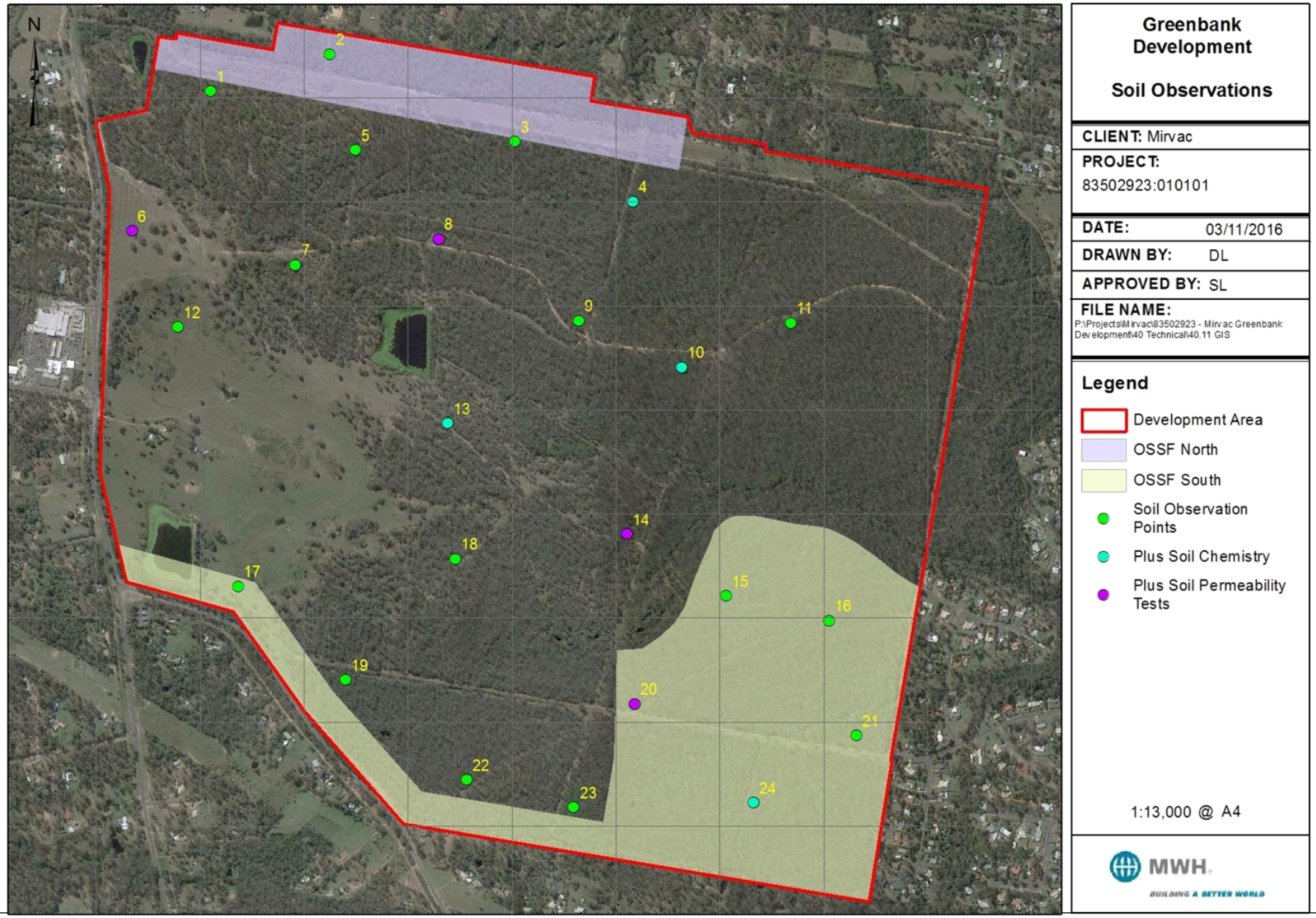
OSSF North
OSSF South
Development Area
1:13,000 @ A4
MWH
BUILDING A BETTER WORLD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Soil Observation Points
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