

Redland Water Sewer Network Master Plan

August 2016

DRAFT



Version Control

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Notation and Abbreviations

AC	Asbestos Cement
ADD	Average Day Demand
ADWF	Average Dry Weather Flow
AHD	Australian Height Datum
DNRM	Department of Natural Resources and Mines
DSS	Desired Standards of Service
DWF	Dry Weather Flow
EP	Equivalent Person
GCW	Gold Coast Water
GIS	Geographical Information System
HLZ	High Level Zone
HRR	Heinemann Road Reservoir complex
ICS	Infrastructure Charges Schedule
IDM	Infrastructure Demand Model
NRW	Department of Natural Resources and Water
PASS	Potential Acid Sulphate Soils
PH	Peak Hour (peak diurnal flow on the Maximum Day)
LGIP	Local Growth Infrastructure Plan
MD	Maximum Day Demand
MDA	Major Development Area
ML/d	Megalitres per day
MUID	Mike Urban Identification Number
NSI	North Stradbroke Island
PDWF	Peak Dry Weather Flow
PWWF	Peak Wet Weather Flow
QAO	Queensland Audit Office
RCC	Redland City Council
RPS	Redland Planning Scheme
RW	Redland Water
SEQ	South East Queensland
SMBI	Southern Moreton Bay Islands (Russell, Macleay, Karragarra and Lamb Island's)
SPS	Sewer Pump Station
U/S	Up Stream
WSAA	Water Services Association of Australia
WWTP	Wastewater Treatment Plant

Executive Summary

Redland Water (RW) is a commercial business unit of Redland City Council (RCC) and recommenced operations on 1 July 2012. Its primary functions are to provide its customers with safe, reliable and high quality water services, as well as to collect and treat wastewater.

The purpose of this Sewer Master Plan is to outline the required Carrier / Trunk main augmentations relative to the growth pattern provided in the Redland City Plan, its current network operating philosophy, and to feed into the Water Netserv Plan.

The South-east Queensland Water (Distribution and Retail) Act 2009 requires Redland Water (RW) to have a Water Netserv Plan in place from 1 March 2014. The Water Netserv Plan must be consistent with the South-east Queensland Regional Plan 2009-2031 and with the planning assumptions for Redland City Council. The Water Netserv Plan is a key strategic document guiding the delivery and operation of RW's infrastructure and services which will be adjusted from outputs from this master planning study.

The Water Netserv Plan is to:

- Ensure the provision of safe, reliable and secure water and wastewater services;
- Provide for strategic planning for the operation of the business;
- Provide infrastructure planning for water and wastewater services for at least 20 years;
- Integrate land use planning and infrastructure planning for water and wastewater services;
- Provide for the management of water and wastewater services in a way that seeks to achieve ecological sustainability.

This report will form the basis for the future detailed planning of the wastewater network in Redland. Analysis undertaken has identified the SPS network augmentations required to service the future growth within the WWTP service areas and address existing network limitations and future network requirements in the catchment areas. For significant development areas (i.e. Kinross Road, Toondah Harbour, Weinam Creek and Clay Gully Road) it is expected the developer will undertake detailed network modelling to determine the appropriate network sizes and the requirement for any network augmentations. The intent of this Master Plan should be considered when sizing the new development network.

From the analysis completed \$16,309,454 (Total) of Trunk infrastructure augmentations has been identified for Redland Water to deliver and operate their infrastructure and so provide a safe, reliable and high quality wastewater network (sewer pipes and pumps) service to their existing and future customers.

The augmentation cost associated for each planning horizon for Sewer Trunk Infrastructure are detailed in the following table:

Planning Horizon	Total Costs (\$)
2016	\$6,143,810
2021	\$557,689
2026	\$7,662,241
2031	\$0
2036	\$1,945,705
TOTAL	\$16,309,454

A breakdown of the costs identified for each catchment area is shown below:

Catchment Area	Total Cost (\$)
Capalaba	\$ 752,382
Cleveland	\$ 1,264,439
Thorneside	\$ 3,306,640
Victoria Point	\$ 413,845
Mount Cotton	\$ 351,626
Dunwich	No Infrastructure Augmentations identified*
Point Lookout	\$ 10,220,522
TOTAL	\$ 16,309,454

Note * - Dunwich has just had major expansive works

The augmentation philosophy during the modelling and planning was to address existing and future deficiencies in the network to support forward cost estimates and previous infrastructure planning. Augmentation size and timing (planning horizons) have been identified to support these requirements.

A pragmatic approach was adopted to identify material system deficiencies and potential augmentations. Interest areas were nominated by spatially identifying areas of significant growth and investigating the supporting infrastructure in more detail.

Modelling outcomes have been adopted to identify conveyance deficiencies.

Alternative assessment mechanisms have been undertaken when considering non-conveyance network capacity, i.e. volume assessment, as modelling outcomes may not provide the best tools for assessment.

Definition of Failure

The definition of failure (deficiencies) is when the assets within the sewerage system fall outside Councils Standards of Service. These definitions are described further below:

Gravity Mains

Gravity mains were deemed to exceed requirements where Peak Wet Weather Flow (PWWF) water levels surcharge greater than 1m below ground level or where overflows occur from overflow structures.

Rising Mains

Rising mains were deemed to exceed requirements where existing or proposed velocities would exceed 0.7m/s and 3 m/s.

Pumping Stations

Pump stations were identified for further consideration where growth within the catchment areas exceeds 130% compared to the 2016 loads.

Pump capacity augmentations have been identified where modelling indicates capacity has been exceeded.

It was considered impractical to augment a pump wet well where minor exceedances prevail. Consideration for augmentations were limited to instances where significant growth (approximately 200% from 2016 loads) occurs.

Options for Service Provision

For the purpose of developing this Master Plan, augmentations have generally maintained the existing infrastructure alignments. Consideration was given to potential alternative servicing strategies where prudent.

The duplication of existing infrastructure was the preferred option when augmentations were identified. However, asset replacement was considered where assets are nearing their end of nominal asset life. Asset replacements were limited to SPS wet wells and a select few rising mains.

Augmentations proposed are limited to resolving exceedances of Councils Standards of Service. For example, gravity mains may continue to surcharge upstream from proposed augmentations if the resulting surcharge does not exceed 1m from ground level.

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1. Introduction

Redland Water is responsible for collecting, treating and disposing of wastewater produced within the Redland City Council service provider area. Redland households produce a daily average of 210 L/EP/day. The Wastewater is treated at one of seven Wastewater Treatment Plants (WWTP) throughout the Redland Water service area, located at:

- Capalaba
- Cleveland
- Thorneside
- Victoria Point
- Mount Cotton
- Dunwich
- Point Lookout

The outcomes of this Master Plan in terms of network augmentations to service growth form part of the Redland Water Netserv Plan and will be used as part of RCC's Local Government Infrastructure Plan (LGIP).

1.1 Background

Redland Water (RW) is a commercial business unit of Redland City Council (RCC) and recommenced operations on 1 July 2012. Its primary functions are to provide its customers with safe, reliable and high quality water services, as well as to collect and treat wastewater. RW is also responsible for charging customers for water and wastewater services. Continued investment in water and wastewater infrastructure reflects the need to meet the requirements of a growing population, which is projected to be approximately 180,000 people by 2036.

RW owns and operates 7 Wastewater Treatment Plants, these WWTPs service the catchment service areas as shown on Figures 001 – 007 in Appendix F.

The WWTPs treat incoming wastewater collected from approximately 50,000 properties across the existing wastewater connections area via a network of pump stations (150) with 92 km of rising mains and over 1,100 km of gravity service mains with 24,000 Maintenance Holes. Each year, these treatment plants collectively process around 11,695 mega litres of wastewater.

1.2 Previous Planning

The most recent whole of system planning document is the previous Sewer Network Master Plan. Since the preparation of the previous version of the Master Plan, the capital works program identified within it has been progressively built subject to actual demand triggers for construction being met and budgetary approval.

Redland Water have undertaken a hydraulic sewerage system model validation exercise upon which a capital works program has been developed and detailed in this master planning document. The new models are a significant improvement on the preceding models in terms of the extent of the accuracy of the network attributes. A data gathering exercise to provide a greater understanding of the Sewer Pump Stations (SPS) operation was completed, site visits were undertaken and a review of SCADA data to determine pump run hours and pump starts per day.

Correlation of the Infrastructure Demand Model (IDM) to the SPS catchment areas has allowed greater accuracy to the Design Flow and Peak Wet Weather Flow (PWWF) attributed to each of the SPS.

The background reports used in the preparation of this version of the Master Plan include Preliminary Design of Pump Stations for the following catchment areas:

- Victoria Point
- Thorneside
- Mount Cotton

And, Sewerage Master Planning Reports for the following catchment areas:

- Cleveland
- Capalaba

1.2.1 Hydraulic Model

Redland Water has used its Mike Urban hydraulic models for the preparation of this Master Plan. Details of the validation of the hydraulic model can be found in the individual catchment area sections of this report

1.3 Links to Redland City Council Corporate Plan

The Redland City Council Corporate Plan can be found at:

http://www.redland.qld.gov.au/AboutCouncil/CommunityPlan/Documents/Corporate_Plan/Corporate%20Plan%202015%20-%202020.pdf

Namely this report is associated with the Corporate Plan Appendix 1 – p17, the significant business (Redland Water) activity's third point below

“Significant business activity

Redland Water provides the following services to achieve its primary objectives:

- *provide a continuous supply of clean drinking water at an adequate pressure and flow rate for household and business needs*
- *collect, treat and dispose of wastewater in accordance with our environmental obligations*
- *plan, construct and maintain infrastructure and assets”*

1.4 Purpose of the Master Plan

The purpose of this Sewer Master Plan is to outline the required Carrier / Trunk main augmentations relative to the growth pattern provided in the Redland City Plan, its current network operating philosophy and to feed into the Water Netserv Plan.

The South-east Queensland Water (Distribution and Retail) Act 2009 requires Redland Water (RW) to have a Water Netserv Plan in place from 1 March 2014. The Water Netserv Plan must be consistent with the South-east Queensland Regional Plan 2009-2031 and with the planning assumptions for Redland City Council. The Water Netserv Plan is a key strategic document guiding the delivery and operation of RW's infrastructure and services which will be adjusted from outputs from this master planning study.

The Water Netserv Plan is to:

- Ensure the provision of safe, reliable and secure water and wastewater services;
- Provide for strategic planning for the operation of the business;
- Provide infrastructure planning for water and wastewater services for at least 20 years;
- Integrate land use planning and infrastructure planning for water and wastewater services;
- Provide for the management of water and wastewater services in a way that seeks to achieve ecological sustainability.

The focus for this report has been to identify the SPS network augmentations required to service the future growth within the WWTP service areas and address existing failures in the catchment areas. The output is expected to form the basis for the future detailed planning of the wastewater network in Redland. For those significant development areas (i.e. Kinross Road) it is expected the developer will undertake detailed network modelling to determine the appropriate network sizes and the requirement for any network augmentations. The intent of this Master Plan should be considered when sizing the new development network.

To assist the utilisation of the outputs from this report in future reports, Table 1 – MUID Naming Convention shows the naming convention when identifying the proposed augmentations within the hydraulic models and the service area abbreviations.

Table 1 – MUID Naming Convention

Prefix to MUID	Description
FGM_??_IDXXXX <i>Eg FGM_CL_08</i>	Augmentation of future gravity main for a catchment area with associated model ID reference. Augmentation is for duplication of existing infrastructure not replacement. <i>Eg - Future Gravity main in Cleveland with model ID 08</i>
FRM_??_IDXXXX <i>Eg FRM_CL_01</i>	Augmentation of future rising main for a catchment area with associated model ID reference. Augmentation is for duplication of existing infrastructure not replacement. <i>Eg - Future Rising main in Cleveland with model ID 08</i>
SPSXX <i>Eg SPS12</i>	Upgrade of SPS assets with associated SPS Reference. Upgrade can be for the pump replacement or refurbishment, (i.e. switchboard upgrade) or a new pump station. Augmentation ca <i>Eg – Sewer Pump Station 12</i>
CA	Capalaba
CL	Cleveland
TH	Thorneside
VP	Victoria Point
MC	Mount Cotton
PT	Point Lookout

1.5 Options assessment

Redland Water's option assessment must consider:

- 'Do nothing'
- Existing Asset Options – (Modification to the existing network operations to defer expenditure)
- Non-infrastructure alternatives e.g. demand management
- New infrastructure options

The following sub-sections detail the way in which each of these options are considered throughout this report.

1.5.1 'Do nothing'

With the increase in demand which this report assesses against the current network, the 'do nothing' option will result in a failure to meet Councils Service Standards as detailed in Table 2 - Sewer Design Criteria. It may be possible at some point in the future to review and adjust the service standards (reduce) so the service standards are achieved within the catchment areas and the 'do nothing' option will be applicable.

1.5.2 Existing Asset Options

This report assesses the catchment area configuration and existing assets within the boundary of the catchment area when looking at ways of addressing service standards failures due to the impact of population growth. The configuration option could be for transfer of demands between catchment areas, the assessment of existing assets could have identified an upgrade of the SPSs or gravity or rising main augmentations within the network. Augmentations proposed are to achieve service standards within the catchment areas.

1.5.3 Non-infrastructure alternatives

A non-infrastructure option was not considered when assessing catchment area options to attain Councils Standards of Service. Augmentations which have been identified have been sized based on duplication of existing infrastructure. Subsequent detailed planning may determine that an additional project may conclude the replacement of some existing infrastructure could be valid.

1.5.4 New-infrastructure options

The new infrastructure options identified in this report is a list of proposed network augmentations required to ensure the catchment area meets Council's Standards of Service for the projected demands. Augmentations identified for any new infrastructure has been sized based on the duplication of existing infrastructure not replacement. Subsequent detailed planning may determine that an alternative servicing strategy or reduced infrastructure sizing and the replacement of some existing infrastructure could be applicable.

1.6 Assumptions

The following assumptions have been made in the preparation of this report:

- The design criterion for demand per Equivalent Person (EP) is 210L/EP/day, this figure has decreased from the previous 270L/EP/day which was used to calculate demands for the previous Priority Infrastructure Plan (PIP).

1.7 Format of the Master Plan

The remainder of this report is divided into 15 sections, the first four, Desired Standards of Service, Demand Assessment, Model Set Up and Augmentation Philosophy are relevant to all sections of the wastewater catchment areas and the subsequent 7 sections being catchment area specific discussions which include the following topics:

- Catchment Overview
- Sewerage Model
- Capacity of Existing System:
 - SPS Hours of Operation
- Model Confirmation
- Capacity of the Ultimate System (2036)
- Required Augmentations:
 - SPS Catchment Area
 - Gravity Network
- Augmentation Timing:
 - 2016 Augmentations
 - 2021 Augmentations
 - 2026 Augmentations
 - 2031 Augmentations
 - 2036 Augmentations

The final sections include Proposed Works, Cost Estimates, Summary of Costs, Conclusions & Recommendations and references.

2. Standards of Service

The proposed Desired Standards of Service for the Redland sewerage network are in accordance with those outlined in the SEQ D&C Code. Table 2 - Sewer Design Criteria below sets out some of the key design criteria from the SEQ D&C Code for sewers. The complete SEQ D&C Code can be found at:

<http://www.seqcode.com.au/seq-water-supply-code/>

Table 2 - Sewer Design Criteria

No	Parameter	Redlands	
D1	Average dry weather flow (ADWF)	210 L/EP/d	
D2	Peak dry weather flow (PDWF)	$PDWF = C2 \times ADWF$ where $C2 = 4.7 \times (EP)^{-0.105}$	
D3	Peak wet weather flow (PWWF)	For RIGS PWWF= 5 x ADWF	
D4	Pump station servicing requirements	Ops Storage = $0.9 \times Q / N$ Q = pump rate (L/s) of duty pump or Total Pump Capacity (L/s) if multiple duty pumps. However, Number of starts per hr are: N=12 for motors<100kw N=8 for 100-200kw	
	Operating storage (m3)	N=5 of motors >200kw	
	Minimum wet well diameter	As shown in the Sewer Pump Station Code (As amended)	
	Emergency storage(New)	4hrs at ADWF	6hrs at ADWF Minimum 4 hours (up to 6hours)
	Emergency storage(existing)	No Requirement	
	Pump operation mode	Duty/assist	
	Single pump capacity	Min pump capacity for SPStns(duty & assist) = $C1 \times ADWF$	
		Where $C1 = 15 \times (EP)^{-0.1587}$	
	Total pump station capacity	Value of C1 to be within the range 3.5 - 5	Value of C1 to be minimum of 3.5
		PWWF	PWWF (i.e. 5 x ADWF min or $C1 \times ADWF$; Whichever is the greater) Overflows should not occur at flow < 5 x ADWF or $C1 \times ADWF$ (whichever is the larger).
	Size of pump station lot (and buffer)	Refer Clause 5.2.4 of Sewer Pump Station Code (As amended)	
D5	Maximum Velocity	3 m/s	
	Preferred Velocity	1.0 – 1.5 m/s	
	Minimum velocity	0.75m/s	

3. Demand Assessment

3.1 Demand Model

In 2013, Redland Water commissioned the production of a revised Infrastructure Demand Model (IDM). The revised IDM was prepared using inputs from the early stages of the Redland City Plan 2015. These inputs came in the form of GIS based population projections and tabular projections of employment and non-residential floor areas. In 2016, a finalised set of population projections and employment projections prepared by Urbis, in line with the draft Redland City Plan were provided, which Redland Water used to prepare its 2016 IDM.

Key development areas not included in the IDM are:

- Redland Bay South Investigation Area (known as Shoreline through the development application submitted in 2014).
- Toondah Harbour Priority Development Area (PDA).
- Weinam Creek PDA.

Other potential development areas which are also not included in the IDM are:

- Giles Road area which is not in the urban development planning scheme.
- Springacre Road area which is not in the urban development planning scheme.

All of these development areas have the potential to significantly increase the demands on key wastewater infrastructure.

3.2 Planning Scheme

As identified above, the *draft* Redland City Plan 2015 has been used for the calculation of the demands in the planning scheme.

3.3 Sewer Treatment Catchment Areas

A requirement of Redland Water as a Service Provider under the South-east Queensland Water (Distribution and Retail Restructuring) Act 2009 is to have a Water Netserv Plan which shows its Sewer Treatment catchment Areas. These maps can be seen at:

http://www.redland.qld.gov.au/EnvironmentWaste/Water/Documents/Netserv%20Part%20A_AUG2014.pdf

The catchment service areas are generally consistent with the Priority Infrastructure Areas (PIA). Some areas have been added where Redland Water now provides sewer treatment and some areas which are currently not included as it was previously considered to be not economically viable to construct the infrastructure to service these areas.

3.4 Adopted Demands

The adopted demands in Equivalent Persons (EP) for each Wastewater Treatment Plant (WWTP) catchment area across the planning horizons 2016 – 2036 in the new Redland IDM, are shown in Table 3 with the Sewer Pump Station (SPS) breakdown shown in Table 4.

Table 3 – Adopted Demands EP by WWTP

WWTP Service Area	2016	2021	2026	2031	2036
Capalaba	28,110	28,900	29,786	30,645	30,997
Cleveland	41,053	45,071	47,964	50,590	51,381
Thorneside	42,615	44,268	45,840	46,856	47,470
Victoria Point	30,721	32,940	34,813	36,243	36,642
Mount Cotton	4,205	5,314	5,352	5,409	5,494
Dunwich	957	1,158	1,167	1,175	1,178
Point Lookout*	1,834	7,116	7,600	7,600	7,600
Total	149,495	164,767	172,522	178,518	180,762

Note : * Point Lookout figures include a Tourist Peak Loading

Table 4 – Adopted Demands EP by SPS

Catchment SPS No.	2036 Demand (EPs)	Design Flow (L/s)	PWWF (L/s)
CAPALABA			
21	1828	20	22
23	527	6	6
24	1214	14	15
25	487	6	6
26	48	1	1
44	258	3	3
47	1232	15	15
53	235	3	3
62	2255	24	27
65	534	6	6
125	237	3	3
137	335	4	4
164	680	8	8
CLEVELAND			
1	319	4	4
2	1220	14	15
3	610	7	7
4	2235	24	27
5	5299	50	64
6	6839	61	83
8	268	3	3
9	389	5	5
11	1474	17	18
12	1666	19	20
13	35	0	0
14	83	1	1
19	1573	18	19
45	342	4	4
73	149	2	2
74	1261	15	15
75	251	3	3
76	155	2	2
81	721	9	9
82	1283	15	16
86	5593	52	68
87	78	1	1
100	2418	26	29

Catchment SPS No.	2036 Demand (EPs)	Design Flow (L/s)	PWWF (L/s)
107	379	5	5
113	276	3	3
114	105	1	1
116	385	5	5
117	112	1	1
119	129	2	2
120	121	1	1
121	64	1	1
122	175	2	2
123	240	3	3
126	115	1	1
128	0	0	0
130	337	4	4
136	1553	18	19
139	4167	40	51
141	0	0	0
145	1374	16	17
147	2859	29	35
165	3384	34	41
THORNESIDE			
16	819	10	10
28	5903	54	72
29	3008	31	37
30	352	4	4
31	422	5	5
32	783	10	10
33	8194	71	100
34	836	10	10
35	3230	33	39
36	713	9	9
37	213	3	3
38	86	1	1
39	33	0	0
40	257	3	3
41	10126	86	123
42	4478	43	54
43	853	10	10
48	4061	40	49
52	773	9	9

Catchment SPS No.	2036 Demand (EPs)	Design Flow (L/s)	PWWF (L/s)
83	182	2	2
84	116	1	1
85	447	5	5
93	169	2	2
98	96	1	1
99	239	3	3
106	70	1	1
109	216	3	3
110	180	2	2
115	58	1	1
140	5	0	0
146	203	2	2
VICTORIA POINT			
22	202	2	2
49	1445	17	18
54	566	7	7
55	108	1	1
56	594	7	7
57	300	4	4
58	762	9	9
59	508	6	6
60	323	4	4
61	1366	16	17
66	960	12	12
67	6452	58	78
68	46	1	1
88	314	4	4
89	62	1	1
90	2481	26	30
91	381	5	5
92	3499	35	43
95	420	5	5
96	224	3	3
97	121	1	1
101	261	3	3
111	585	7	7
112	1335	16	16
118	65	1	1
124	349	4	4

Catchment SPS No.	2036 Demand (EPs)	Design Flow (L/s)	PWWF (L/s)
129	329	4	4
132	1532	17	19
135	227	3	3
138	758	9	9
152	283	3	3
153	104	1	1
154	618	8	8
155	324	4	4
MOUNT COTTON			
134	2929	30	36
151	1684	19	20
158	150	2	2
161	78	1	1
162	652	8	8
163	494	6	6
DUNWICH			
142	386	5	5
143	666	8	8
144	563	7	7
159	0	0	0
POINT LOOKOUT			
69	287	3	3
70	566	7	7
71	1345	16	16
72	1173	14	14
103	1300	15	16
104	1464	17	18
131	693	8	8
156	111	1	1
157	111	1	1

3.5 WWTP Treatment Strategy

The Waste Water Treatment Plant (WWTP) strategy is outlined in the Sewer Treatment Master Plan, in brief the relevant components to this project are detailed below.