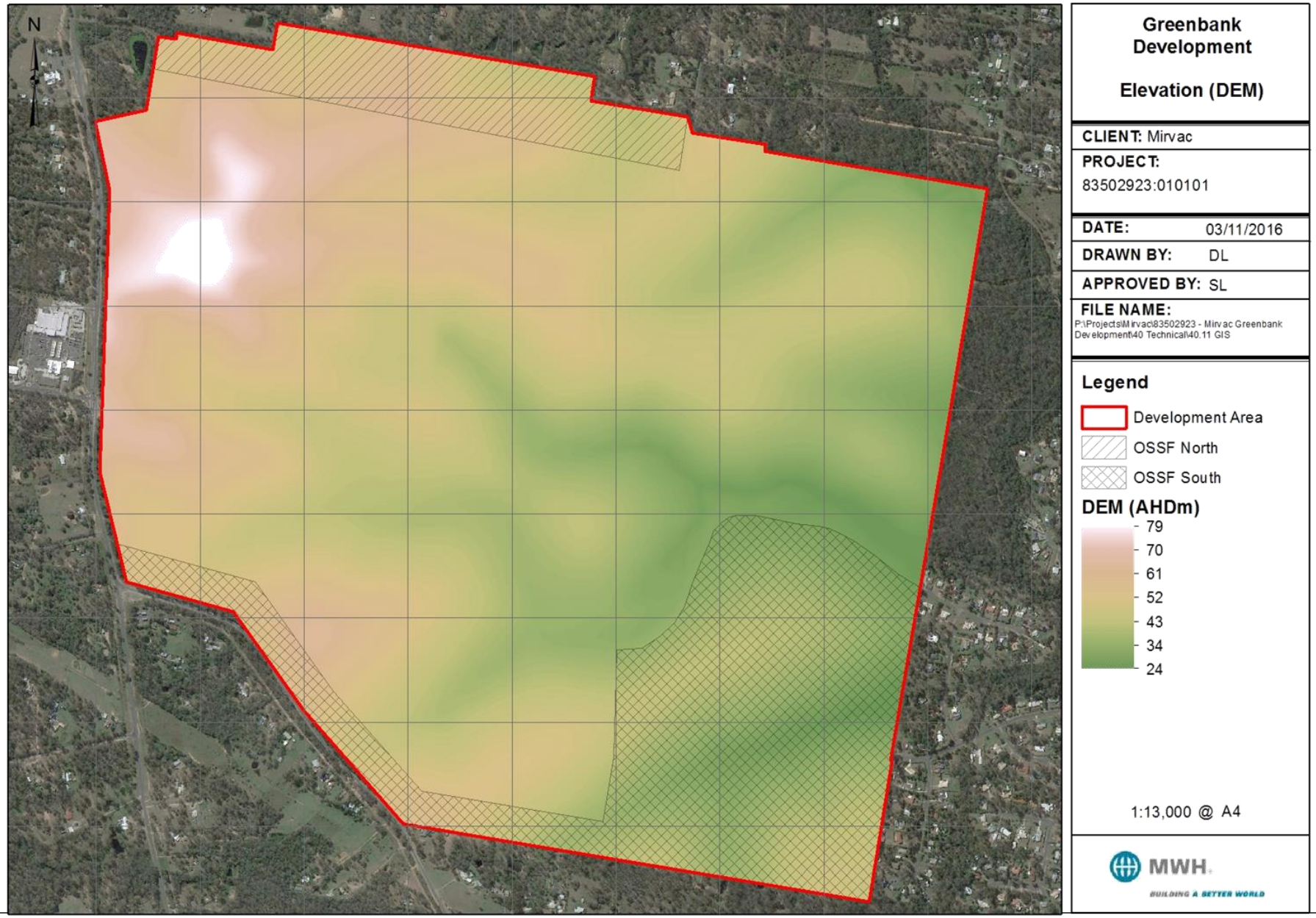
MWH
BUILDING A BETTER WORLD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Legend
Development Area
OSSF North
OSSF South
DEM (AHDm)
79
70
61
52
43
34
24
1:13,000 @ A4
MWH
BUILDING A BETTER WORLD


N
Greenbank Development
Natural Surface Slope (%)
CLIENT: Mirvac
PROJECT: 83502923:010101
DATE: 03/11/2016
DRAWN BY: DL
APPROVED BY: SL
FILE NAME: P:\Projects\Mirvac\83502923 - Mirvac Greenbank Development\40 Technical\40.11 GIS
Legend
Development Area
OSSF North
OSSF South
Slope (%)
< 6
6 - 10
10 - 20
1:13,000 @ A4
MWH
BUILDING A BETTER WORLD

Greenbank Development

Natural Drainage Lines

CLIENT: Mirvac

PROJECT:
83502923:010101

DATE: 03/11/2016

DRAWN BY: DL

APPROVED BY: SL

FILE NAME:
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Legend

- Development Area
- OSSF North
- OSSF South

Occurance of Drainage Lines

- Moderate
- Minor
- Very minor

1:13,000 @ A4

MWH
BUILDING A BETTER WORLD

Greenbank Development

Groundwater bores

CLIENT: Mirvac

PROJECT: 83502923:010101

DATE: 03/11/2016

DRAWN BY: DL

APPROVED BY: SL

FILE NAME: P:\Projects\Mirvac\83502923 - Mirvac Greenbank Development\40 Technical\40.11 GIS

Legend

- Development Area
- OSSF North
- OSSF South
- Registered Groundwater Bores

0 0.1 0.2 0.4 0.6 Km

1:15,000 @ A4

MWH
BUILDING A BETTER WORLD

Appendix B Setback distances

Table 5: Recommended setback distances (metres) for land application systems (to be used in conjunction with Table 6)

Feature	Setback distance range	Site constraint items of specific concern
Horizontal setback distance (m)		
Property boundaries	1.5 - 50	A, D, J
Buildings/houses	2.0 - > 6	A, D, J
Surface water	15 – 100	A, B, D, E, F, G, J
Bore, well	15 – 50	A, C, H, J
Recreational areas (including swimming pools)	3 – 15	A, E, J
In-ground water tank	4 – 15	A, E, J
Retaining wall and Embankment, escarpment, cuttings	3.0	D, G, H
Vertical setback distances (m)		
Groundwater	0.6 - > 1.5	A, C, F, H, I, J
Hardpan or bedrock	0.5 - ≥ 1.5	A, C, J

Table 6: Site constraints scale for development of setback

Item	Feature	Constraint scale Lowest ⟷ Highest		Sensitive features
A	Quality of effluent	Effluent quality ≤ 10 cfu/100mL *E.Coli*	Effluent quality ≥ 10^6 cfu/100mL *E.Coli*	Groundwater and surface water pollution
B	Surface water	Cat. 1 to 3 soils, no surface water down gradient >100m, low rainfall area	Cat. 4 to 6 soils, permanent surface water down gradient <50m, high rainfall area	Surface water pollution
C	Groundwater	Cat. 5 and 6 soils, low resource and environmental value	Cat. 1 and 2 soils, gavel aquifer, low resource and environmental value	Groundwater pollution
D	Slope	0 – 6% (surface effluent application) 0 – 10% (subsurface effluent applications)	> 10% (surface effluent application) > 30% (subsurface effluent applications)	Off-site export and erosion
E	Position in landscape	Down-gradient of surface water, property boundary, recreational area	Up-gradient of surface water, property boundary, recreational area	Surface water pollution, off-site export
F	Drainage	Cat 1 and 2 soils, gently sloping area	Cat 6 soils, site with visible seepage, moisture tolerant veg., low lying area	Groundwater pollution
G	Flood potential	Above 1 in 20 year flood contour	Below 1 in 20 year flood contour	Off-site export, system failure
H	Geology/soils	Cat. 3 and 4 soils, low porous regolith, deep, uniform soils	Cat. 1 and 6 soils, fracture rock, gravel aquifer, high porous regolith	Groundwater pollution
I	Landform	Hill crest, convex side slopes, and plains	Drainage plains and incise channels	Groundwater pollution
J	Application method	Drip irrigation or subsurface application	Surface/above ground application	Off-site export, surface water pollution

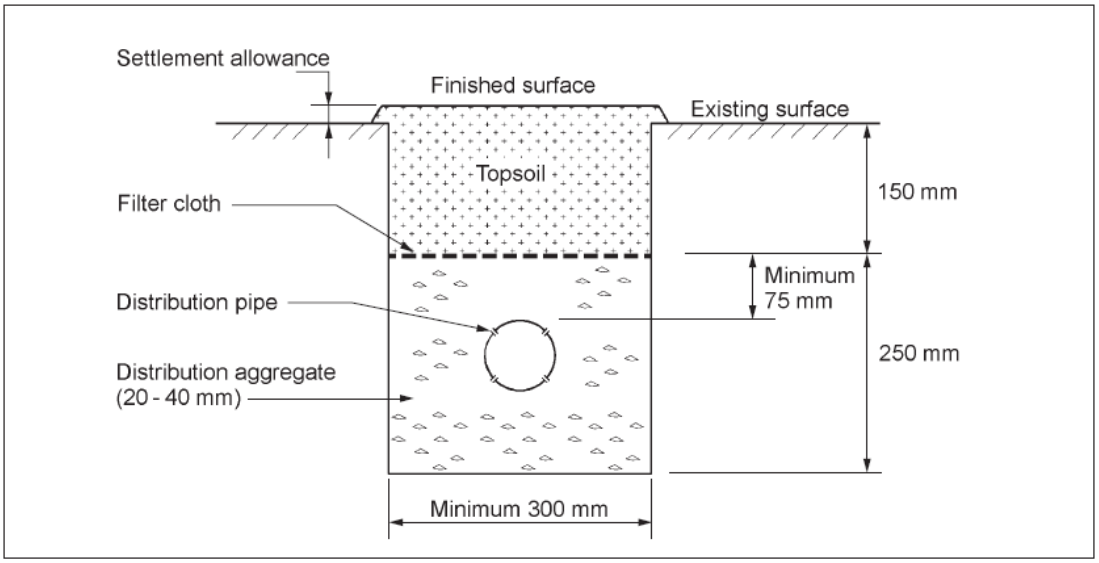
Appendix C Design loading/Irrigation rate