The wastewater treatment plant strategy involves using proven technology to achieve the required discharged effluent wastewater quality. This will be achieved through use of the following unit operations:

- Inlet works:
 - Screening to remove rags and large debris
 - Grit removal to remove sand and other small particles

Without these individual operations unwanted materials will accumulate within the downstream treatment processes leading to damage to essential equipment and frequent cleaning of treatment tanks.

- Activated sludge processes:
 - Depending on the configuration of the bioreactor either all or a combination of the following processes occur:
 - Nitrification: whereby the ammonia contained in the raw wastewater is oxidised to nitrate by specialised autotrophic bacteria
 - Denitrification: whereby the nitrate produced through nitrification is reduced to nitrogen gas by specialised heterotrophic bacteria thereby releasing it to the natural air streams
 - Carbon oxidation: any carbon not specifically used to assist in the denitrification reaction must also be oxidised to carbon dioxide, also by specialised heterotrophic bacteria, to meet COD/BOD discharge requirements
 - Biological phosphorus removal: this process varies in each treatment plant and occurs to varying degrees. The principle behind this process is that the phosphorus accumulates within the bacterial cell and is then wasted from the system, thereby removing it from the wastewater in a solid form.
- Chemical phosphorus removal: a more reliable form of phosphorus removal whereby chemicals, such as ferric chloride or aluminium sulphate are dosed into the bioreactor to form metal phosphate salts which then precipitate and are removed with the wasted activated sludge
- Secondary clarification: in order to maintain the activated sludge within the bioreactor and to ensure a clear effluent clarification is employed whereby the solids contained in the activated sludge are allowed to settle. A specialised tank or basin is used for this settling process. Note: primary clarification, on screened raw wastewater, is not employed in any of the treatment plants within the Redland catchment.
- Chlorination: either chlorine gas or sodium hypochlorite is used to disinfect the clear effluent from the clarifiers which may still contain microscopic pathogenic bacteria and viruses. This process is essential to minimising any potential health impact on the receiving environment and nearby residents who may use the receiving waters for recreation purposes.
- Dewatering: an outcome of the activated sludge process is the growth of bacteria within the bioreactor. In order to maintain acceptable clarification efficiency the suspended solids concentration must not be allowed to reach a pre-determined limit which may vary for each plant. To achieve this limit a certain percentage of mixed liquor must be wasted from the bioreactor. This waste activated sludge is then processed by a dewatering system to increase the percentage of dry solids to minimise disposal costs. Anything above this limit will result in poor clarification leading to an environmental breach

4. Model Set Up

Redland Water's wastewater sewerage system models are prepared in DHI's MikeUrban modelling software platform. Sewerage system models were prepared for the following WWTP service areas:

- Capalaba
- Cleveland
- Thorneside
- Victoria Point
- Mount Cotton

No hydraulic models were developed for the Dunwich and Point Lookout Catchment areas, the assessment of future infrastructure requirements for these catchment area were undertaken using alternative tools.

Redland Water's 'control copies' of the MikeUrban hydraulic models were adopted and amended as required. The 'control copy' models had been prepared for similar uses and have been subject to ongoing maintenance. After review they were considered fit-for-purpose and adopted as the baseline for this Master Planning project.

Amendments to the models for Master Planning included:

- Rationalisation of the proposed catchment areas to reflect current land use planning and WWTP catchment boundaries;
- Restructuring of the models to correlate with planning horizons outlined within the current Infrastructure Demand Model (IDM);
- Updating populations in accordance with the current IDM;
- Updating the ADWF and PWWF loading parameters to be consistent with current Standards of Service, refer Section 2;
- The importing of recently delivered infrastructure relevant to modelling outcomes;
- Removal of decommissioned assets;
- The update of modelled pump stations in accordance with the pump audit undertaken in 2015;
- Latest corporate GIS information when importing new infrastructure into the model;
- Future augmentation scenarios from legacy Master Planning were not taken forward into the current Master Planning but were considered for adoption where deficiencies prevailed; and
- Modelling of the pump stations to ensure each pump station reflected the data gathered from the recent pump audit project, the operating levels, pump curves and the number of pumps and configuration were confirmed.

4.1 Demand Assignment

Assigning of the population demands and planning horizons were adopted in accordance with Council's latest Infrastructure Demand Model (IDM), in five year intervals from 2016 – 2036.

Historic demand allocation was maintained from the 'control copy' models except where reconfiguration of a lot had occurred. In the case of reconfiguration of a lot, demands were reallocated in accordance with the associated infrastructure servicing strategy.

Where trunk main ($\geq$ DN300) extensions are planned into Greenfield development areas, future demands were allocated to the planned infrastructure accordingly.

4.2 Diurnal Patterns

The diurnal patterns in the hydraulic models were set up with the following parameters:

- PWWF loads have been attributed as a steady state load.
- Peak flow is in accordance with PWWF as set out in the Standard of Service, refer Section 2.
- ADWF pattern only relevant to Emergency storage calculations.

4.3 Pipe Friction Factors

Various pipe friction factors have been allocated throughout the hydraulic models. These are typically dependant on the pipe material and age to represent the existing network.

The pipe friction model and associated coefficients adopted for proposed rising mains and gravity mains has been outlined in Table 5, below.

Table 5 – Pipe Friction Assumptions

Application	Friction Model	Coefficients adopted for Augmentation
Gravity Mains	Mannings	0.013
Rising Mains	Colebrook-White	0.3 - 1mm

These values are consistent with existing infrastructure in the hydraulic models and within WSAA guidelines.

5. Augmentation Philosophy

The augmentation philosophy during the modelling and planning was to address existing and future deficiencies in the network to support forward cost estimates and previous infrastructure planning. Augmentation sizing and timing (through the planning horizons) have been identified to support these requirements.

A pragmatic approach was adopted to identify material system deficiencies and potential augmentations. Interest areas were nominated by spatially identifying areas of significant growth and investigating the supporting infrastructure in more detail.

Modelling outcomes were adopted to identify conveyance deficiencies within the networks.

Alternative assessment mechanisms were undertaken when considering non-conveyance network capacity, i.e. volume assessment, as modelling outcomes may not provide the best tools for assessment.

5.1 Definition of Failure

The definition of failure is when the assets within the sewerage system fall outside Councils Standards of Service. These definitions are described further below:

5.1.1 Gravity Mains

Gravity mains were deemed to exceed requirements where Peak Wet Weather Flow (PWWF) water levels surcharge greater than 1m below ground level or where overflows occur from overflow structures.

5.1.2 Rising Mains

Rising mains were deemed to exceed requirements where existing or proposed velocities would exceed 0.7m/s and 3 m/s.

5.1.3 Pumping Stations

Augmentations to Pump stations was identified where growth within the catchment areas exceeds 130% compared to the 2016 loads.

Pump capacity augmentations have been identified where modelling indicates capacity has been exceeded.

It was considered impractical to augment a pump wet well where minor exceedances prevail. Consideration for augmentations were limited to instances where significant growth (approximately 200% from 2016 loads) occurs.

5.2 Options for Service Provision

The options for service provision have been outlined below to address the deficiencies identified in the Master Planning.

For the purpose of developing this Master Plan, augmentations have generally maintained the existing infrastructure alignments. However, consideration was given to potential alternative servicing strategies where prudent. Alternative servicing strategies may be identified and should be considered for more detailed planning. Detailed planning was outside the scope of this report.

The duplication of existing infrastructure was the preferred option when augmentations were identified. However, asset replacement was considered where assets are nearing their end of nominal asset life. Asset replacements were limited to SPS wet wells and a select few rising mains.

Augmentations proposed are limited to resolving exceedances of Councils Standards of Service. For example, gravity mains may continue to surcharge upstream from proposed augmentations if the resulting surcharge does not exceed 1m from ground level.

5.2.1 Gravity Mains

5.2.1.1 Greenfield development areas

Gravity main extensions in Greenfield development areas are to support PWWF at no greater than 75% pipe full.

5.2.1.2 Brownfield development areas

Gravity main duplications in Brownfield development areas are to support PWWF at no greater than 100% pipe full. The duplication is assumed to be at the same invert level as the existing pipe. It was considered acceptable should the original pipe be surcharged subject to the augmentation meeting performance requirements.

5.2.2 Rising Mains

Rising main augmentations were located along the existing rising main corridor where deficiencies have been identified. Some exceptions are where existing rising mains have a history of rupture or nearing the end of their nominal asset life.

5.2.3 Pumping Stations

Pump station augmentations have generally been considered as two principal components:

- Conveyance capacity: resulting in mechanical and electrical augmentations to enhance pump capacity
- Operating volume: resulting in civil augmentations to enhance wet well storage

6. Capalaba

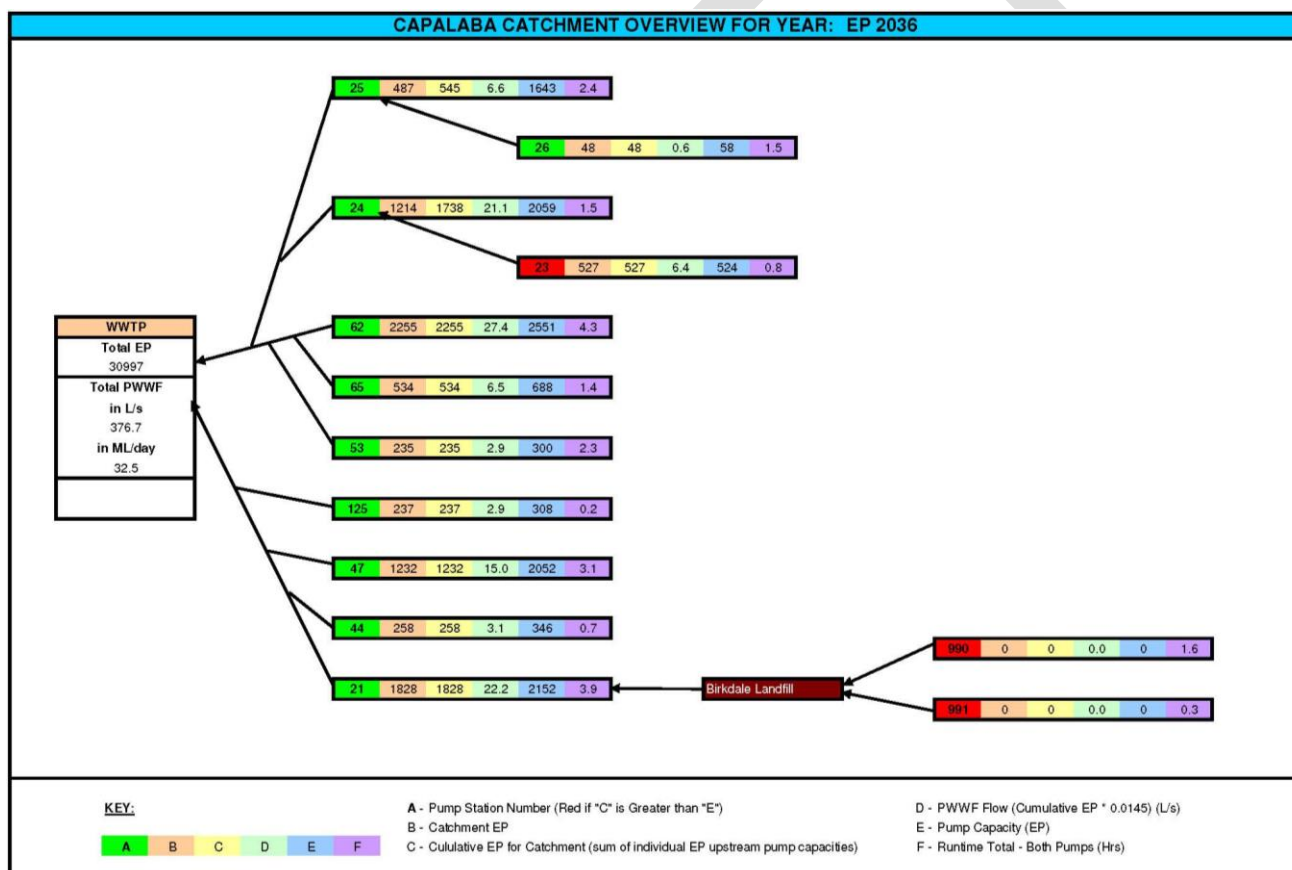
6.1 Catchment Overview

The existing Capalaba catchment area is approximately 4.5 km wide and 5.4 km long and covers an area of nearly 1,460ha. The ground elevations in the catchment vary from 60mAHD along the eastern edge, 45 mAHD along the western edge to 8mAHD at the Capalaba Wastewater Treatment Plant (WWTP). With a 3mAHD bed level at Coolnwynpin Creek, the creek drains in a north-westerly direction through the centre of the catchment, originating from the Burwood Heights area in the southeast corner of the catchment, joining Tingalpa Creek to the north. The Capalaba WWTP is centrally located within the catchment.

Figure 001 in Appendix F provides an overview of the Capalaba catchment area, showing the location of the existing infrastructure and the proposed augmentations from the hydraulic modelling completed for the LGIP project.

The catchment is serviced by a total of 13 Sewer Pump Stations (SPS). A schematic of the existing Capalaba sewerage system and catchment loadings is shown below in Figure 1 – Capalaba Catchment Overview:

Figure 1 – Capalaba Catchment Overview



6.2 Sewerage Model

As detailed in Section 4, the hydraulic models were restructured and updated to undertake the Master Planning.

The Capalaba sewerage system model has been maintained by Redland Water and only minimal updates were required to facilitate Master Planning. The following assets were added:

- Pump Station SPS164 and associated gravity catchment network. As-constructed details were incorporated into the model, with the intermediate high point on the SPS164 rising main also added into the model.

6.3 Capacity of Existing System

Analysis of the existing sewerage catchment area capacities showed the existing trunk sewers in the Capalaba catchment area have the capacity to contain PWWF events within the pipe. Deficiencies were identified in the gravity sewers adjacent to Coolnwynpin Creek, near Silvara Circuit.

The existing pump stations within the catchment areas typically have sufficient capacity to service their associated demands with changes only required at SPS25, SPS53 and SPS65 which can occur during the pump renewal phase.

6.3.1 Capalaba Sewer Pump Station Hours of Operation

The SPS operating hours for the 13 stations located within the Capalaba catchment area are detailed in Table 6 – Capalaba SPS hours of operation, below.

Table 6 – Capalaba SPS hours of operation

SPS No.	Street Address	Pump run hours / day	Pump starts / day
21	Cnr William Street & Crown Road	3.89	114
23	36A Brewer Street	0.78	19
24	164 Old Cleveland Road	1.51	41
25	126 Old Cleveland Road	2.38	87
26	30 Old Cleveland Road	1.51	9
44	56A Glover Drive	0.68	12
47	Frost Street, Near Spirit Drive	3.12	39
53	Cnr Noeleen Street and Morten Bay Road	2.26	120
62	31-37 Killarney Crescent	4.33	198
65	15 Pittwin Road North	1.37	24
125	351-353 Mount Cotton Road	0.24	8
137	St Anthony's School (Private)	Private	Private
164	401 Redland Bay Road	0.83	31

6.4 Model Confirmation

To confirm the status of the hydraulic model configuration and pump station set-up, a visual review of the model was undertaken against Council's latest corporate GIS to identify new infrastructure and asset details from the Pump Station audit incorporated. New infrastructure was imported into the hydraulic model where relevant.

A high level validation exercise was then completed, a comparison was made of flows derived from the hydraulic model against the GIS catchments for each pump station. This exercise sought to resolve misallocated demands on new infrastructure and capture planned diversions. The model was verified satisfactorily for each pump station catchment.

Similarly, modelled discharge to the wastewater treatment plant was compared with Infrastructure Demand Model outcomes to confirm PWWF calculations. Discharges to the WWTP achieved satisfactory correlation.

6.5 Capacity of the Ultimate System (2036)

A capacity assessment of the sewerage system was extended through to the 2036 planning horizon.

The assessment showed the Capalaba system has the capacity to service the planned 2036 demands with minimal augmentations. The proposed augmentations have been identified in Figure 001 - Appendix F.

Capacity constraints were identified where the sewerage system is surcharging. These commonly extend from the future proposed augmentations, in some cases the pump operating levels may cause surcharge to some gravity network elements immediately upstream from the pump stations and may not represent a material concern.

Pump augmentations have been identified at various locations to support growth (SPS25, SPS53 and SPS65), these augmentations are limited to mechanical and electrical equipment upgrades at the pump stations. All wet well storage and rising mains are sufficiently sized to support future growth.

6.6 Required Augmentations

Population growth was identified throughout the catchment area with principal growth areas located within the major commercial centre precinct and along Finucane Road. Augmentations within the Capalaba sewerage system were limited to the following catchment areas and shown on Figure 001 – Appendix F:

- The local network supporting the major commercial precinct area located between Old Cleveland Road and Moreton Bay Road, and
- Gravity sewers following Coolnwynpin Creek, near Silvara Circuit

6.6.1 SPS Catchment Areas

Augmentations identified within the SPS25 catchment area are independent of each other, the upstream gravity main (FGM_CA_12) and augmentations at SPS25 (limited to mechanical and electrical equipment) are driven by planned growth within the catchment.

Augmentation identified within the SPS53 catchment area are independent of each other, the upstream gravity main (FGM_CA_11) and augmentations at SPS53 (limited to mechanical and electrical equipment) are driven by planned growth within the catchment.

Augmentations identified at SPS65 will trigger downstream gravity network augmentations (FGM_CA_07 – FGM_CA_10). These augmentations are linked and must be undertaken concurrently.

6.6.2 Gravity Network

Augmentation of the gravity network following Coolnwynpin Creek near Silvara Circuit is required to service the planned growth (FGM_CA_01 – FGM_CA_06).

6.7 Augmentation Timing

Timing of augmentations within the Capalaba sewerage system are:

6.7.1 2016 Augmentations

- DN225 gravity sewers along Coolnwynpin Creek, near Silvara Circuit – Phase 1 and the existing system.

Table 7 – Capalaba – 2016 Augmentations below shows the augmentations proposed within the Capalaba sewerage system. The model identification number (MUID) references the augmentations on Figure 001 – Appendix F.

Table 7 – Capalaba – 2016 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_CA_03	225	10	\$10,506	2016
FGM_CA_04	225	80	\$29,286	2016

*Note: The model identification number (MUID) references the augmentations on Figure 001 – Appendix F.

6.7.2 2021 Augmentations

No network augmentations were identified for the 2021 planning horizon

6.7.3 2026 Augmentations

No network augmentations were identified for the 2026 planning horizon

6.7.4 2031 Augmentations

No network augmentations were identified for the 2031 planning horizon

6.7.5 2036 Augmentations

The following augmentations were identified for the 2036 planning horizon:

- DN300 / DN225 gravity sewers along Coolnwynpin Creek, near Silvara Circuit – Phase 2.
- Pump Station SPS25
- DN225 gravity sewers in the SPS25 catchment area
- Pump Station SPS53
- DN150 gravity sewers in the SPS53 catchment area
- Pump Station SPS65
- DN300 / DN150 gravity sewers in the SPS65 catchment area

Table 8 – Capalaba 2036 Augmentations below shows the augmentations proposed within the Capalaba sewerage system. The model identification number (MUID) references the augmentations on Figure 001 – Appendix F.

Table 8 – Capalaba 2036 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_CA_01	300	70	\$28,760	2036
FGM_CA_02	300	75	\$32,149	2036
FGM_CA_05	300	4	\$1,536	2036
FGM_CA_06	225	50	\$29,017	2036
FGM_CA_07	150	60	\$24,938	2036
FGM_CA_08	150	190	\$92,629	2036
FGM_CA_09	300	50	\$35,463	2036
FGM_CA_10	300	80	\$80,828	2036
FGM_CA_11	150	150	\$49,294	2036
FGM_CA_12	225	185	\$84,226	2036
SPS 25			\$95,250	2036
SPS 53			\$63,250	2036
SPS 65			\$95,250	2036

*Note: The model identification number (MUID) references the augmentations on Figure 001 – Appendix F.

7. Cleveland

7.1 Catchment Overview

The existing Cleveland sewerage catchment area is approximately 5.5km wide and 6.6km long and covers an area of nearly 2,250ha. The ground elevations in the catchment vary from 60m AHD along the western edge to sea level in the east and north of the catchment. Hilliards Creek drains through the catchment from south to north.

Figure 002 in Appendix F provides an overview of the catchment area showing the location of the existing infrastructure and proposed augmentations from the hydraulic modelling completed for the Local Growth Infrastructure Plan (LGIP) project

Most of the development in the Cleveland sewerage catchment is located to the west of Hilliards Creek. The catchment includes areas of Alexandra Hills, Thornlands and Pinklands to the south, Cleveland which is centrally located within the catchment and Raby Bay and Ormiston to the north. The proposed Toondah Harbour development and the consequential upgrade of SPS 2 is not part of this master planning and needs to be considered as part of a separate infrastructure agreement.