Table 7: Soil categories and recommended design loading/Irrigation rate (DLR/DIR) for land application systems#

Soil Cat.	Soil Texture	Structure	Indicative K_{sat} (m/d)	Design loading/Irrigation rate (DLR/DIR) (mm/d)						
				Trenches and beds			ETA/ETS beds and trenches	Drip and Spray Irrigation	LPED Irrigation	Mound
				Primary treated effluent		Secondary treated effluent				
				Cons. rate	Max. rate					
1	Gravels sands	Structureless	> 3.0	20	35	50	NA#	5	NA#	32
2	Sandy loams	Weak structure	> 3.0	20	30	50			4	24
		Massive	1.4 – 3.0	15	25	50				
3	Loams	Strong/Mod structure	1.5 – 3.0	15	25	50		4	3.5	24
		Weak/massive structure	0.5 – 1.5	10	15	30				16
4	Clay Loams	High/Mod structure	0.5 – 1.5	10	15	30	12	3.5	3	16
		Weak structure	0.12 – 0.5	6	10	20	8			8
		Massive structure	0.06 – 0.12	4	5	10	5			5#
5	Light clays	Strong structure	0.12 – 0.5	5	8	12	8	6	2.5	8
		Moderate structure	0.06 – 0.12	Requires more detailed assessment#		10	5#			5#
		Weak/massive structure	< 0.06			8				
6	Medium to heavy clays	Strong structure	0.06 – 0.5					2	NA#	
		Moderate structure	< 0.06							
		Weak/massive structure	< 0.06							

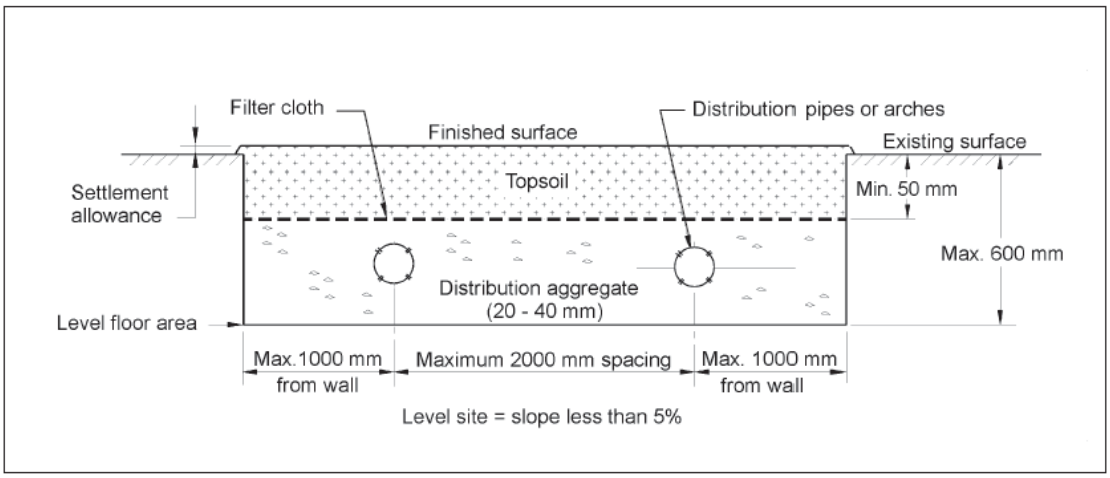
Refer to AS/NZS 1547:2012 for full explanation of restrictions to these loading rates, NA – not generally applied