The Cleveland Wastewater Treatment Plant (WWTP) is located on the western side of Hilliard's Creek. The ground level at the WWTP is approximately 50m AHD. The range of ground elevations of maintenance holes in the catchment varies as follows:

Elevation Range	% of Catchment
• 40m AHD to 60m AHD	9%
• 30m AHD to 40m AHD	11%
• 20m AHD to 30m AHD	16%
• 10m AHD to 20m AHD	28%
• 2m AHD to 10m AHD	36%

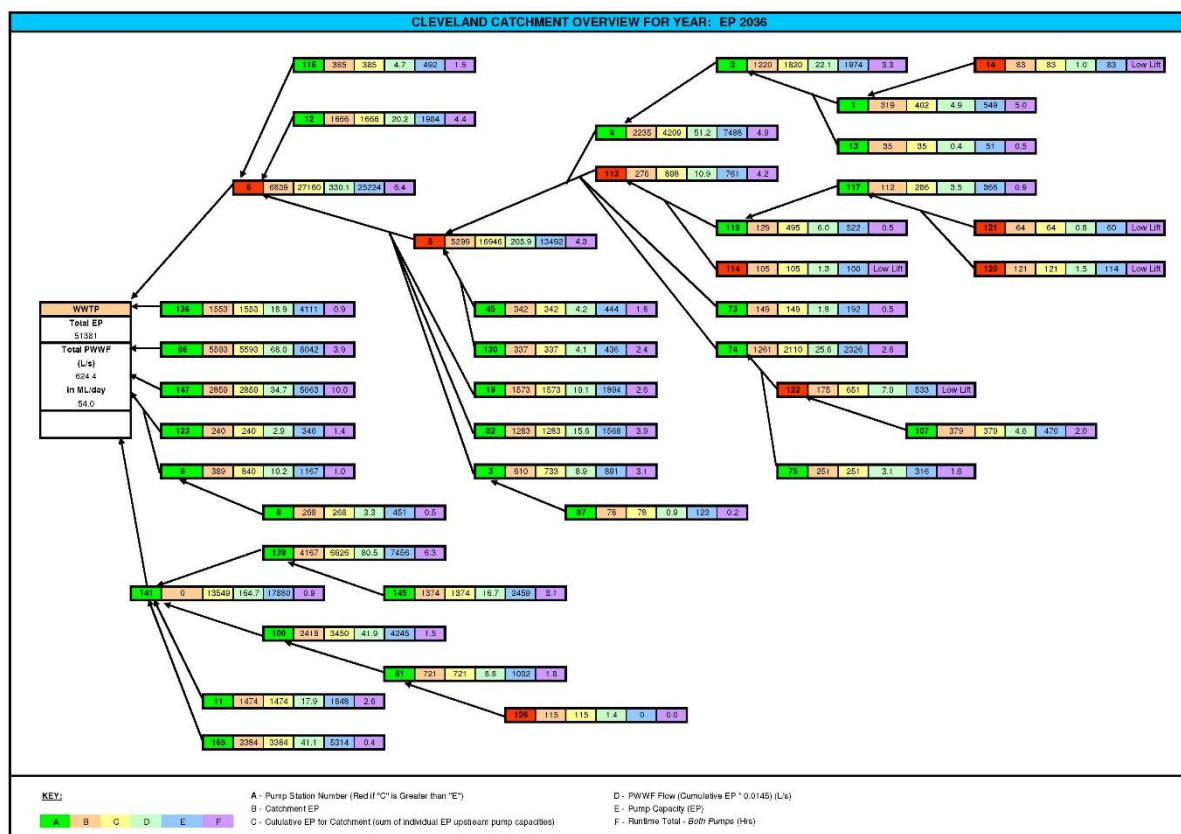
Almost two thirds of the catchment is located below 20m AHD and more than one third is located between 2m and 10m AHD. With the average ground level of sewerage in the catchment at approximately 10m the energy requirements to transfer sewerage to Cleveland WWTP are high (almost 40m static lift on average) and this indicates the focus should be on optimising pump efficiency.

The catchment is serviced by a total of 42 Sewer Pump Stations (SPS) which includes two major pump station catchments, SPS6 - Cleveland Showgrounds, 44 Smith Street which is the largest and SPS141(165 South Street). The SPS6 catchment is centrally located and includes a total number of 27 smaller sewer pump stations.

SPS141 which is smaller than SPS6 and services the southern areas of the catchment and includes a total of 6 upstream SPSs. In addition to SPS6 and SPS141 there a number of smaller pump stations that deliver directly to the Cleveland WWTP.

A schematic of the existing Cleveland sewerage system and catchment loadings is shown below in Figure 2 – Cleveland Catchment Overview:

Figure 2 – Cleveland Catchment Overview



7.2 Sewerage Model

As detailed in Section 4, the hydraulic models were restructured and updated to undertake the Master Planning where required.

The Cleveland sewerage system model has been maintained by Redland Water and only minimal updates were required to facilitate Master Planning. The following assets were added:

- The current augmentation to pump station SPS6 and associated rising main was included from As-Constructed and design information.
- The pump station SPS165 system including pump station, rising main and trunk main collection system.
- SPS128 was removed from the model as this pump station has been decommissioned in the sewer network.

Reticulation from various new developments located in the southern catchments including the SPS145 catchment and the Kinross Road Structure Planned area.

7.3 Capacity of Existing System

Analysis of the existing sewerage catchment areas capacities showed the existing trunk sewers in the Cleveland catchment area have the capacity to contain PWWF events within the pipe. Existing deficiencies were identified in the gravity sewers of the largely industrial catchment area SPS86 and in the receiving sewers immediately downstream from SPS12.

Pump deficiencies were also identified within SPS12.

7.3.1 Cleveland Sewer Pump Station Hours of Operation

The SPS operating hours for the 42 pump stations located within the Cleveland catchment area are detailed in Table 9 – Cleveland SPS hours of operation, below:

Table 9 – Cleveland SPS hours of operation

SPS No.	Street Address	Pump run hours / day	Pump starts / day
1	Adjacent to 171 Shore Street	4.96	50
2	Middle Street, Near Wharf Street	3.26	161
3	Princess Street, Near Erobin Street	3.08	99
4	Middle Street, Near Island Street	4.92	227
5	Cultural Centre, 2-16 Middle Street	4.31	84
6	Cleveland Showgrounds, 44 Smith Street	6.38	109
8	McDonald Road, North of Flinders Street	0.51	90
9	Cleveland WWTP Land - Flinders Street	0.95	52
11	65 Redland Bay Road	2.60	110
12	Adjacent to 1 Cleary Street	4.40	147
13	Shore Street East, Near Cross Street	0.53	11
14	Shore St North, Northern End	Low Lift	Low Lift
19	Adjacent to 20 Ostend Court	2.59	174
45	46-48 Troy Street	1.79	31
73	Bowsprit Parade, Opposite Bollard Street	0.46	27
74	Adjacent 2 Sentinel Court	2.59	36
75	44 Anchorage Drive	1.63	30
76	67-75 Dinwoodie Road (Private)	Private	Private
81	173 Redland Bay Road	1.78	80
82	Cricket grounds, 143 Fitzroy Street	3.94	71
86	Cleveland WWTP land	3.89	134
87	Southern end of Passage Street	0.22	2
100	Adjacent to 45 Albicore Drive	1.53	128
107	Adjacent to 2 Sentinel Court	1.99	27
113	Opposite 6 Sommersea Drive	4.25	55
114	24 Caravel Court	Low Lift	Low Lift
116	84 Sunshine Drive	1.47	22
117	Adjacent 1 Raby Bay Boulevard	0.94	20
119	3-11 Sommersea Drive, Opposite Martingale Drive	0.48	14
120	25 Piermont Place	Low Lift	Low Lift
121	Adjacent 21 Raby Bay Boulevard	Low Lift	Low Lift
122	48-58 Masthead Drive	Low Lift	Low Lift
123	End of easement between 72 and 76 Hanover Drive	1.36	46
126	190-262 Redland Bay Road	N/A	N/A
128	229 Long Street (Booster Station)	Decommissioned	
130	6 Cayman Crescent	2.44	50
136	23 Weippin Street	0.94	27
139	31 Manning Esplanade	6.32	81

SPS No.	Street Address	Pump run hours / day	Pump starts / day
141	165 South Street	0.92	98
145	Opposite 2 Tindappah Drive	3.06	92
147	Opposite 4 Lorikeet Drive	10.01	128
165	Near Rachow Street Thornlands	0.43	7

7.4 Model Confirmation

To confirm the status of the hydraulic model configuration and pump station set-up a visual review of the model was undertaken against Council's latest corporate GIS to identify new infrastructure and asset details from the Pump Station audit were incorporated. New infrastructure was imported into the hydraulic model where relevant.

A high level validation exercise was then completed, a comparison was made of flows derived from the hydraulic model against the GIS catchments for each pump station. This exercise sought to resolve misallocated demands on new infrastructure and capture planned diversions. The model was verified satisfactorily for each pump station catchment.

Similarly, modelled discharge to the wastewater treatment plant was compared with Infrastructure Demand Model outcomes to confirm PWWF calculations. Discharges to the WWTP achieved satisfactory correlation

7.5 Capacity of the Ultimate System (2036)

A capacity assessment of the sewerage system was extended through to the Ultimate (2036) planning horizon.

The assessment showed the Cleveland network has the capacity to service the planned 2036 demands with minimal augmentations. The proposed augmentations have been identified in Figure 002 - Appendix F.

Capacity constraints were identified where the sewerage system is surcharging. These commonly extend from the future proposed augmentations, in some cases pump operating levels may cause surcharge to some gravity network elements immediately upstream from the pump stations and may not represent a material concern.

Pump augmentations have been identified at various locations to support growth, these augmentations are limited to mechanical and electrical equipment at the pump stations. All wet well storage and rising mains are sufficiently sized to support future growth.

The discharge sewers downstream from SPS2 are inherently undersized to support the current pump capacity. Exceedance of the downstream gravity network results where pump event durations are not short. Downstream augmentations have been identified where population growth results in longer pumps runs. This could cause SPS2 issues downstream earlier than identified in this assessment (wet weather flows exceed population based flow estimates).

7.6 Required Augmentations

Population growth has been identified throughout the catchment area with principal growth areas dominating the northern catchment areas off Bloomfield Street and Middle Street. The principal development areas in the south are characterised by the Kinross Road Structure Planned area and a significant development precinct (South-East Thornlands) off Cleveland Redland Bay Road. Augmentations within the Cleveland sewerage system are shown on Figure 002 – Appendix F.

To service the population growth in the catchment areas, future augmentations have been identified within the following catchments:

- Gravity network of pump station SPS86 catchment
- Pump Station SPS12 and the associated upstream and downstream gravity network
- Receiving sewers downstream from pump station SPS2
- Collection sewers upstream from pump station SPS6
- Rising Main connection from pump station PS147 to a common rising main

- Pump Station SPS100

7.6.1 SPS Catchment Areas

Augmentations identified within the SPS12 catchment area are independent of each other, the upstream gravity main and augmentations at SPS12 (limited to mechanical and electrical equipment) are driven by planned growth within the catchment.

Augmentation of the rising main connections within the SPS147 catchment area is to mitigate excessive velocity in the existing rising main (FRM_CL_01).

Augmentation of SPS100 is limited to mechanical and electrical equipment.

7.6.2 Gravity Network

The following gravity network augmentations are required to service future growth:

- Augmentations within the SPS2 catchment gravity network (FGM_CL_08).
- Augmentations within the SPS5 catchment gravity network (FGM_CL_14).
- Augmentations within the SPS6 catchment gravity network (FGM_CL_01, and FGM_CL_02).
- Augmentations within the SPS12 catchment gravity network. Two sections of gravity mains have been identified for augmentation (FGM_CL_05 and FGM_CL_06) and (FGM_CL_10 to FGM_CL_13).
- Augmentations within the SPS81 catchment gravity network (FGM_CL_09).
- Augmentations within the SPS86 catchment gravity network (FGM_CL_03, FGM_CL_04 and FGM_CL_07).

7.7 Augmentation Timing

Timing of augmentations within the Cleveland sewerage system are:

7.7.1 2016 Augmentations

The following augmentations were identified for the 2016 planning horizon:

- DN300 downstream gravity sewers in pump station SPS86 catchment
- Pump Station SPS12 and DN150 downstream receiving sewers.

Table 10 – Cleveland 2016 Augmentations below shows the augmentations proposed within the Cleveland sewerage system. The model identification number (MUID) references the augmentations on Figure 002 – Appendix F.

Table 10 – Cleveland 2016 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_CL_03	300	200	\$95,303	2016
FGM_CL_04	300	410	\$272,490	2016
FGM_CL_07	300	155	\$87,338	2016
FGM_CL_10	150	60	\$20,160	2016
FGM_CL_11	150	45	\$18,986	2016
FGM_CL_12	150	75	\$15,566	2016
FGM_CL_13	150	50	\$21,437	2016
SPS12			\$ 91,000	2016

*Note: The model identification number (MUID) references the augmentations on Figure 002 – Appendix F.

7.7.2 2021 Augmentations

No network augmentations were identified for the 2021 planning horizon

7.7.3 2026 Augmentations

The following augmentations were identified for the 2026 planning horizon:

- DN150 gravity main downstream from pump station SPS2 will be required in 2026.
- DN225 gravity main downstream from pump station SPS5 will be required in 2026.

Table 11 – Cleveland 2026 Augmentations below shows the augmentations proposed within the Cleveland sewerage system. The model identification number (MUID) references the augmentations on Figure 002 – Appendix F.

Table 11 – Cleveland 2026 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_CL_08	150	105	\$53,865	2026
FGM_CL_14	225	180	\$120,126	2026

*Note: The model identification number (MUID) references the augmentations on Figure 001 – Appendix F.

7.7.4 2031 Augmentations

No network augmentations were identified for the 2031 planning horizon

7.7.5 2036 Augmentations

The following augmentations were identified for the 2036 planning horizon:

- DN150 gravity main duplication in the pump station SPS81 catchment
- DN225 gravity mains and inlet into Pump station SPS12
- DN150 rising main connection from pump station SPS147 to common rising main
- DN375 receiving gravity mains from pump station SPS6
- Pump Station SPS100

Table 12 – Cleveland 2036 Augmentations below shows the augmentations proposed within the Cleveland sewerage system. The model identification number (MUID) references the augmentations on Figure 002 – Appendix F.

Table 12 – Cleveland 2036 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_CL_01	375	135	\$98,053	2036
FGM_CL_02	375	170	\$148,225	2036
FGM_CL_05	225	6	\$2,392	2036
FGM_CL_06	225	150	\$54,768	2036
FGM_CL_09	150	25	\$16,908	2036
FRM_CL_01	150	40	\$9,322	2036
SPS100			\$ 138,500	2036

*Note: The model identification number (MUID) references the augmentations on Figure 001 – Appendix F.

8. Thorneside

8.1 Catchment Overview

The Thorneside catchment area is approximately 7.1km wide and 7.5km long, covering an area of nearly 2,500 Ha. The elevations in the catchment vary from 60 mAHD along the southern edge of the catchment to sea level in the east and north. Tingalpa Creek drains the western boundary of the catchment and flows adjacent to the catchment north to Moreton Bay. Figure 003 in Appendix F provides an overview of the catchment area and shows the location of the existing infrastructure and proposed augmentations from the hydraulic modelling completed for the LGIP project.

Most of the development in the Thorneside catchment area is located to the west of Hilliards Creek. The suburbs west of Hilliards Creek include Alexandra Hills, Birkdale, Capalaba, Thorneside and Wellington Point. The suburb of Ormiston is located to the east of Hilliards Creek.

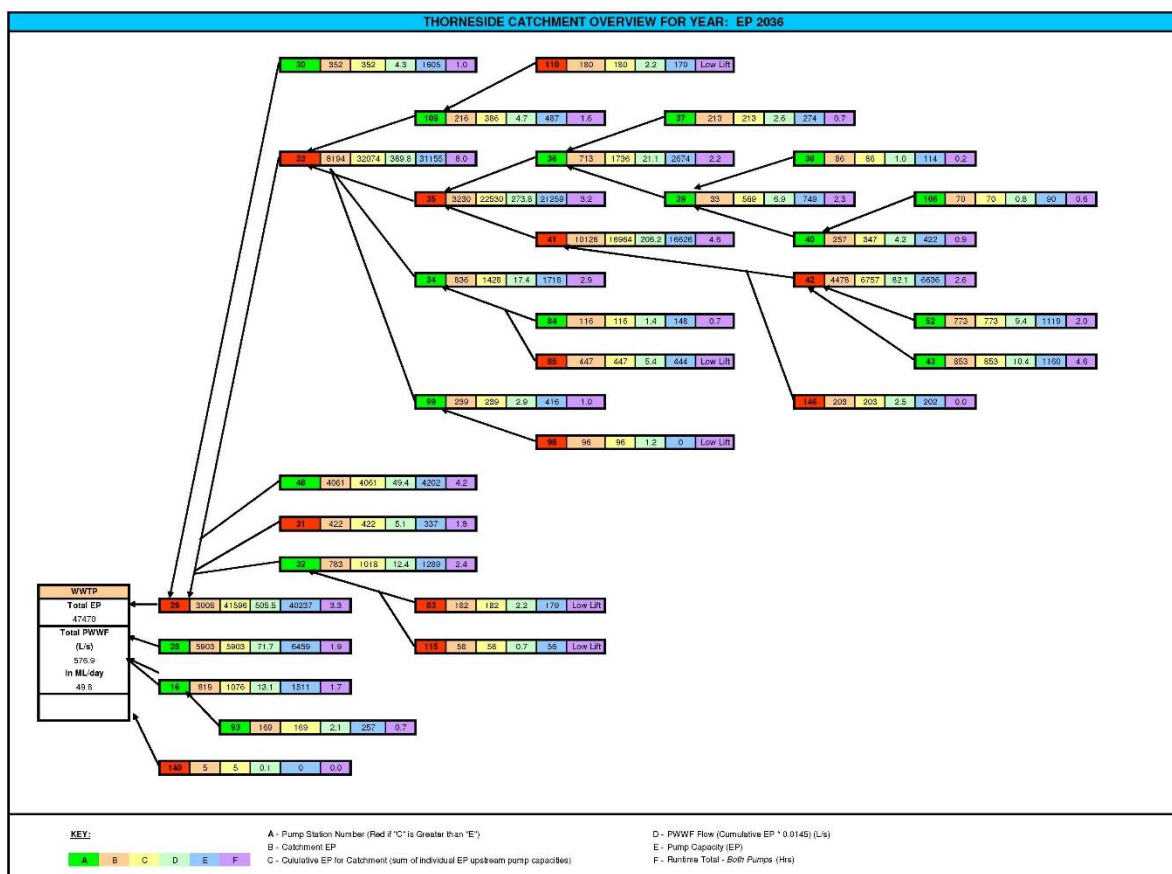
The Thorneside Wastewater Treatment Plant (WWTP) is located in the north-west of the catchment and adjacent to the mouth of Tingalpa Creek. The ground level at the WWTP is approximately 1.5 mAHD. The range of ground elevations in the catchment varies as shown below:

Elevation Range	% of Catchment
• 40mAHD to 60mAHD	31%
• 30mAHD to 40mAHD	34%
• 20mAHD to 30mAHD	20%
• 10mAHD to 20mAHD	10%
• 2mAHD to 10mAHD	5%

Sub catchments located in the south of the Thorneside catchment are situated at higher elevations relevant to the WWTP and are able to transfer the majority of flow via gravity networks. Low lying areas to the east and north require pump stations to transfer flows through intermediate sub-catchments to the WWTP. The catchment is serviced by 31 Sewer Pump Stations (SPS). The majority of the load passes through SPS029 – Eva Street which services approximately 86% of the total catchment flows.

SPS029 transfers the majority of flows from the low lying areas to the north and east of the catchment area, these low lying areas are serviced by 27 smaller sub-catchments and respective SPSs. The remaining 3 sub-catchments are located to the south west of the catchment adjacent to Tingalpa Creek, transferring their loads to the Thorneside WWTP. A schematic of the existing Thorneside sewerage system and catchment loadings is shown below in Figure 3 – Thorneside Catchment Overview:

Figure 3 – Thorneside Catchment Overview



8.2 Sewerage Model

As detailed in Section 4, the hydraulic models were restructured and updated to undertake the Master Planning where required.

The Thorneside sewerage system model has been maintained by Redland Water, only minimal updates were required to facilitate Master Planning. The model represents the recent pump station rationalisation transfers which have been undertaken in recent years.

8.3 Capacity of Existing System

Analysis of the existing sewerage catchment area capacity showed the existing trunk sewers in the Thorneside catchment area have the capacity to contain PWWF events within the pipe.

Surcharges were identified at the following locations:

- Gravity mains between SPS35, SPS33 and SPS29.
- Receiving sewers downstream from SPS146.

Existing deficiencies were identified at pump station SPS35 and associated rising main, and the connection to the common rising main from SPS48 and localised rising main section connecting SPS28.

8.3.1 Thorneside Sewer Pump Station Hours of Operation

The SPS operating hours for the 31 pump stations located within the Thorneside catchment area are detailed in Table 13– Thorneside SPS hours of operation:

Table 13– Thorneside SPS hours of operation

SPS No.	Street Address	Pump run hours / day	Pump starts / day
16	4A Whitehall Avenue, Near Tingalpa Creek	1.69	64
28	1-29 St Andrews Avenue	1.88	168
29	Eva Street	3.33	N/A
30	Queens Esplanade, Near Helen Street	0.98	41
31	Queens Esplanade, Near Mark Street	1.84	29
32	Queens Esplanade, Near Bates Drive	2.39	82
33	226 Birkdale Road	7.95	111
34	56 Thomas Street	287	104
35	347 Birkdale Road	3.19	319
36	Opposite Jellicoe Street, Main Road	2.24	74
37	Adjacent to 9-11 Acacia Street	0.75	17
38	Adjacent to 232 Main Road	0.24	6
39	122 Main Road	2.28	16
40	49 Main Road	0.89	45
41	38 Fernbourne Road	4.61	321
42	51 Hilliard Street	2.56	64
43	Opposite 248 Wellington Street	4.60	30
48	Opposite 32 Victor Street	4.19	176
52	Easement beside 35 Counihan Street	1.96	63
83	Adjacent to 1 Ruth Street	Low Lift	Low Lift
84	1A Bath Street	0.66	23
85	Adjacent to 36 Makaha Drive	Low Lift	Low Lift
93	Adjacent to 9 Catherine Street	0.75	54
98	22 Dorsal Drive	Low Lift	Low Lift
99	68 Dorsal Drive	0.96	30
106	8 Esplanade	0.55	19
109	3 Keel Street	1.56	20
110	30 Downwind Court	Low Lift	Low Lift
115	7 Mainsail Street	Low Lift	Low Lift
140	Railway Parade, Canoe Club Toilet Block	0.01	1
146	12 Lincoln Close	Low Lift	Low Lift

8.4 Model Confirmation

To confirm the status of the hydraulic model configuration and pump station set-up a visual review of the model was undertaken against Council's latest corporate GIS to identify new infrastructure and asset details from the Pump Station audit incorporated. New infrastructure was imported into the hydraulic model where relevant

A high level validation exercise was then completed, a comparison was made of flows derived from the hydraulic model against the GIS catchments for each pump station. This exercise sought to resolve misallocated demands on new infrastructure and capture planned diversions. The model was verified satisfactorily for each pump station catchment.

Similarly, modelled discharge to the wastewater treatment plant was compared with Infrastructure Demand Model outcomes to confirm PWWF calculations. Discharges to the WWTP achieved satisfactory correlation

8.5 Capacity of the Ultimate System (2036)

A capacity assessment of the sewerage system was extended through to the Ultimate (2036) planning horizon.