Appendix D Application Methods



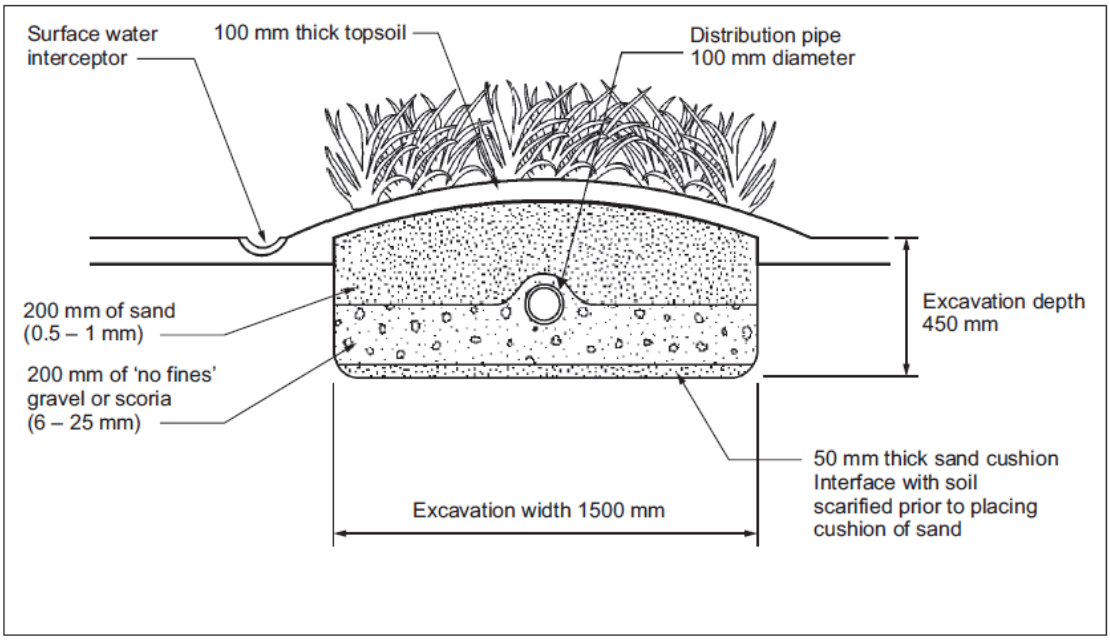
NOTE: LPED lines can be used to replace distribution pipes when dose loading effluent into trenches.

Figure 2: Example configuration of a conventional trench application system (AS/NZS 1547)



NOTE: LPED lines can be used instead of distribution pipes when dose loading effluent into beds.

Figure 3: Example configuration of a conventional bed application system (AS/NZS 1547)



NOTE: An LPED line can be used to dose load the ETA/ETS bed.

Figure 4: Example configuration of an ETA bed (AS/NZS 1547)