The assessment showed the Thorneside network has the capacity to service the planned 2036 demands with minimal augmentations. The proposed augmentations have been identified in Figure 003, Appendix F.

Capacity constraints were identified where the sewerage system is surcharging. These commonly extend from the future proposed augmentations, in some cases pump operating levels may cause surcharge to some gravity network elements immediately upstream from the pump stations and so may not represent a material concern. This situation can be applicable to those mains immediately upstream from SPS16, SPS31, SPS32 and SPS36.

Pump augmentations have been identified at various locations to support growth, these augmentations are limited to mechanical and electrical equipment at the pump stations. All wet well storage and rising mains are sufficiently sized to support future growth.

8.6 Required Augmentations

Future population growth is dispersed throughout the catchment with concentrations occurring around the major road and rail corridors such as Birkdale Road, Quarry Road, Old Cleveland Road East, Finucane Road and Main Road. Augmentations within the Thorneside sewerage system shown on Figure 003 – Appendix F

To service the population growth in the catchment areas, future augmentations have been identified within the following catchment areas:

- Gravity network of pump station SPS29 catchment
- Pump Station SPS35 and the associated rising main upstream and downstream gravity network
- Pump Station SPS33
- Pump station SPS48

8.6.1 SPS Catchment Areas

Augmentation of SPS35 requires replacement of all elements including wet well, pumps and rising main. Operational issues at the pump station does not support continued use of the existing assets in the long term. Augmentation of SPS35 pump capacity will trigger augmentation of the associated rising main (FRM_TH_01) and wet well.

Augmentation of SPS33 is limited to mechanical and electrical equipment.

Augmentation of SPS42 is limited to mechanical and electrical equipment.

Augmentation of the rising main connections from pump station SPS48 have been identified to mitigate excessive velocity (FRM_TH_02).

Augmentation of the rising main connections from pump station SPS28 have been identified to mitigate excessive velocity (FRM_TH_03).

8.6.2 Gravity Network

Augmentations within the SPS29 upstream trunk collection gravity network are required to service future growth (FGM_TH_02 and FGM_TH_03).

Augmentations within the SPS35 gravity network are required to service future growth (FGM_TH_01).

8.7 Augmentation Timing

Timing of augmentations within the Thorneside sewerage system are:

8.7.1 2016 Augmentations

The following augmentations were identified for the 2016 planning horizon:

- DN675 upstream gravity main connections in the pump stations SPS35 catchment
- DN525 upstream trunk collection gravity network in the SPS29 catchment
- Pump Station SPS35 wet well, pumps and DN450 rising main
- DN200 rising main connections at SPS48
- DN300 rising main connections at SPS28

Table 14 – Thorneside 2016 Augmentations below shows the augmentations proposed within the Thorneside sewerage system. The model identification number (MUID) references the augmentations on Figure 003 – Appendix F.

Table 14 – Thorneside 2016 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_TH_01	675	10	\$30,715	2016
FGM_TH_02	525	80	\$95,578	2016
FRM_TH_01	450	550	\$277,378	2016
FRM_TH_02	200	15	\$3,244	2016
FRM_TH_03	300	5	\$2,051	2016
SPS35 (Inc. new WW)			\$2,200,000	2016

*Note: The model identification number (MUID) references the augmentations on Figure 003 – Appendix F.

8.7.2 2021 Augmentations

No network augmentations were identified for the 2021 planning horizon

8.7.3 2026 Augmentations

No network augmentations were identified for the 2026 planning horizon

8.7.4 2031 Augmentations

No network augmentations were identified for the 2031 planning horizon

8.7.5 2036 Augmentations

The following augmentations were identified for the 2036 planning horizon:

- DN525 upstream trunk collection gravity network at SPS29 will be required in in 2036 – Phase 2
- Pump Station SPS33
- Pump Station SPS42

Table 15 – Thorneside 2036 Augmentations below shows the augmentations proposed within the Thorneside sewerage system. The model identification number (MUID) references the augmentations on Figure 003 – Appendix F.

Table 15 – Thorneside 2036 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_TH_03	525	130	\$130,934	2036
SPS33			\$443,240	2036
SPS42			\$123,500	2036

*Note: The model identification number (MUID) references the augmentations on Figure 003 – Appendix F.

9. Victoria Point

9.1 Catchment Overview

The Victoria Point catchment is approximately 5.6km wide and 9.3km long, the catchment also includes Coochiemudlo Island located to the north east which is approximately 1.6km wide and 1.0km wide. The catchment covers an area of nearly 2,500 Ha. The elevations in the catchment vary from 51 mAHD in the west of the catchment to sea level in the east. Moogurrapum Creek and Eprapah Creek transect the catchment area, draining the majority of the catchment towards Moreton Bay to the east.

Figure 004 in Appendix F provides an overview of the catchment area and shows the location of the existing infrastructure and proposed augmentations from the hydraulic modelling completed for the LGIP project.

Most of the development in the Victoria Point catchment area is located to the south of Eprapah Creek.

Victoria Point Wastewater Treatment Plant (WWTP) is located in the north of the catchment adjacent to Eprapah Creek. The ground level at the WWTP is approximately 3.0 mAHD. The range of ground elevations in the catchment varies as shown below:

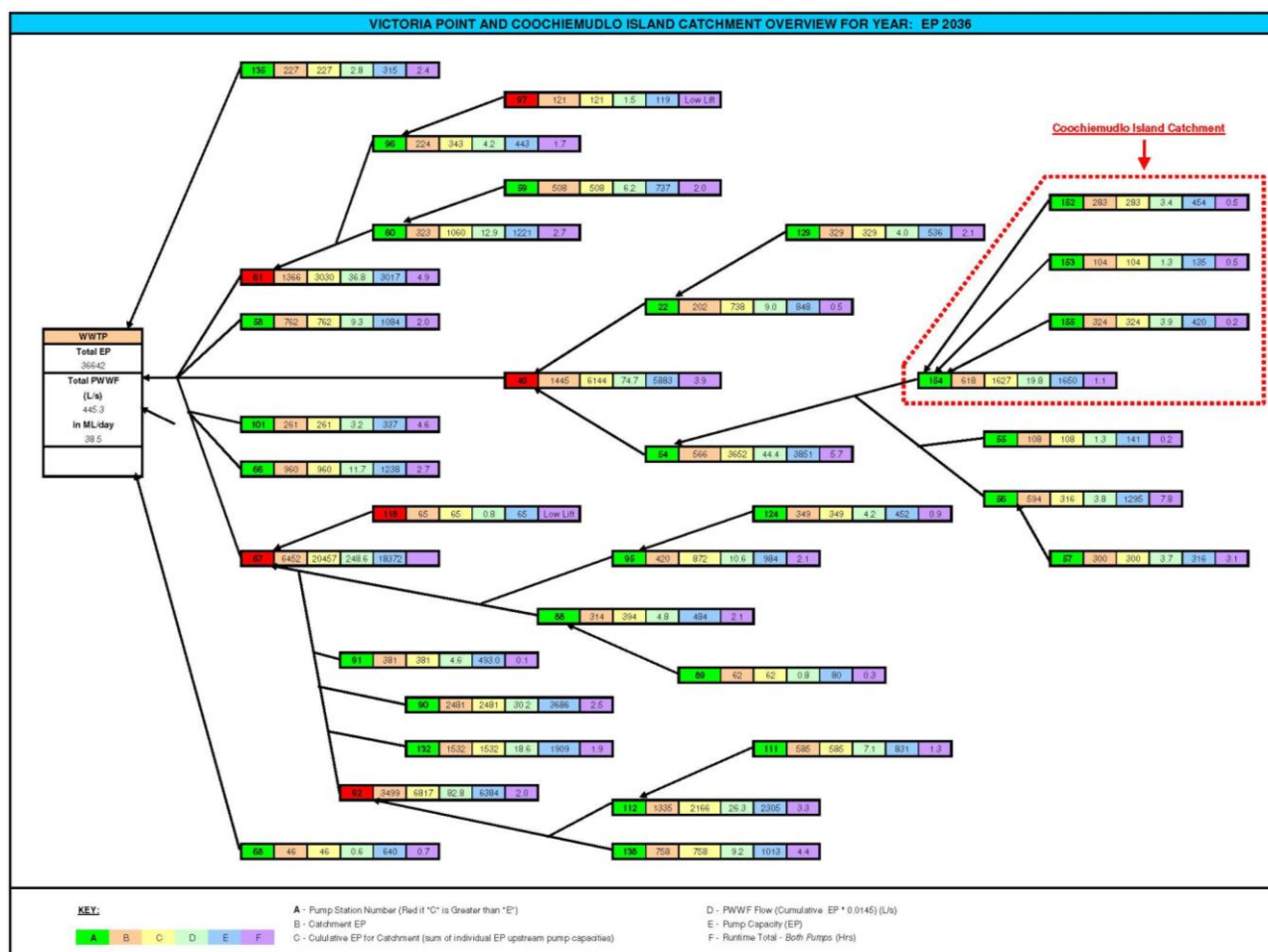
Elevation Range	% of Catchment
• 40mAHD to 60mAHD	7.3%
• 30mAHD to 40mAHD	40.8%
• 20mAHD to 30mAHD	34.3%
• 10mAHD to 20mAHD	13.7%
• 2mAHD to 10mAHD	3.9%

The majority of the developed catchment is above 3 mAHD, which enables the majority of the network to transfer loads via a gravity network. The existing pump stations transfer the loads from the low lying areas through to Victoria Point WWTP.

The catchment is serviced by a total of 34 Sewer Pump Stations (SPS) with the majority of the load passing through SPS67 – Fir Street. SPS67 services the sub catchments to the south of Moogurrapum Creek which contributes a total of 43% of the catchment flows. Pump station SPS49 – Simon Street transfers flows from Coochiemudlo Island and sub catchments from the east, this arrangement contributes an additional 14% of the catchment flows. The remaining pump stations are located in the north of the catchment and transfer flows to the Victoria Point WWTP, all flows directly entering the WWTP are transferred via a gravity network.

A schematic of the existing Victoria Point sewerage system and catchment loadings is shown below in Figure 4 – Victoria Point Catchment Overview:

Figure 4 – Victoria Point Catchment Overview



9.2 Sewerage Model

As detailed in Section 4, the hydraulic models were restructured and updated to undertake the Master Planning where required.

The Victoria Point sewerage system model has been maintained by Redland Water as an ongoing concern and only minimal updates were required to facilitate Master Planning.

9.3 Capacity of Existing System

Analysis of the existing sewerage catchment area capacity showed the existing trunk sewers in the Victoria Point catchment area have the capacity to contain PWWF events within the pipe. Existing deficiencies were minimal within the Catchment area, with surcharges identified around pump station SPS138.

9.3.1 Victoria Point Sewer Pump Station Hours of Operation

The SPS operating hours for the 34 pump stations located within the Victoria Point catchment area are detailed in Table 16 – Victoria Point SPS hours of operation:

Table 16 – Victoria Point SPS hours of operation

SPS No.	Street Address	Pump run hours / day	Pump starts / day
22	8 Link Road	0.51	41
49	Simon Street, Near Sharr Street	3.93	108
54	Adjacent to 4 Pelican Street	5.72	120
55	Reserve at end of Wilson Street	0.17	10
56	Adjacent to 8-10 Wilson Street	7.75	187
57	23A Wilson Esplanade	3.05	178
58	Adjacent to 13-15 Pt O'Halloran Road	2.01	74
59	Opposite 20 Mallet Street	2.03	43
60	Cnr Orana Street & Orana Esplanade	2.69	92
61	50 Orana Street	4.94	141
66	2 Robin Parade, Near Jordana Court	2.69	119
67	Reserve beside 66 Fir Street	4.83	82
68	East of Boundary Road, Near Roundabout	0.70	18
88	Opposite 39 Esplanade	2.07	36
89	Behind 2 Bay Street	0.30	8
90	46-72 Banana Street, Near Weinam Street	2.49	72
91	Opposite 2A Marine Street	0.12	4
92	7 Donald Road	2.00	123
95	33 Anita Street	2.09	67
96	10 Tiplers Street	1.68	37
97	24 Tiplers Street	Low Lift	Low Lift
101	16 Beachside Court	4.55	38
111	Opposite 8 Christopher Street	1.29	61
112	29 McWilliam Street	3.32	114
118	48 Prescoter Drive, Opposite Troon Court	Low Lift	Low Lift
124	1 Buggy Place	0.91	27
129	54 Fryar Street	2.13	48
132	18 Moores Road	1.87	52
135	64 Aspect Drive	2.37	234.43
138	Opposite 52 Penzance Drive	4.43	60
152	Victoria Parade, Northern Side	0.51	12
153	Victoria Parade, Eastern Side	0.51	52
154	Victoria Parade, Southern Side, Near Barge ramp	1.11	30
155	Victoria Parade, Western Side, Near Golf Course	0.25	11

9.4 Model Confirmation

To confirm the status of the hydraulic model configuration and pump station set-up a visual review of the model was undertaken against Council's latest corporate GIS to identify new infrastructure and asset details from the Pump Station audit incorporated. New infrastructure was imported into the hydraulic model where relevant.

A high level validation exercise was then completed, a comparison was made of flows derived from the hydraulic model against the GIS catchments for each pump station. This exercise sought to resolve misallocated demands on new infrastructure and capture planned diversions. The model was verified satisfactorily for each pump station catchment.

Similarly, modelled discharge to the wastewater treatment plant was compared with Infrastructure Demand Model outcomes to confirm PWWF calculations. Discharges to the WWTP achieved satisfactory correlation

9.5 Capacity of the Ultimate System (2036)

A capacity assessment of the sewerage system was extended through to the Ultimate (2036) planning horizon.

The assessment showed the Victoria Point network has the capacity to service the planned 2036 demands with minimal augmentations. The proposed augmentations have been identified in Figure 004, Appendix F.

Capacity constraints were identified where the sewerage system is surcharging. These commonly extend from the future proposed augmentations, in some cases pump operating levels may cause surcharge to some gravity network elements immediately upstream from the pump stations and so may not represent a material concern.

9.6 Required Augmentations

Future population growth is dispersed throughout the catchment with significant development proposed with the Clay West and Clay Gully Road LDA. The Clay Gully Road LDA is outside the LGIP boundary so has not been considered in this Master Planning. Augmentations within the Victoria Point sewerage system shown on Figure 004 – Appendix F.

To service the population growth in the catchment areas, future augmentations have been identified within the following catchment areas:

- Pump Station SPS138 and 68
- Gravity network of pump station SPS61 catchment
- Gravity network of pump station SPS67 catchment

9.6.1 SPS Catchment Areas

Augmentation of SPS138 is limited to mechanical and electrical equipment

Augmentation of SPS68 is limited to mechanical and electrical equipment

9.6.2 Gravity Network

Augmentations within the SPS61 gravity network are required to service future growth (FGM_VP_25 to FGM_VP_27).

Augmentations within the SPS67 gravity network are required to service future growth (FGM_VP_22 to FGM_VP_24).

9.7 Augmentation Timing

Timing of augmentations within the Victoria Point sewerage system are:

9.7.1 2016 Augmentations

The following augmentations were identified for the 2016 planning horizon:

- Pump Station SPS138

Table 17 – Victoria Point 2016 Augmentations below shows the augmentations proposed within the Victoria Point sewerage system. The model identification number (MUID) references the augmentations on Figure 004 – Appendix F

Table 17 – Victoria Point 2016 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
SPS138			\$ 95,250	2016

*Note: The model identification number (MUID) references the augmentations on Figure 004 – Appendix F.

9.7.2 2021 Augmentations

The following augmentations were identified for the 2021 planning horizon:

- DN450 / DN375 downstream of SPS67 discharge within the collection gravity network for Victoria Point WWTP.
- DN300 upstream collection gravity network for future replacement of SPS118 – Phase 1.

Table 18 – Victoria Point 2021 Augmentations below shows the augmentations proposed within the Victoria Point sewerage system. The model identification number (MUID) references the augmentations on Figure 004 – Appendix F

Table 18 – Victoria Point 2021 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_VP_22	450	40	\$36,677	2021
FGM_VP_23	450	35	\$22,375	2021
FGM_VP_24	375	150	\$147,020	2021

*Note: The model identification number (MUID) references the augmentations on Figure 004 – Appendix F.

9.7.3 2026 Augmentations

The following augmentations were identified for the 2026 planning horizon:

- Pump Station SPS68

Table 19 – Victoria Point 2026 Augmentations below shows the augmentations proposed within the Victoria Point sewerage system. The model identification number (MUID) references the augmentations on Figure 004 – Appendix F

Table 19 – Victoria Point 2026 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
SPS68			\$ 95,250	2026

*Note: The model identification number (MUID) references the augmentations on Figure 004 – Appendix F.

9.7.4 2031 Augmentations

No network augmentations were identified for the 2031 planning horizon.

9.7.5 2036 Augmentations

The following augmentations were identified for the 2036 planning horizon:

- DN250 / DN200 upstream collection gravity network at SPS61.

Table 20 – Victoria Point 2036 Augmentations below shows the augmentations proposed within the Victoria Point sewerage system. The model identification number (MUID) references the augmentations on Figure 004 – Appendix F

Table 20 – Victoria Point 2036 Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_VP_25	200	15	\$3,855	2036
FGM_VP_26	200	10	\$11,887	2036
FGM_VP_27	250	5	\$1,531	2036

*Note: The model identification number (MUID) references the augmentations on Figure 004 – Appendix F.

10. Mount Cotton

10.1 Catchment Overview

The Mount Cotton catchment is approximately 2.7km wide and 3.5km long, the catchment covers an area of nearly 685 Ha. The elevations in the catchment vary from 50 mAHD in the north east to 8 mAHD in the south. Development in the catchment is restricted between the surrounding major roads as the centre ridge is 65 mAHD and the northern ridge 78 mAHD. The Mount Cotton catchment contains the Mount Cotton suburb which slopes outwards from the central crest. All flows drain towards the lowest points of the catchment located in the southern and eastern areas of the catchment. Figure 005 in Appendix F provides an overview of the catchment area and shows the location of the existing infrastructure and proposed augmentations from the hydraulic modelling completed for the LGIP project.

The Mount Cotton sub catchments in the north-west are park residential. The majority of the development surrounds the central ridge of the catchment area, with future growth planned throughout the catchment area.

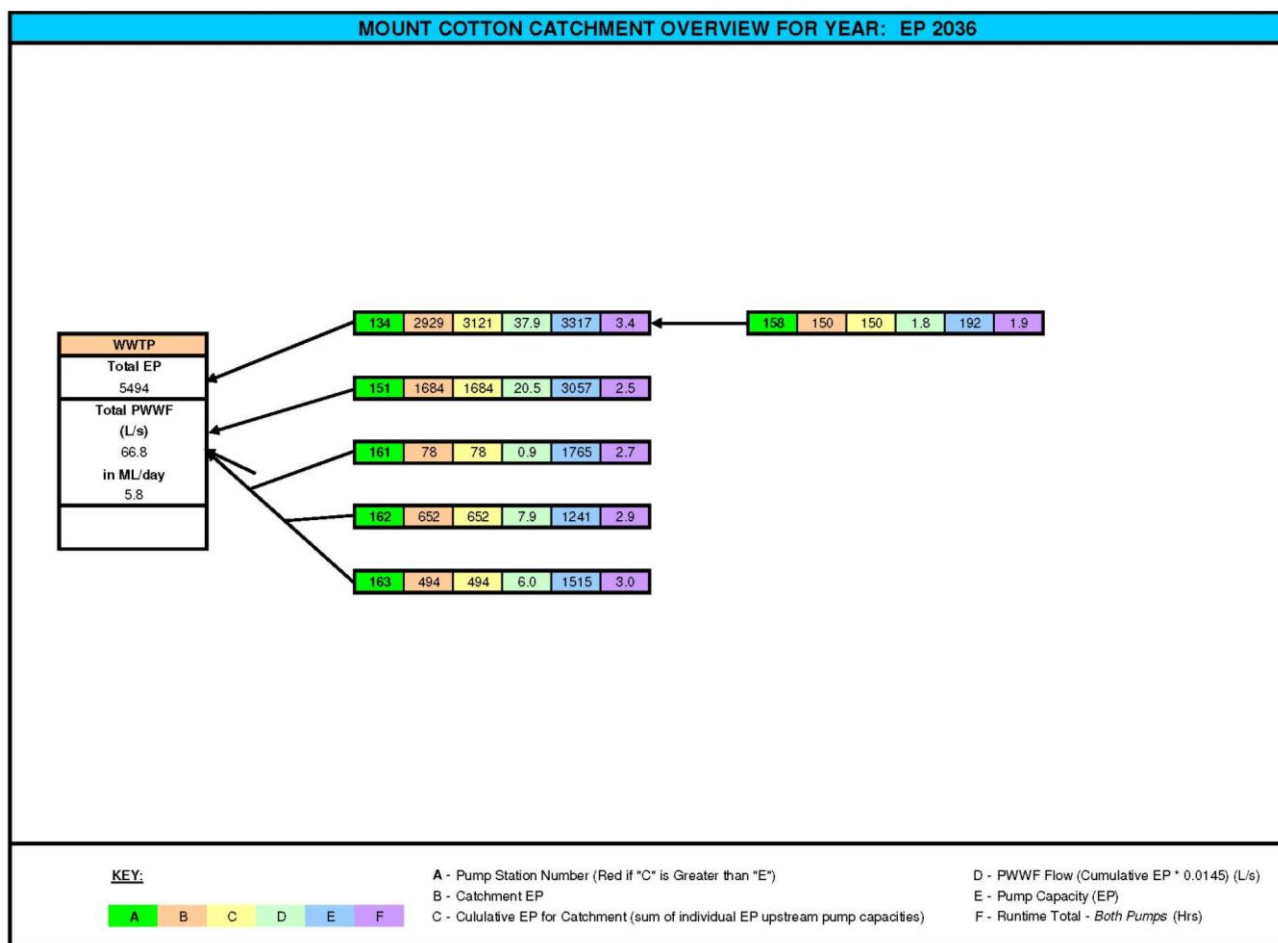
The Mount Cotton Wastewater Treatment Plant (WWTP) is located in the east of the catchment on German Road. The ground level at the WWTP is approximately 21.1 mAHD. The range of ground elevations in the catchment varies as shown below:

Elevation Range	% of Catchment
• 50mAHD to 60mAHD	0.0%
• 40mAHD to 50mAHD	6.7%
• 30mAHD to 40mAHD	34.9%
• 21mAHD to 30mAHD	41.8%
• 0mAHD to 21mAHD	16.5%

The majority of the catchment is above 21 mAHD of the WWTP. Existing pump stations transfer the loads from the low lying areas in the south and east of the catchment.