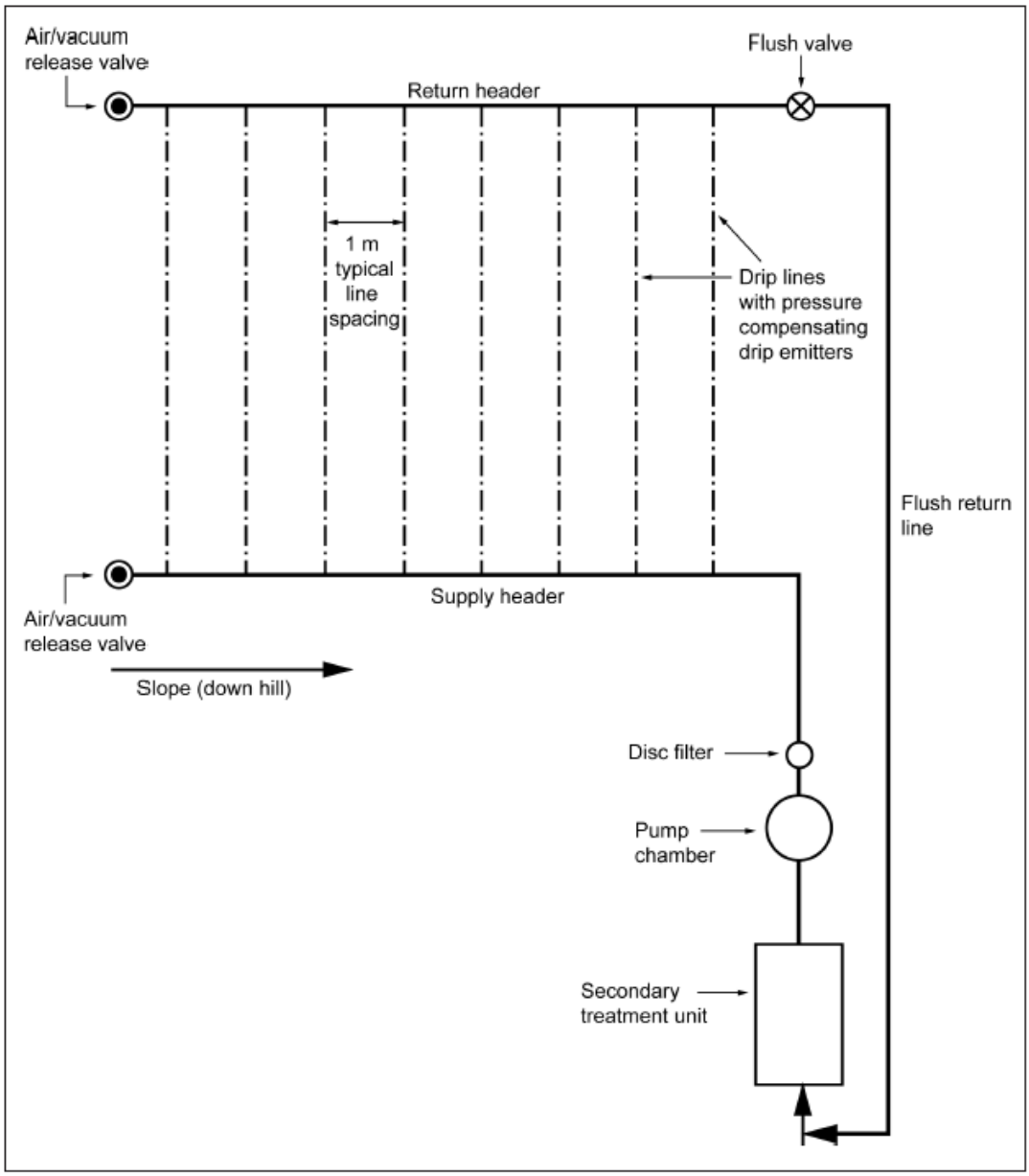


Figure 5: Drip irrigation system – example layout of components (AS/NZS 1547)

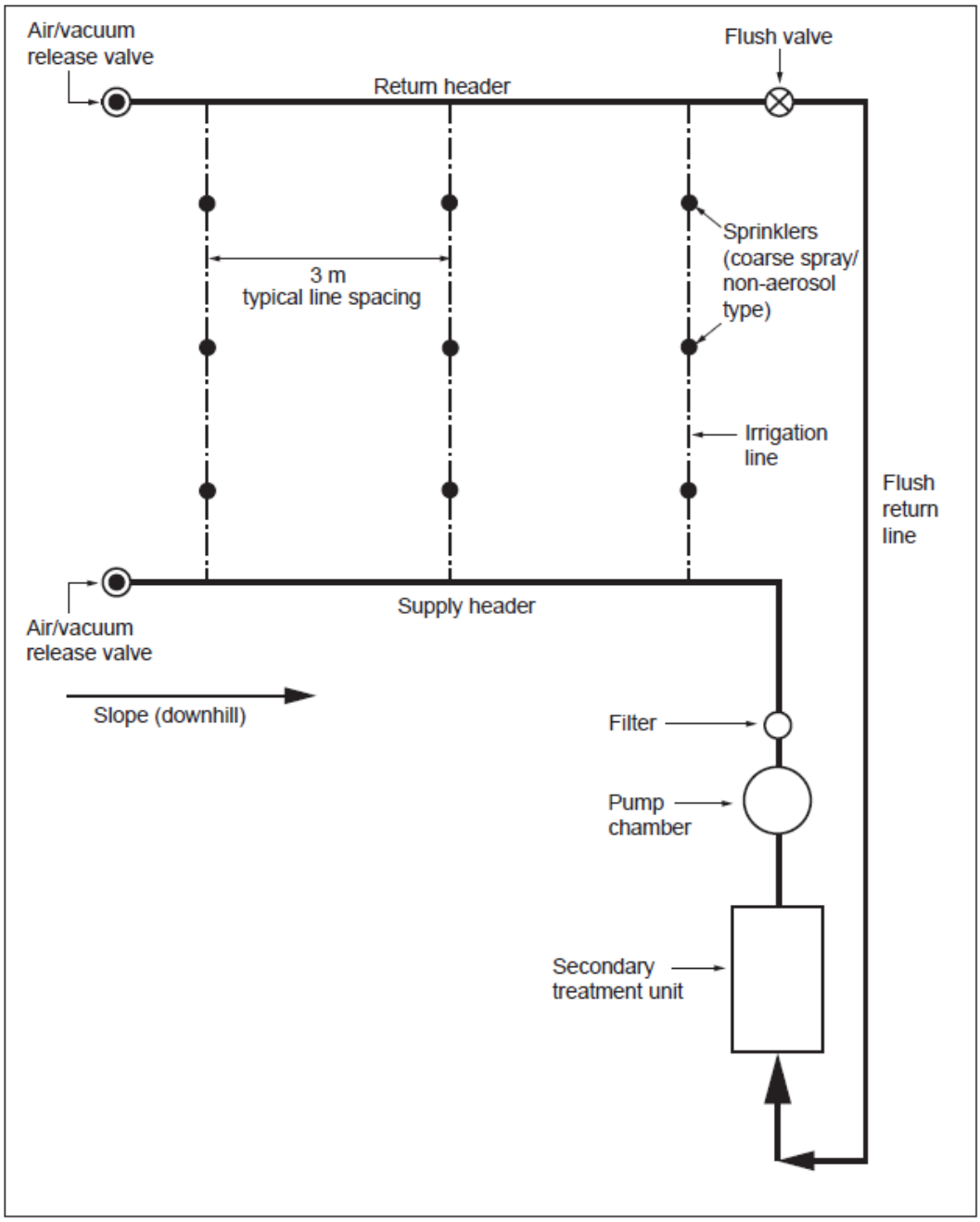


Figure 6: Spray irrigation system – example layout of components (AS/NZS 1547)

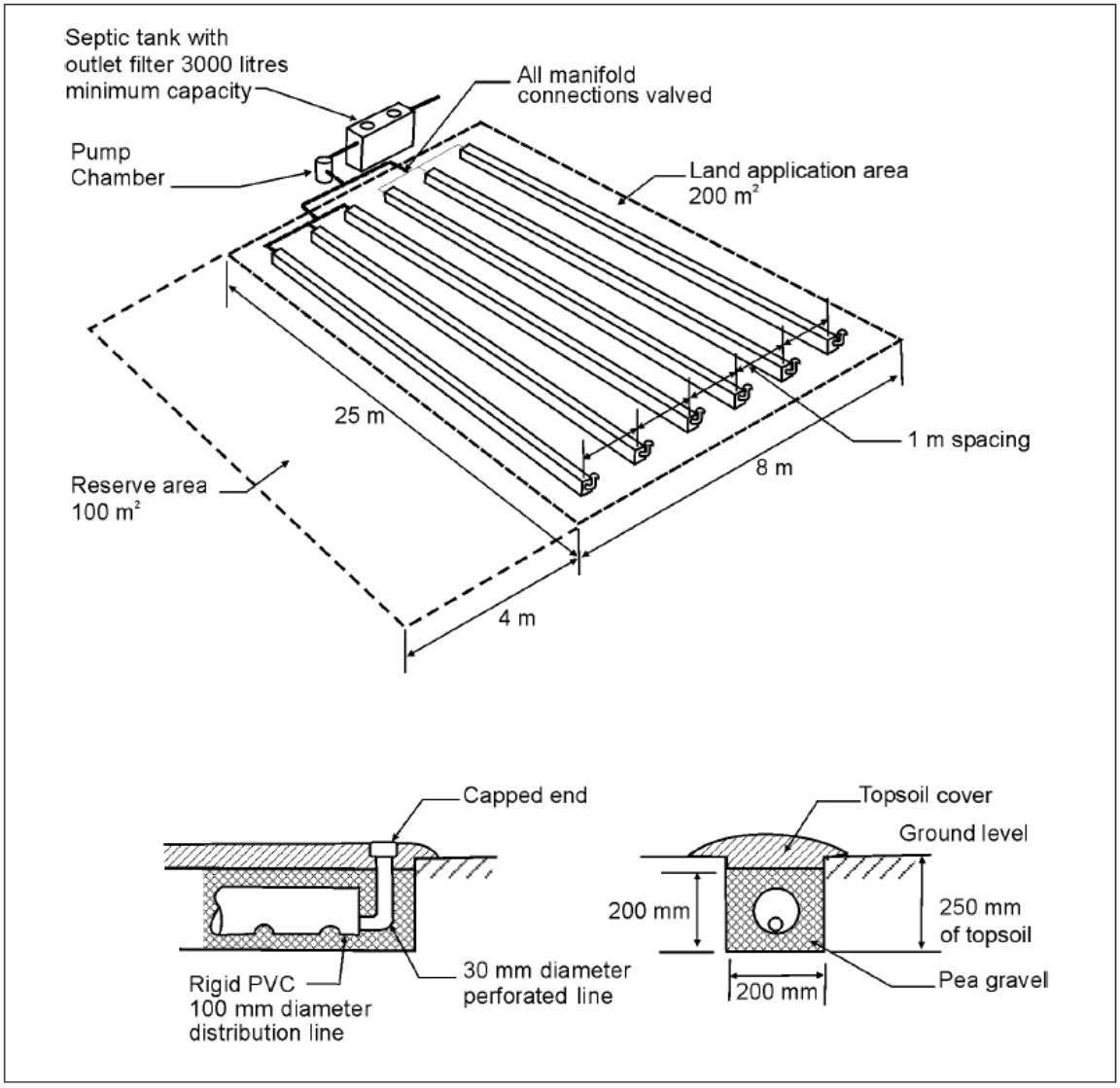


Figure 7: Shallow subsurface LPED system – example layout of components (AS/NZS 1547)