The catchment is serviced by 6 sewer pump stations (SPS) and transfer flows to the Mount Cotton WWTP, all flows directly entering the WWTP are transferred via a pressure main network. A schematic of the existing Mount Cotton sewerage system and catchment loadings is shown below in Figure 5:

Figure 5 – Mt Cotton Catchment Overview



10.2 Sewerage Model

As detailed in Section 4, the hydraulic models were restructured and updated to undertake the Master Planning where required.

The Mount Cotton sewerage system model has been maintained by Redland Water, only minimal updates were required to facilitate Master Planning.

10.3 Capacity of Existing System

Analysis of the existing sewerage catchment area capacity showed the existing trunk sewers in the Mount Cotton catchment area have the capacity to contain PWWF events within the pipe. Existing deficiencies were identified in the SPS134 rising main network.

10.3.1 Mount Cotton Sewer Pump Station Hours of Operation

The SPS operating hours for the 6 pump stations located within the Mount Cotton catchment area are detailed in Table 21 – Mount Cotton SPS hours of operation:

Table 21 – Mount Cotton SPS hours of operation

SPS No.	Street Address	Pump run hours / day	Pump starts / day
134	off the Eastern end of Hardwood Drive	3.41	78
151	354 German Church Road	2.54	49
158	2 - 8 Paperback Street	1.86	10
161	167 - 183 Hardwood Drive, Opposite 16 Bunya Pine Place	2.68	19
162	32 - 58 Sugargum Avenue	2.89	23
163	Golden Wattle Avenue	2.96	12

10.4 Model Confirmation

To confirm the status of the hydraulic model configuration and pump station set-up a visual review of the model was undertaken against Council's latest corporate GIS to identify new infrastructure and asset details from the Pump Station audit incorporated. New infrastructure was imported into the hydraulic model where relevant.

A high level validation exercise was then completed, a comparison was made of flows derived from the hydraulic model against the GIS catchments for each pump station. This exercise sought to resolve misallocated demands on new infrastructure and capture planned diversions. The model was verified satisfactorily for each pump station catchment.

Similarly, modelled discharge to the wastewater treatment plant was compared with Infrastructure Demand Model outcomes to confirm PWWF calculations. Discharges to the WWTP achieved satisfactory correlation

10.5 Capacity of the Ultimate System (2036)

A capacity assessment of the sewerage system was extended through to the 2036 planning horizon.

The assessment showed the Mount Cotton network has the capacity to service the planned 2036 demands with minimal augmentations. The proposed augmentations have been identified in Figure 005 - Appendix F.

10.6 Required Augmentations

Future population growth is dispersed throughout the catchment. Augmentations within the Mount Cotton sewerage system shown on Figure 005 – Appendix F

To service the population growth in the catchment areas, future augmentations have been identified within the following catchment areas:

Rising Main connection from pump station SPS134 through to Mount Cotton WWTP.

10.6.1 SPS Catchment Areas

Augmentation of the upstream rising main from SPS134 to Mount Cotton WWTP.

10.6.2 Gravity Network

No augmentations were identified within the Mount Cotton gravity network.

10.7 Augmentation Timing

Timing of augmentations within the Mount Cotton sewerage system are:

10.7.1 2016 Augmentations

No network augmentations were identified for the 2016 planning horizon

10.7.2 2021 Augmentations

The following augmentations were identified for the 2021 planning horizon:

- Rising Main connection from pump station SPS134 through to Mount Cotton WWTP (FRM_MC_01 - FRM_MC_04).

Table 22 – Mount Cotton 2021 Augmentations below shows the augmentations proposed within the Mount Cotton sewerage system. The model identification number (MUID) references the augmentations on Figure 005 – Appendix F

Table 22 – Mount Cotton 2021 Augmentations

MUID	Diameter (mm)	Length (m)	Amount	Year
FRM_MC_01	225	92	\$27,571	2016
FRM_MC_02	225	240	\$72,317	2016
FRM_MC_03	225	720	\$216,950	2016
FRM_MC_04	225	130	\$34,788	2016

*Note: The model identification number (MUID) references the augmentations on Figure 005 – Appendix F.

10.7.3 2026 Augmentations

No network augmentations were identified for the 2026 planning horizon

10.7.4 2031 Augmentations

No network augmentations were identified for the 2031 planning horizon

10.7.5 2036 Augmentations

No network augmentations were identified for the 2036 planning horizon

11. Dunwich

11.1 Catchment Overview

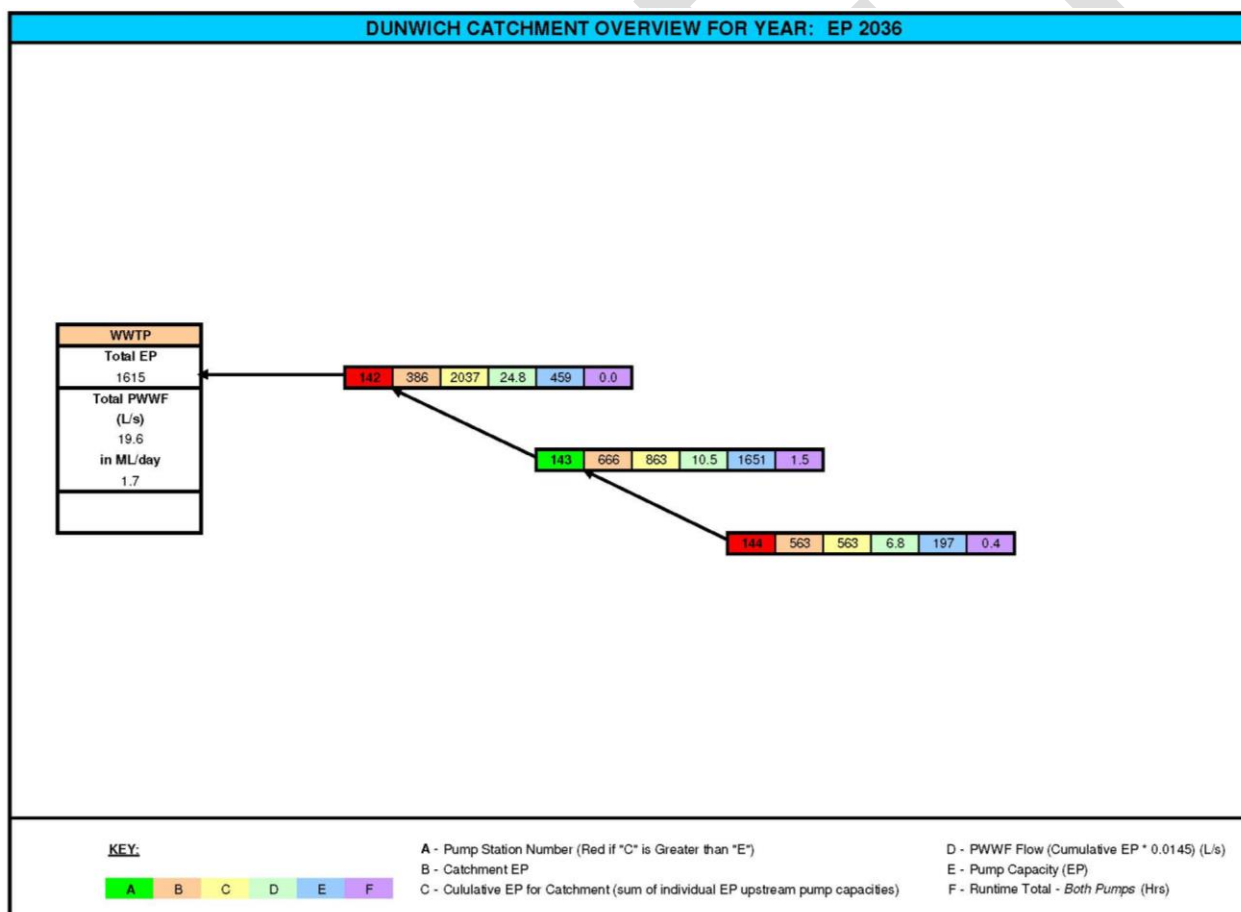
The Dunwich catchment contains the Dunwich suburb which slopes outwards from the central crest. All flows drain towards the lowest points of the catchment located in the south-east of the catchment. Figure 006 - Appendix F provides an overview of the catchment area and shows the location of the existing infrastructure.

Redland Water have recently completed approximately \$4.2M worth of infrastructure upgrades to the existing catchment area. It is intended with these augmentations to the sewerage system will allow the existing properties to connect to the sewer network.

It is understood a couple of external planning projects are currently in progress, the first study is to determine the validity of a pressurised system along Cherry Lane, this proposed upgrade is to service the indigenous area. A second study is looking to validate an extension of the existing sewerage system beyond the existing Redland Water depot on One Mile Hill.

A schematic of the existing Dunwich sewerage system and catchment loadings is shown below in Figure 6 – Dunwich Catchment Overview:

Figure 6 – Dunwich Catchment Overview



11.2 Sewerage Model

No hydraulic model was developed for the Dunwich WWTP sewerage system.

11.3 Capacity of Existing System

The Dunwich service area has recently received approximately \$4.2M worth of infrastructure augmentations, these augmentation have been sized to service the existing and future sewerage demands.

11.3.1 Dunwich Sewer Pump Station Hours of Operation

The SPS hours for the 4 pump stations located within the Dunwich catchment area are detailed in Table 23 – Dunwich SPS hours of operation:

Table 23 – Dunwich SPS hours of operation

SPS No.	Street Address	Pump run hours / day	Pump starts / day
142	Ballow Road	Dunwich WWTP	Dunwich WWTP
143	Flinders Avenue	1.53	66
144	East Coast Road	0.44	10
159	Lang Lane (Owned by mining company)	Private	Private

11.4 Model Confirmation

No hydraulic model was developed for the Dunwich WWTP sewerage system. System augmentations recently completed were calculated on a hydraulic spreadsheet.

11.5 Capacity of the Ultimate System (2036)

A capacity assessment of the sewerage system was extended through to the 2036 planning horizon.

The assessment showed the Dunwich network has the capacity to service the planned 2036 demands with the infrastructure augmentations recently completed.

11.6 Required Augmentations

No augmentations have been identified to service the existing or future planning horizons for the Dunwich sewerage system.

11.7 Augmentation Timing

Not applicable for the Dunwich sewerage system.

12. Point Lookout

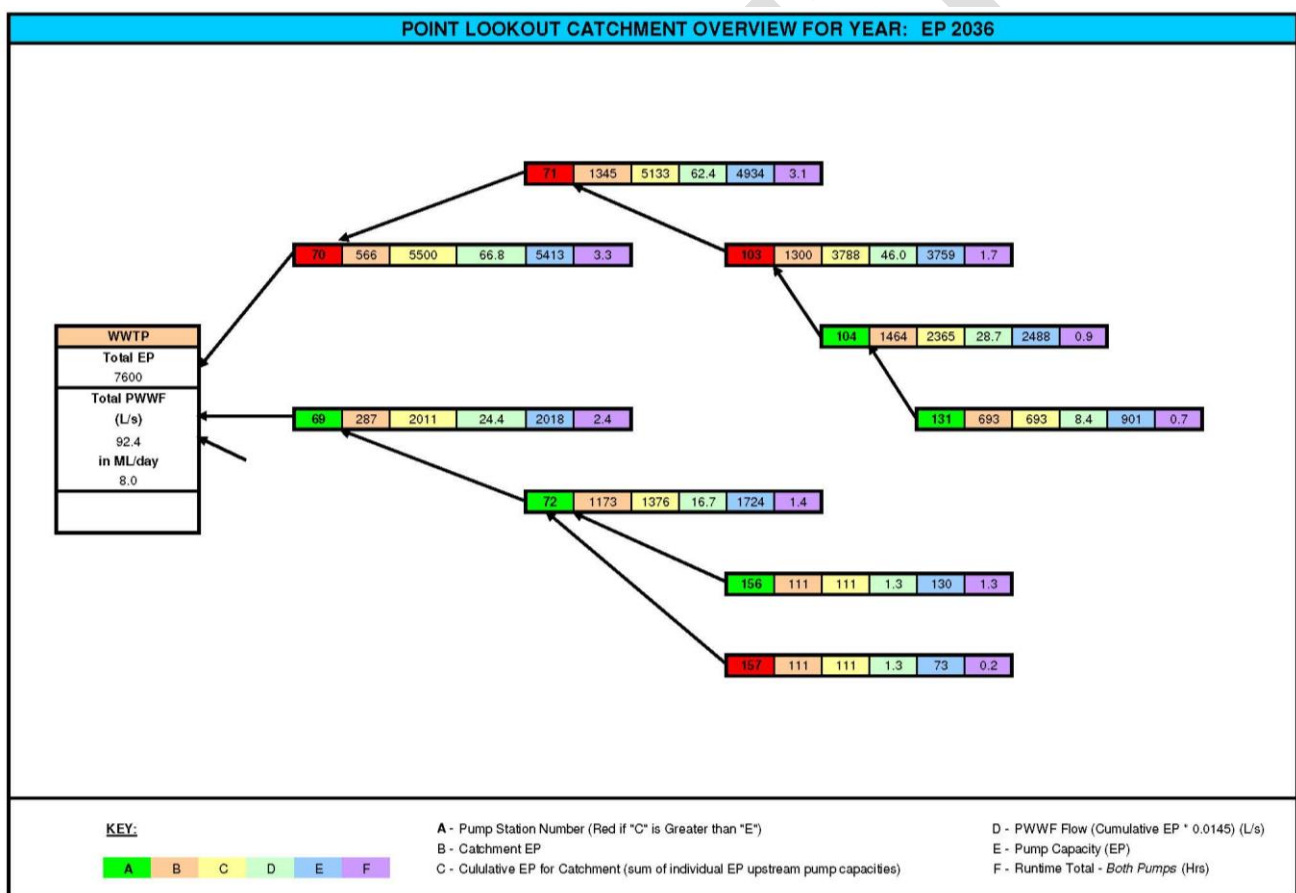
12.1 Catchment Overview

The Point Lookout catchment contains the Point Lookout suburb which slopes outwards from the central crest. All flows drain towards the lowest points of the catchment located in the south of the catchment where the WWTP is located.

Figure 007 in Appendix F provides an overview of the catchment area and shows the location of the existing infrastructure.

A schematic of the existing Point Lookout sewerage system and catchment loadings is shown below in Figure 7 – Point Lookout Catchment Overview:

Figure 7 – Point Lookout Catchment Overview



12.2 Sewerage Model

No hydraulic model was developed for the Point Lookout WWTP sewerage system.

12.3 Capacity of Existing System

Analysis of the existing sewerage catchment area capacity showed the existing trunk sewers in the Point Lookout catchment area have the capacity to contain PWWF events within the pipe

12.3.1 Point Lookout Sewer Pump Station Hours of Operation

The SPS operating hours for the 9 pump stations located within the Point Lookout catchment area are detailed in Table 24 – Point Lookout SPS hours of operation:

Table 24 – Point Lookout SPS hours of operation

SPS No.	Street Address	Pump run hours / day	Pump starts / day
69	Reserve behind 71 Tramican Street	2.35	75
70	End of Roseby Court	3.31	92
71	George Nothling Drive, Near Mooloomba Road	3.07	94
72	Adjacent to 85 Dickson Way	1.39	50
103	Adjacent to Cylinder Beach Caravan park	1.71	71
104	Southern end of Bimba Street	0.91	44
131	Kennedy Drive, near SLSC	0.72	24
156	Adder Rock Caravan Park	1.32	55
157	Adder Rock Caravan Park	0.22	14

12.4 Model Confirmation

No hydraulic model was developed for the Point Lookout WWTP sewerage system. System augmentations were calculated on a hydraulic spreadsheet.

12.5 Capacity of the Ultimate System (2036)

A capacity assessment of the sewerage system was extended through to the 2036 planning horizon.

12.6 Required Augmentations

Future population growth is dispersed throughout the catchment. Augmentations within the Point Lookout sewerage system shown on Figure 007 – Appendix F

To service the population growth in the catchment areas, future augmentations have been identified within the following catchment areas:

- Pump Station SPS69
- Pump Station SPS70
- Pump Station SPS71 and the associated rising main upstream and downstream gravity network
- Pump Station SPS72 and the associated downstream gravity network
- Pump Station SPS103

12.6.1 SPS Catchment Areas

Augmentation of a rising main from SPS71 through to the Point Lookout WWTP (FRM_PT_01).

Augmentation of SPS69 is limited to mechanical and electrical equipment

Augmentation of SPS70 is limited to mechanical and electrical equipment

Augmentation of SPS71 including new well, mechanical and electrical equipment

Augmentation of SPS72 is limited to mechanical and electrical equipment

Augmentation of SPS103 is limited to mechanical and electrical equipment

12.6.2 Gravity Network

Significant augmentations within the SPS71 downstream gravity network are required to service future growth (See Appendix F).

Significant augmentations of the SPS72 downstream gravity network are required to service future growth in the catchment area (See Appendix F).

12.7 Augmentation Timing

Timing of augmentations within the Point Lookout sewerage system are:

12.7.1 2016 Augmentations

The following augmentations were identified for the 2016 planning horizon:

- DN150 / DN225 gravity main augmentations

Table 25 – 2016 Point Lookout Augmentations below shows the augmentations proposed within the Point Lookout sewerage system. The model identification number (MUID) references the augmentations on Figure 007 – Appendix F

Table 25 – 2016 Point Lookout Augmentations

MUID*	Diameter (mm)	Length (m)	Amount	Year
FGM_PT_01	225	271.0	\$ 381,896	2016
FGM_PT_02	225	400.0	\$ 591,335	2016
FGM_PT_03	225	90.0	\$ 135,953	2016
FGM_PT_04	150	104.0	\$ 432,912	2016
FGM_PT_05	150	65.0	\$ 68,879	2016
FGM_PT_06	150	116.0	\$ 131,224	2016
FGM_PT_07	150	195.0	\$ 213,467	2016
FGM_PT_08	150	271.0	\$ 320,168	2016
FGM_PT_09	150	114.0	\$ 122,484	2016
FGM_PT_10	150	131.0	\$ 138,712	2016
FGM_PT_11	150	209.0	\$ 240,492	2016

*Note: The model identification number (MUID) references the augmentations on Figure 007 – Appendix F.

12.7.2 2021 Augmentation

No network augmentations were identified for the 2021 planning horizon.

12.7.3 2026 Augmentations

The following augmentations were identified for the 2026 planning horizon:

- DN300 rising main connection from pump station SPS71 through to Point Lookout WWTP.
- Pump Station SPS69
- Pump Station SPS70
- Pump Station SPS71
- Pump Station SPS72

Table 26 – 2026 Point Lookout Augmentations below shows the augmentations proposed within the Point Lookout sewerage system. The model identification number (MUID) references the augmentations on Figure 007 – Appendix F

Table 26 – 2026 Point Lookout Augmentations

MUID*	Diameter	Amount	Year
Rising Main	300	\$ 2,863,000	2023
SPS69		\$50,000	2023
SPS70		\$50,000	2023
SPS71		\$4,380,000	2023
SPS72		\$50,000	2023

*Note: The model identification number (MUID) references the augmentations on Figure 007 – Appendix F.

12.7.4 2031 Augmentations

No network augmentations were identified for the 2031 planning horizon.

12.7.5 2036 Augmentations

The following augmentations were identified for the 2036 planning horizon:

- Pump Station SPS103

Table 27 – 2036 Point Lookout Augmentations below shows the augmentations proposed within the Point Lookout sewerage system. The model identification number (MUID) references the augmentations on Figure 007 – Appendix F

Table 27 – 2036 Point Lookout Augmentations

MUID*	Diameter	Amount	Year
SPS103		\$50,000	2036

*Note: The model identification number (MUID) references the augmentations on Figure 007 – Appendix F.

13. Cost Estimates

13.1 Methodology

The cost of trunk infrastructure was calculated based on unit rates included in the Redland City Council, *Redland Water Assets Revaluation 2012, Underground Assets* (GHD, June 2013). The report includes a base cost and then additional adjustment factors depending on estimates of local site conditions. The methodology and assumptions associated with these adjustment factors are described below.

13.1.1 Base Year for Costs

The rates provided in the Redland City Council, *Redland Water Assets Revaluation 2012, Underground Assets*, are provided in 1 July 2012 dollars.

13.1.2 Base Rates (for pipelines)

All the base rates for pipelines are exclusive of overheads and other adjustment factors. It has been assumed that, all pipes will be replaced with a standard pipe diameter (modern engineering equivalent) and the work packaged with other works, so the non-standard diameter and short-pipe length adjustment factors have not been used.

13.1.3 Pipe Depth Adjustment Factor (for pipelines & manholes)

The following depth ranges have been assumed for pipelines:

- 0 to 1.5m deep
- 1.5m to 3.0m deep
- 3.0m to 4.5m deep ; and
- Greater than 4.5m deep

The following depth ranges have been assumed for manholes:

- 0 to 1.5m deep
- 1.5m to 2.0m deep
- 2.0m to 3.0m deep
- 3.0m to 4.0m deep
- 4.0m to 5.0m deep
- 5.0m to 6.0m deep

Manhole diameters costed include 1,050mm diameter, 1,200mm diameter and 1,500mm diameter.

13.1.4 Soil Type Adjustment Factor (for pipelines)

The adopted soil type has been calculated with Councils corporate GIS utilising the GEO_GLS_SOI_VALUATIONTYPE_FC feature class. The soil type has been allocated based on the spatial location in GIS with each pipe being given the attribute of the polygon that is closest to it.

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13.1.5 Development Density of site (for pipelines)

The development density was determined using the GIS layer *rsc.GISSU.CUL_URB_PLN_RPSZONEBDYS_P* which was converted to the *ZoningRPS7_Dissolve* layer. This layer included the adopted densities shown in Table 28 – Adopted Density. Each pipe was then given the attribute of the polygon closest to it.

Table 28 – Adopted Density

Planning Scheme Zone	Adopted Density
Commercial Industry	CBD
Community Purposes	Urban
Conservation	Rural
District Centre	Urban
Emerging Urban Community	HDU
Environmental Protection	Rural
General Industry	Urban
Investigation Zone	Rural
Island Industry	Islands
Local Centre	CBD
Low Density Residential	Urban
Major Centre	CBD
Marine Activity	Rural
Medium Density Residential	Urban
Neighbourhood Centre	Urban
Open Space	Rural
Park Residential	Urban
Point Lookout Centre	Islands
Point Lookout Residential	Islands
Point Lookout Tourist	Islands
Rural Non-Urban	Rural
SMBI Centre	Islands
SMBI Residential	Islands
Unzoned	Rural
Urban Residential	HDU

13.1.6 Submarine Adjustment Factor (for pipelines)

There are no submarine pipelines included in this report.