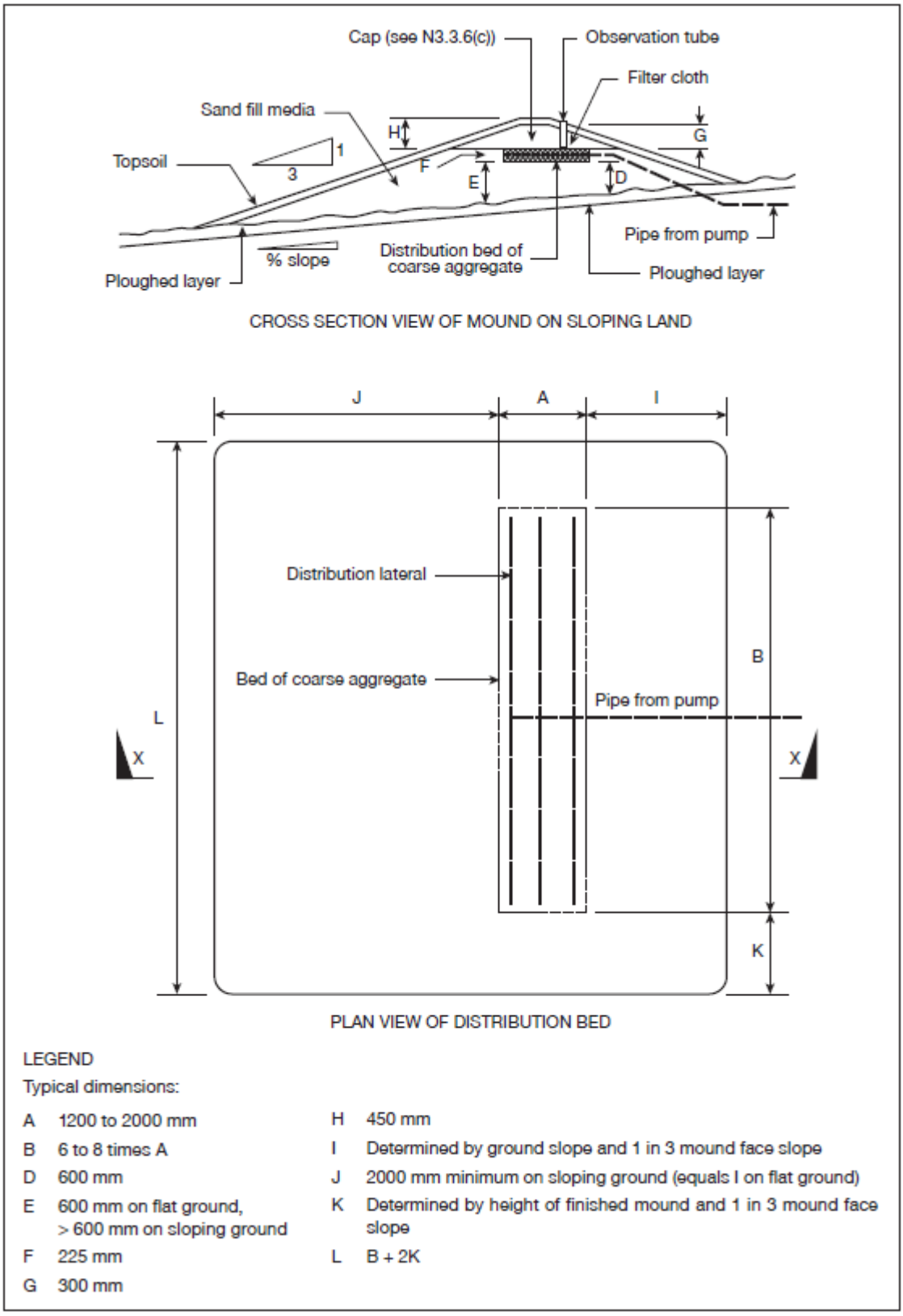


Figure 8: Example of a Wisconsin mound system (AS/NZS 1547)

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