13.1.7 Island Adjustment Factor

The adjustments factors made for Pipes and assets in the sewer network are shown in Table 29.

13.1.8 Pipes

Redland Water also operates water supply networks on the Southern Moreton Bay Islands and North Stradbroke Island. Specific adjustment factors have been determined for constructing mains on these islands to take into account the extra costs for mobilising labour, plant and materials to site. The original planning report and its addendum for the inclusion of the Southern Moreton Bay Islands in the scheme have been reviewed to identify the costs for the construction of mains on islands. The factors used in this costing exercise are the same as those used in the 2013 asset revaluation and are shown below in Table 29 – Island Adjustment Factors. The island construction factor is applied in addition to the other adjustment factors detailed above.

Table 29 – Island Adjustment Factors

Pipe Diameter*(mm)	Island Adjustment Factor*
20	1.2164
25	1.2184
30	1.2204
35	1.2224
40	1.2244
70	1.2364
60	1.2324
80	1.2404
100	1.2484
150	1.2684
200	1.2884
225	1.2984
250	1.3084
300	1.3284
350	1.3484
375	1.3584
450	1.3884
500	1.4084
550	1.4284
575	1.4384
600	1.4484
675	1.4784
750	1.5084
900	1.5684

13.1.8.1 Other Infrastructure (pump stations)

For other infrastructure constructed on the islands, a single adjustment factor has been used in addition to the other adjustment factors detailed above. This adjustment factor has been determined by averaging the factors determined from the actual island construction costs only (i.e. not over the whole range of pipe diameters). The adopted island factor is 1.4.

13.1.9 Adjustment for Subsidies

There has been no adjustment for subsidies in this report.

13.1.10 Risk Management Contingency Allowance

In accordance with previous Master Planning cost estimates, an allowance of 20% for existing infrastructure and 30% for future infrastructure has been applied for risk management contingency. These values were previously used in our infrastructure charges calculations. Note, in our renewal estimates (prepared by GHD following the 2013 asset revaluation) a further 20% factor is applied to manage costs associated with replacing existing infrastructure in urban environments.

13.1.11 Administrative Allowance

An administrative allowance of 15% for items such as survey, planning, design, supervision and contract administration has also been adopted as per the 2013 asset revaluation.

13.1.12 Discounting and Administration Fee

For the final determination of the infrastructure charges, the infrastructure establishment costs have been discounted in accordance with the Redland City Council discounting methodology. Full details of this can be found in the RPS PIP document.

13.2 Summary of Costs

13.2.1 Infrastructure Charges Costs

No infrastructure charges costs identified in this report.

13.2.2 Augmentation Costs

The Augmentation Costs identified in this report are summarised in Table 30 – Future Augmentation Costs

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Table 30 – Future Augmentation Costs

Catchment Area	Augmentation	MUID*	Diameter	Length	Total Cost	Planning Horizon (Year)				
			(mm)	(m)	(\$)	2016	2021	2026	2031	2036
Capalaba	Gravity	FGM_CA_03	225	10	\$10,506	\$10,506				
Capalaba	Gravity	FGM_CA_04	225	80	\$29,286	\$29,286				
Capalaba	Gravity	FGM_CA_01	300	70	\$28,760					\$28,760
Capalaba	Gravity	FGM_CA_02	300	75	\$32,149					\$32,149
Capalaba	Gravity	FGM_CA_05	300	4	\$1,536					\$1,536
Capalaba	Gravity	FGM_CA_06	225	50	\$29,017					\$29,017
Capalaba	Gravity	FGM_CA_07	150	60	\$24,938					\$24,938
Capalaba	Gravity	FGM_CA_08	150	190	\$92,629					\$92,629
Capalaba	Gravity	FGM_CA_09	300	50	\$35,463					\$35,463
Capalaba	Gravity	FGM_CA_10	300	80	\$80,828					\$80,828
Capalaba	Gravity	FGM_CA_11	150	150	\$49,294					\$49,294
Capalaba	Gravity	FGM_CA_12	225	185	\$84,226					\$84,226
Capalaba	Pump Station	SPS 25			\$95,250					\$95,250
Capalaba	Pump Station	SPS 53			\$63,250					\$63,250
Capalaba	Pump Station	SPS 65			\$95,250					\$95,250
Cleveland	Gravity	FGM_CL_03	300	200	\$95,303	\$95,303				
Cleveland	Gravity	FGM_CL_04	300	410	\$272,490	\$272,490				
Cleveland	Gravity	FGM_CL_07	300	155	\$87,338	\$87,338				
Cleveland	Gravity	FGM_CL_10	150	60	\$20,160	\$20,160				
Cleveland	Gravity	FGM_CL_11	150	45	\$18,986	\$18,986				
Cleveland	Gravity	FGM_CL_12	150	75	\$15,566	\$15,566				
Cleveland	Gravity	FGM_CL_13	150	50	\$21,437	\$21,437				
Cleveland	Pump Station	SPS12			\$91,000	\$91,000				

Catchment Area	Augmentation	MUID*	Diameter	Length	Total Cost	Planning Horizon (Year)				
			(mm)	(m)	(%)	2016	2021	2026	2031	2036
Cleveland	Gravity	FGM_CL_08	150	105	\$53,865			\$53,865		
Cleveland	Gravity	FGM_CL_14	225	180	\$120,126			\$120,126		
Cleveland	Gravity	FGM_CL_01	375	135	\$98,053					\$98,053
Cleveland	Gravity	FGM_CL_02	375	170	\$148,225					\$148,225
Cleveland	Gravity	FGM_CL_05	225	6	\$2,392					\$2,392
Cleveland	Gravity	FGM_CL_06	225	150	\$54,768					\$54,768
Cleveland	Gravity	FGM_CL_09	150	25	\$16,908					\$16,908
Cleveland	Rising	FRM_CL_01	150	40	\$9,322					\$9,322
Cleveland	Pump Station	SPS100			\$138,500					\$138,500
Thorneside	Gravity	FGM_TH_01	675	10	\$30,715	\$30,715				
Thorneside	Gravity	FGM_TH_02	525	80	\$95,578	\$95,578				
Thorneside	Rising	FRM_TH_01	450	550	\$277,378	\$277,378				
Thorneside	Rising	FRM_TH_02	200	15	\$3,244	\$3,244				
Thorneside	Rising	FRM_TH_03	300	5	\$2,051	\$2,051				
Thorneside	Pump Station	SPS35 (Inc. new WW)			\$2,200,000	\$2,200,000				
Thorneside	Gravity	FGM_TH_03	525	130	\$130,934					\$130,934
Thorneside	Pump Station	SPS33			\$443,240					\$443,240
Thorneside	Pump Station	SPS42			\$123,500					\$123,500
Victoria Point	Pump Station	SPS138			\$95,250	\$95,250				
Victoria Point	Pump Station	SPS68			\$95,250			\$95,250		
Victoria Point	Gravity	FGM_VP_22	450	40	\$36,677		\$36,677			
Victoria Point	Gravity	FGM_VP_23	450	35	\$22,375		\$22,375			
Victoria Point	Gravity	FGM_VP_24	375	150	\$147,020		\$147,020			
Victoria Point	Gravity	FGM_VP_25	200	15	\$3,855					\$3,855
Victoria Point	Gravity	FGM_VP_26	200	10	\$11,887					\$11,887

Catchment Area	Augmentation	MUID*	Diameter	Length	Total Cost	Planning Horizon (Year)				
			(mm)	(m)	(%)	2016	2021	2026	2031	2036
Victoria Point	Gravity	FGM_VP_27	250	5	\$1,531					\$1,531
Mount Cotton	Rising	FRM_MC_01	225	92	\$27,571		\$27,571			
Mount Cotton	Rising	FRM_MC_02	225	240	\$72,317		\$72,317			
Mount Cotton	Rising	FRM_MC_03	225	720	\$216,950		\$216,950			
Mount Cotton	Rising	FRM_MC_04	225	130	\$34,788		\$34,788			
Point Lookout	Gravity	FGM_PT_01	225	271.0	\$381,896	\$381,896				
Point Lookout	Gravity	FGM_PT_02	225	400.0	\$591,335	\$591,335				
Point Lookout	Gravity	FGM_PT_03	225	90.0	\$135,953	\$135,953				
Point Lookout	Gravity	FGM_PT_04	150	104.0	\$432,912	\$432,912				
Point Lookout	Gravity	FGM_PT_05	150	65.0	\$68,879	\$68,879				
Point Lookout	Gravity	FGM_PT_06	150	116.0	\$131,224	\$131,224				
Point Lookout	Gravity	FGM_PT_07	150	195.0	\$213,467	\$213,467				
Point Lookout	Gravity	FGM_PT_08	150	271.0	\$320,168	\$320,168				
Point Lookout	Gravity	FGM_PT_09	150	114.0	\$122,484	\$122,484				
Point Lookout	Gravity	FGM_PT_10	150	131.0	\$138,712	\$138,712				
Point Lookout	Gravity	FGM_PT_11	150	209.0	\$240,492	\$240,492				
Point Lookout	Rising Main	FRM_PT_01	300	1570	\$2,863,000			\$2,863,000		
Point Lookout	Pump Station	SPS69			\$50,000			\$50,000		
Point Lookout	Pump Station	SPS70			\$50,000			\$50,000		
Point Lookout	Pump Station	SPS71			\$4,380,000			\$4,380,000		
Point Lookout	Pump Station	SPS72			\$50,000			\$50,000		
Point Lookout	Pump Station	SPS103			\$50,000					\$50,000

Table 31 – Consolidated Future Augmentation costs

Catchment Area	Total Cost	Planning Horizon (Year)				
	(%)	2016	2021	2026	2031	2036
Capalaba	\$752,382	\$39,792	\$0	\$0	\$0	\$712,590
Cleveland	\$1,264,439	\$622,280	\$0	\$173,991	\$0	\$468,168
Thorneside	\$3,306,640	\$2,608,966	\$0	\$0	\$0	\$697,674
Victoria Point	\$413,845	\$95,250	\$206,072	\$95,250	\$0	\$17,273
Mount Cotton	\$351,626	\$0	\$351,626	\$0	\$0	\$0
Point Lookout	\$10,220,522	\$2,777,522	\$0	\$7,393,000	\$0	\$50,000
Dunwich	\$0	\$0	\$0	\$0	\$0	\$0
Total	\$16,309,454	\$6,143,810	\$557,698	\$7,662,241	\$0	\$1,945,705

14. Conclusions and Recommendations

Based on the analysis of the Redland Water sewerage system analysis it is concluded that augmentations are required in the immediate timeframe (2016) to address existing deficiencies within the catchment area networks. It is recommended the augmentations proposed within this Master Planning Report are undertaken.

Summary of Findings and Conclusions

This 2016 Master Plan of the Redland Water sewerage system supersedes previous reporting, the results and network augmentations identified are intended to be submitted as part of the Redland City Council LGIP submission.

Significant expenditure has been identified across the planning horizons with the majority of the spend identified in the Point Lookout catchment area, which is approximately 60% (\$10M) of the total network augmentation expenditure \$16M.

Analysis of the existing network has identified network augmentations required in all the catchment areas (except Dunwich) to address existing network deficiencies.

The Master Planning of the Redland Water Sewerage system has identified upgrades to a number of pump stations, these upgrades are predominately for electrical and mechanical components and represent an expenditure of approximately \$ 735,250 across ten sites. Major upgrades to SPS's have been identified at 5 sites, SPS35, SPS33, SPS42, SPS71 and SPS100 (> \$100,000 expenditure required at the sites). The major SPS upgrades are in the Thorneside, Cleveland and Point Lookout catchment areas.

Upgrades within the gravity network is dispersed with most associated with the network pump upgrades.

Upgrades within the rising main network are in the Thorneside and Point Lookout catchment area, this infrastructure is associated with the pump station upgrades (a minimal upgrade of the rising main network is required in the Cleveland catchment area).

14.1 Recommendations

It is recommended the findings of this Redland Water sewerage system Master Planning document be accepted:

- To adopt the infrastructure augmentations identified which are required for the 2016 Planning Horizon. It is recommended detailed planning be undertaken to confirm the findings of this document are still prevalent and the costing schedule is a reflection of the current costs in the marketplace.
- Adopt the infrastructure augmentations identified for the 2021 Planning Horizon.
- Adopt the infrastructure augmentations identified for the 2026 Planning Horizon.
- Adopt the infrastructure augmentations identified for the 2031 Planning Horizon.
- Adopt the infrastructure augmentations identified for the 2036 Planning Horizon.
- Review the development area status across the service area on a regular basis, this will allow Redland Water to understand the timing of development remains aligned with the planning horizons within this document.

15. References

Department of Natural Resources and Mines, *Planning Guidelines for Water Supply and Sewerage*, March 2005.

Cardno, *Cleveland Sewerage, Planning Report Version 1*, January 2009.

Cardno, *Preliminary Design of Pump Stations in Thorneside Catchment, Planning Report Version 1*, August 2009.

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Appendix A

Sewer Pump Station Numbers and Locations

Table 32 – Sewer Pump Station numbers and locations below details the Sewer Pump Station No. with its street address, suburb locality and associated Wastewater Treatment Plant.

Table 32 – Sewer Pump Station numbers and locations

SPS No.	Street Address	Suburb	Treatment Plant
1	Adjacent to 171 Shore Street	CLEVELAND	Cleveland WWTP
2	Middle Street, near Wharf Street	CLEVELAND	Cleveland WWTP
3	Princess Street, near Erobin Street	CLEVELAND	Cleveland WWTP
4	Middle Street, near Island Street	CLEVELAND	Cleveland WWTP
5	Cultural Centre, 2-16 Middle Street	CLEVELAND	Cleveland WWTP
6	Cleveland Showgrounds, 44 Smith Street	CLEVELAND	Cleveland WWTP
7	Decommissioned	Decommissioned	
8	McDonald Road, north of Flinders Street	ALEXANDRA HILLS	Cleveland WWTP
9	Cleveland WWTP Land - Flinders Street	ALEXANDRA HILLS	Cleveland WWTP
10	Decommissioned	Decommissioned	
11	65 Redland Bay Road	THORNLANDS	Cleveland WWTP
12	Adjacent to 1 Cleary Street	CLEVELAND	Cleveland WWTP
13	Shore Street East, near Cross Street	CLEVELAND	Cleveland WWTP
14	Shore St North, northern End	CLEVELAND	Cleveland WWTP
15	Decommissioned	Decommissioned	
16	4A Whitehall Avenue, Near Tingalpa Creek	BIRKDALE	Thorneside WWTP
17	Decommissioned	Decommissioned	
18	Decommissioned	Decommissioned	
19	Adjacent to 20 Ostend Court	CLEVELAND	Cleveland WWTP
20	Decommissioned	Decommissioned	
21	Cnr William Street & Crown Road	ALEXANDRA HILLS	Capalaba WWTP
22	8 Link Road	VICTORIA PT	Victoria Pt WWTP
23	36A Brewer Street	CAPALABA	Capalaba WWTP
24	164 Old Cleveland Road	CAPALABA	Capalaba WWTP
25	126 Old Cleveland Road	CAPALABA	Capalaba WWTP
26	30 Old Cleveland Road	CAPALABA	Capalaba WWTP
27	Decommissioned	Decommissioned	
28	1-29 St Andrews Avenue	BIRKDALE	Thorneside WWTP
29	Eva Street	THORNESIDE	Thorneside WWTP
30	Queens Esplanade, near Helen Street	THORNESIDE	Thorneside WWTP
31	Queens Esplanade, near Mark Street	THORNESIDE	Thorneside WWTP
32	Queens Esplanade, near Bates Drive	BIRKDALE	Thorneside WWTP
33	226 Birkdale Road	BIRKDALE	Thorneside WWTP
34	56 Thomas Street	BIRKDALE	Thorneside WWTP
35	347 Birkdale Road	BIRKDALE	Thorneside WWTP
36	Opposite Jellicoe Street, Main Road	WELLINGTON PT	Thorneside WWTP
37	Adjacent to 9-11 Acacia Street	WELLINGTON PT	Thorneside WWTP

SPS No.	Street Address	Suburb	Treatment Plant
38	Adjacent to 232 Main Road	WELLINGTON PT	Thorneside WWTP
39	122 Main Road	WELLINGTON PT	Thorneside WWTP
40	49 Main Road	WELLINGTON PT	Thorneside WWTP
41	38 Fernbourne Road	WELLINGTON PT	Thorneside WWTP
42	51 Hilliard Street	ORMISTON	Thorneside WWTP
43	Opposite 248 Wellington Street	ORMISTON	Thorneside WWTP
44	56A Glover Drive	ALEXANDRA HILLS	Capalaba WWTP
45	46-48 Troy Street	ORMISTON	Cleveland WWTP
46	Decommissioned	Decommissioned	
47	Frost Street, Near Spirit Drive	CAPALABA	Capalaba WWTP
48	Opposite 32 Victor Street	BIRKDALE	Thorneside WWTP
49	Simon Street, Near Sharr Street	VICTORIA PT	Victoria Pt WWTP
50	Decommissioned	Decommissioned	
51	Decommissioned	Decommissioned	
52	Easement beside 35 Counihan Street	ORMISTON	Thorneside WWTP
53	Cnr Noeleen Street and Morten Bay Road	CAPALABA	Capalaba WWTP
54	Adjacent to 4 Pelican Street	VICTORIA PT	Victoria Pt WWTP
55	Reserve at end of Wilson Street	VICTORIA PT	Victoria Pt WWTP
56	Adjacent to 8-10 Wilson Street	VICTORIA PT	Victoria Pt WWTP
57	23A Wilson Esplanade	VICTORIA PT	Victoria Pt WWTP
58	Adjacent to 13-15 Pt O'Halloran Road	VICTORIA PT	Victoria Pt WWTP
59	Opposite 20 Mallet Street	VICTORIA PT	Victoria Pt WWTP
60	Cnr Orana Street & Orana Esplanade	VICTORIA PT	Victoria Pt WWTP
61	50 Orana Street	VICTORIA PT	Victoria Pt WWTP
62	31-37 Killarney Crescent	CAPALABA	Capalaba WWTP
63	Decommissioned	Decommissioned	
64	Decommissioned	Decommissioned	
65	15 Pittwin Road North	CAPALABA	Capalaba WWTP
66	2 Robin Parade, near Jordana Court	VICTORIA PT	Victoria Pt WWTP
67	Reserve beside 66 Fir Street	VICTORIA PT	Victoria Pt WWTP
68	East of Boundary Road, near Roundabout	THORNLANDS	Victoria Pt WWTP
69	Reserve behind 71 Tramican Street	PT LOOKOUT	Pt Lookout WWTP
70	End of Roseby Court	PT LOOKOUT	Pt Lookout WWTP
71	George Northling Drive, near Mooloomba Road	PT LOOKOUT	Pt Lookout WWTP
72	Adjacent to 85 Dickson Way	PT LOOKOUT	Pt Lookout WWTP
73	Bowsprit Parade, opposite Bollard Street	CLEVELAND	Cleveland WWTP
74	Adjacent 2 Sentinel Court	CLEVELAND	Cleveland WWTP
75	44 Anchorage Drive	CLEVELAND	Cleveland WWTP
76	67-75 Dinwoodie Road (Private)	THORNLANDS	Cleveland WWTP
77	Decommissioned	Decommissioned	
78	Decommissioned	Decommissioned	
79	Decommissioned	Decommissioned	
80	Decommissioned	Decommissioned	
81	173 Redland Bay Road	THORNLANDS	Cleveland WWTP

SPS No.	Street Address	Suburb	Treatment Plant
82	Cricket grounds, 143 Fitzroy Street	CLEVELAND	Cleveland WWTP
83	Adjacent to 1 Ruth Street	BIRKDALE	Thorneside WWTP
84	1A Bath Street	BIRKDALE	Thorneside WWTP
85	Adjacent to 36 Makaha Drive	BIRKDALE	Thorneside WWTP
86	Cleveland WWTP land	CLEVELAND	Cleveland WWTP
87	Southern end of Passage Street	CLEVELAND	Cleveland WWTP
88	Opposite 39 Esplanade	REDLAND BAY	Victoria Pt WWTP
89	Behind 2 Bay Street	REDLAND BAY	Victoria Pt WWTP
90	46-72 Banana Street, near Weinam Street	REDLAND BAY	Victoria Pt WWTP
91	Opposite 2A Marine Street	REDLAND BAY	Victoria Pt WWTP
92	7 Donald Road	REDLAND BAY	Victoria Pt WWTP
93	Adjacent to 9 Catherine Street	BIRKDALE	Thorneside WWTP
94	Decommissioned	Decommissioned	
95	33 Anita Street	REDLAND BAY	Victoria Pt WWTP
96	10 Tipplers Street	VICTORIA PT	Victoria Pt WWTP
97	24 Tipplers Street	VICTORIA PT	Victoria Pt WWTP
98	22 Dorsal Drive	BIRKDALE	Thorneside WWTP
99	68 Dorsal Drive	BIRKDALE	Thorneside WWTP
100	Adjacent to 45 Albicore Drive	THORNLANDS	Cleveland WWTP
101	16 Beachside Court	VICTORIA PT	Victoria Pt WWTP
102	Decommissioned	Decommissioned	
103	Adjacent to Cylinder Beach Caravan park	PT LOOKOUT	Pt Lookout WWTP
104	Southern end of Bimba Street	PT LOOKOUT	Pt Lookout WWTP
105	Decommissioned	Decommissioned	
106	8 Esplanade	WELLINGTON PT	Thorneside WWTP
107	Adjacent to 2 Sentinel Court	CLEVELAND	Cleveland WWTP
108	Decommissioned	Decommissioned	
109	3 Keel Street	BIRKDALE	Thorneside WWTP
110	30 Downwind Court	BIRKDALE	Thorneside WWTP
111	Opposite 8 Christopher Street	REDLAND BAY	Victoria Pt WWTP
112	29 Mcwilliam Street	REDLAND BAY	Victoria Pt WWTP
113	Opposite 6 Sommersea Drive	CLEVELAND	Cleveland WWTP
114	24 Caravel Court	CLEVELAND	Cleveland WWTP
115	7 Mainsail Street	BIRKDALE	Thorneside WWTP
116	84 Sunshine Drive	CLEVELAND	Cleveland WWTP
117	Adjacent 1 Raby Bay Boulevard	CLEVELAND	Cleveland WWTP
118	48 Prescoter Drive, opposite Troon Court	VICTORIA PT	Victoria Pt WWTP
119	3-11 Sommersea Drive, opposite Martingale Drive	CLEVELAND	Cleveland WWTP
120	25 Piermont Place	CLEVELAND	Cleveland WWTP
121	Adjacent 21 Raby Bay Boulevard	CLEVELAND	Cleveland WWTP
122	48-58 Masthead Drive	CLEVELAND	Cleveland WWTP
123	End of easement between 72 and 76 Hanover Drive	ALEXANDRA HILLS	Cleveland WWTP
124	1 Buggy Place	REDLAND BAY	Victoria Pt WWTP
125	351-353 Mount Cotton Road	CAPALABA	Capalaba WWTP

SPS No.	Street Address	Suburb	Treatment Plant
126	190-262 Redland Bay Road	THORNLANDS	Cleveland WWTP
127	Decommissioned	Decommissioned	
128	229 Long Street (Booster Station)	CLEVELAND	Cleveland WWTP
129	54 Fryar Street	VICTORIA PT	Victoria Pt WWTP
130	6 Cayman Crescent	ORMISTON	Cleveland WWTP
131	Kennedy Drive, near SLSC	PT LOOKOUT	Pt Lookout WWTP
132	18 Moores Road	REDLAND BAY	Victoria Pt WWTP
134	off the Eastern end of Hardwood Drive	MT COTTON	Mt Cotton WWTP
135	64 Aspect Drive	VICTORIA PT	Victoria Pt WWTP
136	23 Weippin Street	CLEVELAND	Cleveland WWTP
137	St Anthony's School (Private)	ALEXANDRA HILLS	Capalaba WWTP
138	Opposite 52 Penzance Drive	REDLAND BAY	Victoria Pt WWTP
139	31 Manning Esplanade	THORNLANDS	Cleveland WWTP
140	Railway Parade, Canoe Club toilet block	THORNSIDE	Thornside WWTP
141	165 South Street	CLEVELAND	Cleveland WWTP
142	Ballow Road	DUNWICH	Dunwich WWTP
143	Flinders Avenue	DUNWICH	Dunwich WWTP
144	East Coast Road	DUNWICH	Dunwich WWTP
145	Opposite 2 Tindappah Drive	THORNLANDS	Cleveland WWTP
146	12 Lincoln Close	ALEXANDRA HILLS	Thornside WWTP
147	Opposite 4 Lorikeet Drive	THORNLANDS	Cleveland WWTP
148	Decommissioned	Decommissioned	
149	Decommissioned	Decommissioned	
150	Decommissioned	Decommissioned	
151	354 German Church Road	MT COTTON	Mt Cotton WWTP
152	Victoria Parade, Northern Side	COOCHIEMUDLO	Victoria Pt WWTP
153	Victoria Parade, Eastern Side	COOCHIEMUDLO	Victoria Pt WWTP
154	Victoria Parade, southern side, near barge ramp	COOCHIEMUDLO	Victoria Pt WWTP
155	Victoria Parade, Western Side, near Golf Course	COOCHIEMUDLO	Victoria Pt WWTP
156	Adder Rock Caravan Park	PT LOOKOUT	Pt Lookout WWTP
157	Adder Rock Caravan Park	PT LOOKOUT	Pt Lookout WWTP
158	2-8 Paperback Street	MT COTTON	Mt Cotton WWTP
159	Lang Lane (Owned by mining company)	DUNWICH	Dunwich WWTP
160	Decommissioned	DUNWICH	Dunwich WWTP
161	167 - 183 Hardwood Drive, opposite 16 Bunya Pine Place	MT COTTON	Mt Cotton WWTP
162	32 - 58 Sugargum Avenue	MT COTTON	Mt Cotton WWTP
163	Golden Wattle Avenue	MT COTTON	Mt Cotton WWTP
164	401 Redland Bay Road	CAPALABA	Capalaba WWTP
165	Near Rachow Street, Thornlands	South East Thornlands	Cleveland WWTP

Appendix B

Pump Station Operation Times

Table 33 – Sewer Pump Station Operation Times below details the Sewer Pump Station No. Pump run hours and Operational Pump Starts per day.

Table 33 – Sewer Pump Station Operation Times

SPS No.	Pump Run hours / day	Pump Starts / day
1	4.96	50
2	3.26	161
3	3.08	99
4	4.92	227
5	4.31	84
6	6.38	109
7	Decommissioned	Decommissioned
8	0.51	90
9	0.95	52
10	Decommissioned	Decommissioned
11	2.60	110
12	4.40	147
13	0.53	11
14	Low Lift	Low Lift
15	Decommissioned	Decommissioned
16	1.69	64
17	Decommissioned	Decommissioned
18	Decommissioned	Decommissioned
19	2.59	174
20	Decommissioned	Decommissioned
21	3.89	114
22	0.51	41
23	0.78	19
24	1.51	41
25	2.38	87
26	1.51	9
27	Decommissioned	Decommissioned
28	1.88	168
29	3.33	NA
30	0.98	41
31	1.84	29
32	2.39	82
33	7.95	111
34	2.87	104
35	3.19	319
36	2.24	74
37	0.75	17
38	0.24	6
39	2.28	16
40	0.89	45

SPS No.	Pump Run hours / day	Pump Starts / day
41	4.61	321
42	2.56	64
43	4.60	30
44	0.68	12
45	1.79	31
46	Decommissioned	Decommissioned
47	3.12	39
48	4.19	176
49	3.93	108
50	Decommissioned	Decommissioned
51	Decommissioned	Decommissioned
52	1.96	63
53	2.26	120
54	5.72	120
55	0.17	10
56	7.75	187
57	3.05	178
58	2.01	74
59	2.03	43
60	2.69	92
61	4.94	141
62	4.33	198
63	Decommissioned	Decommissioned
64	Decommissioned	Decommissioned
65	1.37	24
66	2.69	119
67	4.83	82
68	0.70	18
69	2.35	75
70	3.31	92
71	3.07	94
72	1.39	50
73	0.46	27
74	2.59	36
75	1.63	30
76	Private	Private
77	Decommissioned	Decommissioned
78	Decommissioned	Decommissioned
79	Decommissioned	Decommissioned
80	Decommissioned	Decommissioned
81	1.78	80
82	3.94	71
83	Low Lift	Low Lift
84	0.66	23
85	Low Lift	Low Lift

SPS No.	Pump Run hours / day	Pump Starts / day
86	3.89	134
87	0.22	2
88	2.07	36
89	0.30	8
90	2.49	72
91	0.12	4
92	2.00	123
93	0.75	54
94	Decommissioned	Decommissioned
95	2.09	67
96	1.68	37
97	Low Lift	Low Lift
98	Low Lift	Low Lift
99	0.96	30
100	1.53	128
101	4.55	38
102	Decommissioned	Decommissioned
103	1.71	71
104	0.91	44
105	Decommissioned	Decommissioned
106	0.55	19
107	1.99	27
108	Decommissioned	Decommissioned
109	1.56	20
110	Low Lift	Low Lift
111	1.29	61
112	3.32	114
113	4.25	55
114	Low Lift	Low Lift
115	Low Lift	Low Lift
116	1.47	22
117	0.94	20
118	Low Lift	Low Lift
119	0.48	14
120	Low Lift	Low Lift
121	Low Lift	Low Lift
122	Low Lift	Low Lift
123	1.36	46
124	0.91	27
125	0.24	8
126	NA	NA
127	Decommissioned	Decommissioned
128	4.78	NA
129	2.13	48
130	2.44	50

SPS No.	Pump Run hours / day	Pump Starts / day
131	0.72	24
132	1.87	52
134	3.41	78
135	2.37	23
136	0.94	27
137	Private	Private
138	4.43	60
139	6.32	81
140	0.01	1
141	0.92	98
142	Dunwich WWTP	Dunwich WWTP
143	1.53	66
144	0.44	10
145	3.06	92
146	Low Lift	Low Lift
147	10.01	128
148	Decommissioned	Decommissioned
149	Decommissioned	Decommissioned
150	Decommissioned	Decommissioned
151	2.54	49
152	0.51	12
153	0.51	52
154	1.11	30
155	0.25	11
156	1.32	55
157	0.22	14
158	1.86	10
159	Private	Private
160	Decommissioned	Decommissioned
161	2.68	19
162	2.89	23
163	2.96	12
164	0.83	31
165	0.43	7
990*	1.62	6
991*	0.31	2

*Note – Leachate associated SPS, due to be transferred to RW upon commissioning approval.

Table 34- Individual SPS Catchment EP

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
1	261	3	3	258	3	3	312	4	4	317	4	4	319	4	4	377	5	5
2	495	6	6	826	10	10	965	12	12	1204	14	15	1220	14	15	2857	29	35
3	530	6	6	533	6	6	539	7	7	590	7	7	610	7	7	1095	13	13
4	1740	19	21	1797	20	22	2024	22	25	2222	24	27	2235	24	27	2700	28	33
5	4281	41	52	4695	45	57	5075	48	62	5208	49	63	5299	50	64	8048	70	98
6	5741	53	70	6212	57	75	6271	57	76	6771	61	82	6839	61	83	7763	68	94
8	265	3	3	265	3	3	265	3	3	265	3	3	268	3	3	303	4	4
9	388	5	5	388	5	5	388	5	5	388	5	5	389	5	5	402	5	5
11	1405	16	17	1413	16	17	1422	16	17	1444	17	18	1474	17	18	1972	22	24
12	1619	18	20	1626	18	20	1641	18	20	1648	19	20	1666	19	20	1941	21	24
13	27	0	0	34	0	0	34	0	0	34	0	0	35	0	0	40	0	0
14	75	1	1	75	1	1	75	1	1	83	1	1	83	1	1	88	1	1
16	729	9	9	763	9	9	791	10	10	815	10	10	819	10	10	858	10	10
19	1090	13	13	1291	15	16	1469	17	18	1560	18	19	1573	18	19	2138	23	26
21	1808	20	22	1808	20	22	1813	20	22	1816	20	22	1828	20	22	2000	22	24
22	198	2	2	198	2	2	198	2	2	198	2	2	202	2	2	269	3	3
23	377	5	5	377	5	5	424	5	5	526	6	6	527	6	6	554	7	7
24	1093	13	13	1142	14	14	1160	14	14	1199	14	15	1214	14	15	1472	17	18
25	203	2	2	233	3	3	326	4	4	474	6	6	487	6	6	1000	12	12
26	45	1	1	45	1	1	45	1	1	45	1	1	48	1	1	381	5	5
28	5047	48	61	5278	49	64	5677	52	69	5813	54	71	5903	54	72	7095	63	86
29	2949	30	36	2991	31	36	3000	31	36	2996	31	36	3008	31	37	3168	32	39
30	337	4	4	348	4	4	350	4	4	350	4	4	352	4	4	395	5	5
31	400	5	5	400	5	5	407	5	5	413	5	5	422	5	5	578	7	7
32	680	8	8	691	8	8	728	9	9	756	9	9	783	10	10	1262	15	15
33	7754	68	94	7965	70	97	8061	71	98	8105	71	98	8194	71	100	9400	80	114

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
34	821	10	10	827	10	10	831	10	10	831	10	10	836	10	10	900	11	11
35	3054	31	37	3101	32	38	3164	32	38	3203	32	39	3230	33	39	3566	36	43
36	547	7	7	598	7	7	697	8	8	709	9	9	713	9	9	792	10	10
37	123	1	1	123	1	1	199	2	2	209	3	3	213	3	3	272	3	3
38	67	1	1	67	1	1	76	1	1	85	1	1	86	1	1	117	1	1
39	23	0	0	29	0	0	30	0	0	33	0	0	33	0	0	35	0	0
40	174	2	2	188	2	2	206	3	3	255	3	3	257	3	3	305	4	4
41	9191	79	112	9543	81	116	9835	84	120	9991	85	121	10126	86	123	11975	102	146
42	3707	37	45	3997	39	49	4213	41	51	4390	42	53	4478	43	54	5889	54	72
43	804	10	10	804	10	10	822	10	10	838	10	10	853	10	10	1056	13	13
44	242	3	3	246	3	3	246	3	3	253	3	3	258	3	3	297	4	4
45	315	4	4	328	4	4	328	4	4	341	4	4	342	4	4	352	4	4
47	1107	13	13	1223	14	15	1223	14	15	1223	14	15	1232	15	15	1303	15	16
48	3486	35	42	3694	37	45	3804	37	46	4022	39	49	4061	40	49	4672	45	57
49	1313	15	16	1365	16	17	1417	16	17	1433	16	17	1445	17	18	1650	19	20
52	601	7	7	688	8	8	754	9	9	762	9	9	773	9	9	930	11	11
53	77	1	1	88	1	1	214	3	3	231	3	3	235	3	3	565	7	7
54	532	6	6	546	7	7	551	7	7	555	7	7	566	7	7	760	9	9
55	75	1	1	75	1	1	108	1	1	108	1	1	108	1	1	113	1	1
56	501	6	6	507	6	6	580	7	7	589	7	7	594	7	7	728	9	9
57	289	4	4	292	4	4	296	4	4	296	4	4	300	4	4	372	5	5
58	499	6	6	750	9	9	750	9	9	752	9	9	762	9	9	865	11	11
59	499	6	6	502	6	6	501	6	6	501	6	6	508	6	6	608	7	7
60	302	4	4	313	4	4	315	4	4	318	4	4	323	4	4	384	5	5
61	1334	16	16	1334	16	16	1347	16	16	1347	16	16	1366	16	17	1589	18	19
62	1941	21	24	1976	22	24	2139	23	26	2229	24	27	2255	24	27	2606	27	32
65	274	3	3	274	3	3	348	4	4	529	6	6	534	6	6	1604	18	19
66	886	11	11	901	11	11	925	11	11	944	11	11	960	12	12	1162	14	14

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
67	5537	51	67	5743	53	70	6274	57	76	6385	58	78	6452	58	78	7581	67	92
68	46	1	1	46	1	1	46	1	1	46	1	1	46	1	1	46	1	1
69	287	3	3	287	3	3	287	3	3	287	3	3	287	3	3	287	3	3
70	521	6	6	566	7	7	566	7	7	566	7	7	566	7	7	701	9	9
71	1173	14	14	1345	16	16	1345	16	16	1345	16	16	1345	16	16	1898	21	23
72	1017	12	12	1173	14	14	1173	14	14	1173	14	14	1173	14	14	1525	17	19
73	144	2	2	143	2	2	147	2	2	147	2	2	149	2	2	190	2	2
74	967	12	12	1163	14	14	1209	14	15	1215	14	15	1261	15	15	2340	25	28
75	240	3	3	240	3	3	241	3	3	243	3	3	251	3	3	370	4	4
76	155	2	2	155	2	2	155	2	2	155	2	2	155	2	2	155	2	2
81	711	9	9	711	9	9	713	9	9	715	9	9	721	9	9	786	10	10
82	1149	14	14	1219	14	15	1230	15	15	1246	15	15	1283	15	16	1877	21	23
83	151	2	2	170	2	2	177	2	2	179	2	2	182	2	2	239	3	3
84	114	1	1	114	1	1	114	1	1	114	1	1	116	1	1	139	2	2
85	380	5	5	380	5	5	380	5	5	444	5	5	447	5	5	500	6	6
86	5054	48	61	5433	51	66	5433	51	66	5433	51	66	5593	52	68	6601	60	80
87	65	1	1	65	1	1	76	1	1	76	1	1	78	1	1	91	1	1
88	285	3	3	282	3	3	287	3	3	311	4	4	314	4	4	400	5	5
89	56	1	1	56	1	1	56	1	1	61	1	1	62	1	1	81	1	1
90	1621	18	20	1972	22	24	2225	24	27	2465	26	30	2481	26	30	3466	35	42
91	48	1	1	79	1	1	242	3	3	379	5	5	381	5	5	639	8	8
92	2307	25	28	3194	32	39	3256	33	40	3483	35	42	3499	35	43	3712	37	45
93	169	2	2	169	2	2	169	2	2	169	2	2	169	2	2	169	2	2
95	409	5	5	409	5	5	409	5	5	411	5	5	420	5	5	537	7	7
96	218	3	3	220	3	3	222	3	3	222	3	3	224	3	3	266	3	3
97	116	1	1	119	1	1	119	1	1	119	1	1	121	1	1	160	2	2
98	73	1	1	93	1	1	93	1	1	93	1	1	96	1	1	161	2	2
99	227	3	3	227	3	3	227	3	3	227	3	3	239	3	3	405	5	5

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
100	2345	25	28	2363	25	29	2376	25	29	2382	25	29	2418	26	29	2886	30	35
101	259	3	3	259	3	3	259	3	3	259	3	3	261	3	3	275	3	3
103	1271	15	15	1300	15	16	1300	15	16	1300	15	16	1300	15	16	1673	19	20
104	1148	14	14	1464	17	18	1464	17	18	1464	17	18	1464	17	18	2415	26	29
106	64	1	1	64	1	1	69	1	1	69	1	1	70	1	1	82	1	1
107	309	4	4	352	4	4	358	4	4	366	4	4	379	5	5	649	8	8
109	204	2	2	204	2	2	204	2	2	204	2	2	216	3	3	373	5	5
110	170	2	2	170	2	2	170	2	2	170	2	2	180	2	2	310	4	4
111	552	7	7	552	7	7	584	7	7	584	7	7	585	7	7	603	7	7
112	1292	15	16	1299	15	16	1303	15	16	1325	15	16	1335	16	16	1515	17	18
113	254	3	3	254	3	3	260	3	3	260	3	3	276	3	3	648	8	8
114	78	1	1	78	1	1	100	1	1	100	1	1	105	1	1	205	2	2
115	50	1	1	50	1	1	53	1	1	56	1	1	58	1	1	129	2	2
116	362	4	4	368	4	4	369	4	4	378	5	5	385	5	5	445	5	5
117	99	1	1	102	1	1	102	1	1	108	1	1	112	1	1	180	2	2
118	65	1	1	65	1	1	65	1	1	65	1	1	65	1	1	65	1	1
119	120	1	1	120	1	1	120	1	1	120	1	1	129	2	2	247	3	3
120	103	1	1	103	1	1	108	1	1	114	1	1	121	1	1	244	3	3
121	54	1	1	54	1	1	54	1	1	60	1	1	64	1	1	124	2	2
122	140	2	2	167	2	2	167	2	2	167	2	2	175	2	2	335	4	4
123	240	3	3	240	3	3	240	3	3	240	3	3	240	3	3	240	3	3
124	208	3	3	207	3	3	322	4	4	346	4	4	349	4	4	379	5	5
125	233	3	3	233	3	3	234	3	3	237	3	3	237	3	3	237	3	3
126	115	1	1	115	1	1	115	1	1	115	1	1	115	1	1	115	1	1
128	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0
129	326	4	4	327	4	4	327	4	4	327	4	4	329	4	4	349	4	4
130	310	4	4	324	4	4	324	4	4	329	4	4	337	4	4	438	5	5
131	693	8	8	693	8	8	693	8	8	693	8	8	693	8	8	865	11	11

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
132	1418	16	17	1454	17	18	1501	17	18	1523	17	19	1532	17	19	1702	19	21
134	2840	29	35	2854	29	35	2870	30	35	2887	30	35	2929	30	36	3415	34	42
135	208	3	3	211	3	3	221	3	3	221	3	3	227	3	3	269	3	3
136	1231	15	15	1458	17	18	1458	17	18	1458	17	18	1553	18	19	2155	23	26
137	297	4	4	324	4	4	324	4	4	324	4	4	335	4	4	513	6	6
138	697	8	8	735	9	9	738	9	9	746	9	9	758	9	9	861	10	10
139	3930	39	48	4054	40	49	4110	40	50	4135	40	50	4167	40	51	5274	49	64
140	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0
141	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0
142	329	4	4	370	5	5	376	5	5	377	5	5	386	5	5	542	7	7
143	598	7	7	642	8	8	642	8	8	647	8	8	666	8	8	971	12	12
144	343	4	4	552	7	7	554	7	7	554	7	7	563	7	7	679	8	8
145	995	12	12	1258	15	15	1317	15	16	1373	16	17	1374	16	17	1392	16	17
146	192	2	2	192	2	2	199	2	2	202	2	2	203	2	2	221	3	3
147	1938	21	24	2517	26	31	2663	28	32	2857	29	35	2859	29	35	2885	30	35
151	1205	14	15	1599	18	19	1620	18	20	1643	19	20	1684	19	20	2121	23	26
152	195	2	2	230	3	3	264	3	3	282	3	3	283	3	3	328	4	4
153	86	1	1	88	1	1	96	1	1	104	1	1	104	1	1	119	1	1
154	433	5	5	501	6	6	572	7	7	615	7	7	618	8	8	849	10	10
155	191	2	2	200	2	2	268	3	3	323	4	4	324	4	4	340	4	4
156	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1
157	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1
158	127	2	2	149	2	2	149	2	2	149	2	2	150	2	2	178	2	2
159	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0
161	33	0	0	60	1	1	60	1	1	77	1	1	78	1	1	105	1	1
162	0	#DIV/0!	0	652	8	8	652	8	8	652	8	8	652	8	8	652	8	8
163	494	6	6	494	6	6	494	6	6	494	6	6	494	6	6	494	6	6
164	680	8	8	680	8	8	680	8	8	680	8	8	680	8	8	680	8	8

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
165	1793	20	22	2366	25	29	3058	31	37	3374	34	41	3384	34	41	4060	40	49

Table 35 - Combined SPS Catchment EP

SPS No.	2016			2021			2026			2031			2036			Ultimate		
	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
1	337	4	4	334	4	4	387	5	5	400	5	5	403	5	5	465	6	6
2	858	10	10	1194	14	15	1387	16	17	1639	18	20	1657	19	20	3362	34	41
3	595	7	7	598	7	7	616	7	7	667	8	8	688	8	8	1187	14	14
4	2598	27	32	2991	31	36	3411	34	41	3860	38	47	3893	38	47	6062	55	74
5	9699	83	118	10788	92	131	11676	99	142	12297	105	149	12550	107	153	20082	171	244
6	20256	172	246	22102	188	269	23272	198	283	24567	209	299	24984	213	304	35432	301	431
8	265	3	3	265	3	3	265	3	3	265	3	3	268	3	3	303	4	4
9	653	8	8	653	8	8	653	8	8	653	8	8	657	8	8	705	9	9
11	1405	16	17	1413	16	17	1422	16	17	1444	17	18	1474	17	18	1972	22	24
12	1619	18	20	1626	18	20	1641	18	20	1648	19	20	1666	19	20	1941	21	24
13	27	0	0	34	0	0	34	0	0	34	0	0	35	0	0	40	0	0
14	75	1	1	75	1	1	75	1	1	83	1	1	83	1	1	88	1	1
16	899	11	11	933	11	11	960	12	12	983	12	12	987	12	12	1027	12	12
19	1090	13	13	1291	15	16	1469	17	18	1560	18	19	1573	18	19	2138	23	26
21	1808	20	22	1808	20	22	1813	20	22	1816	20	22	1828	20	22	2000	22	24
22	523	6	6	525	6	6	525	6	6	525	6	6	532	6	6	618	8	8
23	377	5	5	377	5	5	424	5	5	526	6	6	527	6	6	554	7	7
24	1470	17	18	1519	17	18	1583	18	19	1725	19	21	1741	19	21	2026	22	25
25	247	3	3	278	3	3	370	5	5	519	6	6	534	6	6	1381	16	17
26	45	1	1	45	1	1	45	1	1	45	1	1	48	1	1	381	5	5
28	5047	48	61	5278	49	64	5677	52	69	5813	54	71	5903	54	72	7095	63	86
29	36658	312	445	38045	324	462	39191	333	476	40049	341	487	40568	345	493	48223	410	586
30	337	4	4	348	4	4	350	4	4	350	4	4	352	4	4	395	5	5
31	400	5	5	400	5	5	407	5	5	413	5	5	422	5	5	578	7	7
32	881	11	11	911	11	11	957	12	12	991	12	12	1023	12	12	1630	18	20
33	28604	243	348	29702	253	361	30673	261	373	31275	266	380	31701	270	385	37780	321	459

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
34	1314	15	16	1320	15	16	1324	15	16	1389	16	17	1399	16	17	1539	18	19
35	18861	160	229	19722	168	240	20593	175	250	21087	179	256	21377	182	260	25592	218	311
36	997	12	12	1069	13	13	1278	15	16	1360	16	17	1372	16	17	1602	18	19
37	123	1	1	123	1	1	199	2	2	209	3	3	213	3	3	272	3	3
38	67	1	1	67	1	1	76	1	1	85	1	1	86	1	1	117	1	1
39	328	4	4	348	4	4	382	5	5	442	5	5	446	5	5	538	7	7
40	238	3	3	253	3	3	276	3	3	325	4	4	327	4	4	386	5	5
41	14809	126	180	15552	132	189	16151	137	196	16524	141	201	16775	143	204	20423	174	248
42	5427	51	66	5817	54	71	6117	56	74	6331	58	77	6446	58	78	8228	72	100
43	804	10	10	804	10	10	822	10	10	838	10	10	853	10	10	1056	13	13
44	539	7	7	571	7	7	571	7	7	577	7	7	593	7	7	810	10	10
45	315	4	4	328	4	4	328	4	4	341	4	4	342	4	4	352	4	4
47	1107	13	13	1223	14	15	1223	14	15	1223	14	15	1232	15	15	1303	15	16
48	3486	35	42	3694	37	45	3804	37	46	4022	39	49	4061	40	49	4672	45	57
49	4139	40	50	4329	42	53	4679	45	57	4830	46	59	4873	46	59	5879	54	71
52	601	7	7	688	8	8	754	9	9	762	9	9	773	9	9	930	11	11
53	77	1	1	88	1	1	214	3	3	231	3	3	235	3	3	565	7	7
54	2303	25	28	2439	26	30	2736	28	33	2872	30	35	2897	30	35	3611	36	44
55	75	1	1	75	1	1	108	1	1	108	1	1	108	1	1	113	1	1
56	790	10	10	799	10	10	877	11	11	885	11	11	895	11	11	1101	13	13
57	289	4	4	292	4	4	296	4	4	296	4	4	300	4	4	372	5	5
58	499	6	6	750	9	9	750	9	9	752	9	9	762	9	9	865	11	11
59	499	6	6	502	6	6	501	6	6	501	6	6	508	6	6	608	7	7
60	800	10	10	814	10	10	816	10	10	819	10	10	831	10	10	992	12	12
61	2469	26	30	2487	26	30	2504	26	30	2506	26	30	2541	27	31	3007	31	37
62	1941	21	24	1976	22	24	2139	23	26	2229	24	27	2255	24	27	2606	27	32
65	274	3	3	274	3	3	348	4	4	529	6	6	534	6	6	1604	18	19
66	886	11	11	901	11	11	925	11	11	944	11	11	960	12	12	1162	14	14

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
67	14430	123	175	15984	136	194	17196	146	209	18019	153	219	18167	155	221	21476	183	261
68	46	1	1	46	1	1	46	1	1	46	1	1	46	1	1	46	1	1
69	1526	17	19	1682	19	20	1682	19	20	1682	19	20	1682	19	20	2034	22	25
70	4805	46	58	5367	50	65	5367	50	65	5367	50	65	5367	50	65	7552	67	92
71	4285	41	52	4801	46	58	4801	46	58	4801	46	58	4801	46	58	6851	61	83
72	1239	15	15	1395	16	17	1395	16	17	1395	16	17	1395	16	17	1747	19	21
73	144	2	2	143	2	2	147	2	2	147	2	2	149	2	2	190	2	2
74	1656	19	20	1922	21	23	1974	22	24	1991	22	24	2066	22	25	3695	37	45
75	240	3	3	240	3	3	241	3	3	243	3	3	251	3	3	370	4	4
76	155	2	2	155	2	2	155	2	2	155	2	2	155	2	2	155	2	2
81	980	12	12	980	12	12	983	12	12	985	12	12	991	12	12	1055	13	13
82	1149	14	14	1219	14	15	1230	15	15	1246	15	15	1283	15	16	1877	21	23
83	151	2	2	170	2	2	177	2	2	179	2	2	182	2	2	239	3	3
84	114	1	1	114	1	1	114	1	1	114	1	1	116	1	1	139	2	2
85	380	5	5	380	5	5	380	5	5	444	5	5	447	5	5	500	6	6
86	5054	48	61	5433	51	66	5433	51	66	5433	51	66	5593	52	68	6601	60	80
87	65	1	1	65	1	1	76	1	1	76	1	1	78	1	1	91	1	1
88	341	4	4	339	4	4	343	4	4	372	5	5	376	5	5	481	6	6
89	56	1	1	56	1	1	56	1	1	61	1	1	62	1	1	81	1	1
90	1621	18	20	1972	22	24	2225	24	27	2465	26	30	2481	26	30	3466	35	42
91	48	1	1	79	1	1	242	3	3	379	5	5	381	5	5	639	8	8
92	4848	46	59	5781	53	70	5880	54	71	6138	56	75	6177	56	75	6691	60	81
93	169	2	2	169	2	2	169	2	2	169	2	2	169	2	2	169	2	2
95	617	7	7	615	7	7	731	9	9	757	9	9	768	9	9	916	11	11
96	335	4	4	339	4	4	341	4	4	341	4	4	345	4	4	426	5	5
97	116	1	1	119	1	1	119	1	1	119	1	1	121	1	1	160	2	2
98	73	1	1	93	1	1	93	1	1	93	1	1	96	1	1	161	2	2
99	300	4	4	320	4	4	320	4	4	320	4	4	335	4	4	566	7	7

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
100	3325	33	40	3344	34	41	3359	34	41	3368	34	41	3409	34	41	3941	39	48
101	259	3	3	259	3	3	259	3	3	259	3	3	261	3	3	275	3	3
103	3112	32	38	3456	35	42	3456	35	42	3456	35	42	3456	35	42	4953	47	60
104	1841	20	22	2157	23	26	2157	23	26	2157	23	26	2157	23	26	3280	33	40
106	64	1	1	64	1	1	69	1	1	69	1	1	70	1	1	82	1	1
107	309	4	4	352	4	4	358	4	4	366	4	4	379	5	5	649	8	8
109	375	5	5	375	5	5	375	5	5	375	5	5	396	5	5	684	8	8
110	170	2	2	170	2	2	170	2	2	170	2	2	180	2	2	310	4	4
111	552	7	7	552	7	7	584	7	7	584	7	7	585	7	7	603	7	7
112	1844	20	22	1852	20	23	1887	21	23	1909	21	23	1921	21	23	2118	23	26
113	710	9	9	713	9	9	745	9	9	761	9	9	807	10	10	1649	19	20
114	78	1	1	78	1	1	100	1	1	100	1	1	105	1	1	205	2	2
115	50	1	1	50	1	1	53	1	1	56	1	1	58	1	1	129	2	2
116	362	4	4	368	4	4	369	4	4	378	5	5	385	5	5	445	5	5
117	257	3	3	260	3	3	265	3	3	281	3	3	297	4	4	548	7	7
118	65	1	1	65	1	1	65	1	1	65	1	1	65	1	1	65	1	1
119	377	5	5	380	5	5	385	5	5	402	5	5	425	5	5	796	10	10
120	103	1	1	103	1	1	108	1	1	114	1	1	121	1	1	244	3	3
121	54	1	1	54	1	1	54	1	1	60	1	1	64	1	1	124	2	2
122	449	5	5	519	6	6	524	6	6	533	6	6	554	7	7	984	12	12
123	240	3	3	240	3	3	240	3	3	240	3	3	240	3	3	240	3	3
124	208	3	3	207	3	3	322	4	4	346	4	4	349	4	4	379	5	5
125	233	3	3	233	3	3	234	3	3	237	3	3	237	3	3	237	3	3
126	115	1	1	115	1	1	115	1	1	115	1	1	115	1	1	115	1	1
128		#DIV/0!	0		#DIV/0!	0		#DIV/0!	0		#DIV/0!	0		#DIV/0!	0		#DIV/0!	0
129	326	4	4	327	4	4	327	4	4	327	4	4	329	4	4	349	4	4
130	310	4	4	324	4	4	324	4	4	329	4	4	337	4	4	438	5	5
131	693	8	8	693	8	8	693	8	8	693	8	8	693	8	8	865	11	11

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
132	1418	16	17	1454	17	18	1501	17	18	1523	17	19	1532	17	19	1702	19	21
134	2967	30	36	3003	31	36	3019	31	37	3036	31	37	3079	31	37	3593	36	44
135	208	3	3	211	3	3	221	3	3	221	3	3	227	3	3	269	3	3
136	1231	15	15	1458	17	18	1458	17	18	1458	17	18	1553	18	19	2155	23	26
137	297	4	4	324	4	4	324	4	4	324	4	4	335	4	4	513	6	6
138	697	8	8	735	9	9	738	9	9	746	9	9	758	9	9	861	10	10
139	4925	47	60	5312	50	65	5426	51	66	5508	51	67	5541	51	67	6667	60	81
140	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0	5	0	0
141	11448	97	139	12435	106	151	13265	113	161	13695	117	166	13809	117	168	16640	142	202
142	1270	15	15	1564	18	19	1572	18	19	1578	18	19	1614	18	20	2192	24	27
143	941	11	11	1194	14	15	1196	14	15	1201	14	15	1228	14	15	1650	19	20
144	343	4	4	552	7	7	554	7	7	554	7	7	563	7	7	679	8	8
145	995	12	12	1258	15	15	1317	15	16	1373	16	17	1374	16	17	1392	16	17
146	192	2	2	192	2	2	199	2	2	202	2	2	203	2	2	221	3	3
147	1938	21	24	2517	26	31	2663	28	32	2857	29	35	2859	29	35	2885	30	35
151	1205	14	15	1599	18	19	1620	18	20	1643	19	20	1684	19	20	2121	23	26
152	195	2	2	230	3	3	264	3	3	282	3	3	283	3	3	328	4	4
153	86	1	1	88	1	1	96	1	1	104	1	1	104	1	1	119	1	1
154	905	11	11	1018	12	12	1200	14	15	1324	15	16	1327	15	16	1637	18	20
155	191	2	2	200	2	2	268	3	3	323	4	4	324	4	4	340	4	4
156	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1
157	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1	111	1	1
158	127	2	2	149	2	2	149	2	2	149	2	2	150	2	2	178	2	2
159	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0	0	#DIV/0!	0
161	33	0	0	60	1	1	60	1	1	77	1	1	78	1	1	105	1	1
162	0	#DIV/0!	0	652	8	8	652	8	8	652	8	8	652	8	8	652	8	8
163	494	6	6	494	6	6	494	6	6	494	6	6	494	6	6	494	6	6
164	680	8	8	680	8	8	680	8	8	680	8	8	680	8	8	680	8	8

	2016			2021			2026			2031			2036			Ultimate		
SPS No.	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)	EP	Design Flow (L/s)	PWWF (L/s)
165	1793	20	22	2366	25	29	3058	31	37	3374	34	41	3384	34	41	4060	40	49

Table 36 – Adopted Soil Types

Soil Type	Dominant Soil	Adjustment Factor Classification
Acid peat		Acid sulphate
Dark soils on basalt	Thin differentiated soils on basalt on low hills and slopes between sandstone	Hard rock
Dark soils on basalt	Prairie-like soils and shallow black earths on low hill crests and gentle slopes	Hard rock
Dark soils on basalt	Differentiated and gleyed soils on basalt in depressions between ridges	Poor soil
Giant podzol		Good soil
Humus podzol		Acid sulphate
Lithosol		Soft rock
Podzol (deep)		Good soil
Podzol (minimal)		Good soil
Podzolic soils on and sedimentary metamorphic	Red-yellow podzolics on low hills of metasediments	Good soil
Podzolic soils on and sedimentary metamorphic	Lateritic podzolics and red-yellow podzolics on moderately high hills with sandy lithosol	Good soil
Podzolic soils on and sedimentary metamorphic	Red-yellow podzolics on low hills with lateritic podzolics near crests	Good soil
Podzolic soils on and sedimentary metamorphic	Lateritic podzolics and sandy red-yellow podzolics on gently undulating surfaces	Good soil
Podzolic soils on and sedimentary metamorphic	Red-yellow podzolics on low hills of sedimentary rocks	Good soil
Podzols (minimal & deep)		Acid sulphate
Red earth		Good soil
Red soils	Krasnozems on crests and prairie-like soils on slopes	Good soil
Red soils	Krasnozems, often lateritic, on low hills and ridges	Good soil
Red soils	Red earths on a gently undulating surface lateritic podzolics on this and on adjacent ste	Good soil
Saline mud		Acid sulphate

Soil Type	Dominant Soil	Adjustment Factor Classification
Shallow stony soils	Lithosols (loam textures) on steep ridges and spurs	Soft rock
Shallow stony soils	Lithosols on high quartzite ridges and red clays on fringing slopes	Soft rock
Shallow stony soils	Lithosols (sand textures) on narrow ridge crests and steep slopes	Soft rock
Siliceous sand		Sand
Siliceous sand		Sand
Soils on transported materials	Yellow podzolics on low terraces, alluvial soils and gleys on floodplains	Acid sulphate
Soils on transported materials	Tidal solonchak	Acid sulphate
Soils on transported materials	Meadow podzolics on low terraces, alluvial soils and gleys on floodplains	Poor soil
Soils on transported materials	Alluvial soils on banks and humic gleys on plains	Acid sulphate
Soils on transported materials	Regosols on low beach aridges and gleys on adjacent plains	Poor soil
Soils on transported materials	Saline gleys on very low plains	Acid sulphate
Soils on transported materials	Peaty gleys in broad shallow depressed areas	Poor soil
Soils on transported materials	Gilgaied acid clays on high terraces	Acid sulphate
Soils on transported materials	Humic gleys on low plains	Poor soil
<i>* Balance areas of NSI (areas that did not come up with a dominant soil type)</i>		<i>Sand</i>
<i>** Submarine Pipes</i>		<i>Water</i>
<i>*** Unknown</i>		<i>Good soil</i>

Appendix D

Cost Estimates

D.1 Capalaba Costs

MUID	Up Level	Dw Level	Length (m)	DIA (mm)	Avg ELEVAT	ZSCONCAT	AVG DEPTH	DEPTH CLS1	DEPTH CLS2	BASERATE	D_S_FCT R	ADJ_RATE	MH costs	Total
FGM_CA_01	10.23	10.08	70	300	11.06	RURGOOD SOIL	0.9	3.00	1.00	\$ 21,000	0.94	\$ 19,740	\$ 9,020	\$28,760
FGM_CA_02	10.34	10.26	75	300	12.50	RURGOOD SOIL	2.2	4.00	2.00	\$ 29,323	0.93	\$ 27,270	\$ 4,879	\$32,149
FGM_CA_03	10.84	10.80	10	225	11.75	RURGOOD SOIL	0.9	3.00	1.00	\$ 2,453	0.94	\$ 2,305	\$ 8,200	\$10,506
FGM_CA_04	10.80	10.46	80	225	12.75	RURGOOD SOIL	2.1	4.00	2.00	\$ 26,244	0.93	\$ 24,406	\$ 4,879	\$29,286
FGM_CA_05	10.40	10.38	4	300	13.13	RURGOOD SOIL	2.7	4.00	2.00	\$ 1,652	0.93	\$ 1,536	\$0	\$1,536
FGM_CA_06	11.85	11.67	50	225	13.25	HDUGOOD SOIL	1.5	4.00	1.00	\$ 10,971	1.86	\$ 20,407	\$ 8,610	\$29,017
FGM_CA_07	9.17	9.24	60	150	11.25	URBGGOOD SOIL	2.0	4.00	2.00	\$ 13,542	1.13	\$ 15,303	\$ 9,635	\$24,938
FGM_CA_08	9.24	7.90	190	150	12.50	URBGGOOD SOIL	3.9	4.00	3.00	\$ 55,797	1.12	\$ 62,493	\$ 30,135	\$92,629
FGM_CA_09	7.84	7.53	50	300	11.50	URBGGOOD SOIL	3.8	4.00	3.00	\$ 25,989	1.12	\$ 29,107	\$ 6,355	\$35,463
FGM_CA_10	7.53	7.13	80	300	11.38	URBGGOOD SOIL	4.0	4.00	3.00	\$ 40,039	1.86	\$ 74,472	\$ 6,355	\$80,828
FGM_CA_11	8.80	4.46	150	150	8.88	CBDGOOD SOIL	2.2	4.00	2.00	\$ 35,044	1.12	\$ 39,249	\$ 10,045	\$49,294
FGM_CA_12	6.18	4.53	185	225	8.13	CBDGOOD SOIL	2.8	4.00	2.00	\$ 60,229	1.12	\$ 67,456	\$ 16,769	\$84,226
SPS 25														\$95,250
SPS53														\$63,250
SPS65														\$95,250

752,382

D.2 Cleveland Costs

MUID	Up Level	Dw Level	Length (m)	DIA (mm)	Avg ELEVAT	ZSCONCAT	AVG DEPTH	DEPTH CLS1	DEPTH CLS2	BASERATE	D_S_FC TR	ADJ_RATE	MH costs	Total
FGM_CL_01	5.210	4.750	135	375	7.50	URBGGOOD SOIL	2.5	4.00	2.00	\$ 90,096	0.98	\$ 88,294	\$ 9,758	\$ 98,053
FGM_CL_02	4.710	3.990	170	375	7.30	RURGOOD SOIL	3.0	4.00	2.00	\$ 115,210	1.16	\$ 133,644	\$14,581	\$148,225
FGM_CL_03	21.430	20.340	200	300	24.37	RURGOOD SOIL	3.5	4.00	3.00	\$ 102,476	0.93	\$ 95,303	\$0	\$ 95,303
FGM_CL_04	23.520	21.480	410	300	27.62	RURGOOD SOIL	5.1	4.00	4.00	\$ 277,261	0.93	\$ 257,853	\$14,637	\$272,490
FGM_CL_05	-0.040	-0.090	6	225	3.75	RURPOOR SOIL	3.8	4.00	3.00	\$ 2,571	0.93	\$ 2,391	\$0	\$ 2,392
FGM_CL_06	0.920	0.400	150	225	2.59	RURPOOR SOIL	1.9	4.00	2.00	\$ 48,900	1.12	\$ 54,768	\$0	\$ 54,768
FGM_CL_07	18.730	18.010	155	300	21.88	RURGOOD SOIL	3.5	4.00	3.00	\$ 78,938	0.93	\$ 73,412	\$13,925	\$ 87,338
FGM_CL_08	5.630	5.380	105	150	7.62	CBDGOOD SOIL	2.1	4.00	2.00	\$ 23,911	1.86	\$ 44,476	\$ 9,389	\$ 53,865
FGM_CL_09	9.150	8.970	25	150	10.37	HDUPOOR SOIL	1.3	4.00	1.00	\$ 4,077	1.13	\$ 4,607	\$12,300	\$ 16,908
FGM_CL_10	12.550	11.860	6	150	14.62	HDUGOOD SOIL	2.4	4.00	2.00	\$ 14,212	1.13	\$ 16,060	\$ 4,100	\$ 20,160
FGM_CL_11	15.920	15.030	45	150	17.62	HDUGOOD SOIL	2.2	4.00	2.00	\$ 10,759	0.93	\$ 10,006	\$ 8,979	\$ 18,986
FGM_CL_12	14.970	12.610	75	150	15.87	HDUGOOD SOIL	2.1	4.00	2.00	\$ 16,737	0.93	\$ 15,565	\$0	\$ 15,566
FGM_CL_13	11.410	10.560	50	150	13.75	RURGOOD SOIL	2.8	4.00	2.00	\$ 11,024	1.13	\$ 12,457	\$ 8,979	\$ 21,437
FGM_CL_14	5.300	-3.200	180	225	5.72	URBGGOOD SOIL	4.7	4.00	4.00	\$ 101,407	1.13	\$ 114,590	\$ 5,535	\$120,126
FRM_CL_01	28.130	26.260	40	150	29.75	RURGOOD SOIL	2.6	4.00	2.00	\$ 9,512	0.98	\$ 9,322	\$0	\$ 9,322
SPS 12														\$ 91,000
SPS 100														\$138,500

1,264,439

D.3 Thorneside Costs

MUID	Up Level	Dw Level	Length (m)	DIA (mm)	Avg ELEVAT	ZSCONCAT	AVG DEPTH	DEPTH CLS1	DEPTH CLS2	BASERATE	D_S_FCT R	ADJ_RATE	MH costs	Total
FGM_TH_01	-2.670	-2.800	10	675	3.00	RURPOOR SOIL	5.7	4.00	4.00	\$ 21,750	1.12	\$ 24,360	\$6,355	\$30,715
FGM_TH_02	9.490	8.210	80	525	10.88	URBGGOOD SOIL	2.0	4.00	2.00	\$ 78,353	1.10	\$ 86,189	\$9,389	\$95,578
FGM_TH_03	5.150	3.460	130	525	6.88	RURGOOD SOIL	2.6	4.00	2.00	\$ 126,409	0.92	\$ 116,296	\$14,637	\$130,934
FRM_TH_01	0.230	5.110	550	450	4.20	RURGOOD SOIL	1.5	4.00	1.00	\$ 301,497	0.92	\$ 277,377	\$0	\$277,378
FRM_TH_02	4.370	3.260	15	200	6.25	RURGOOD SOIL	2.4	4.00	2.00	\$ 3,488	0.93	\$ 3,244	\$0	\$3,244
FRM_TH_03	13.300	13.220	5	300	15.50	URBGGOOD SOIL	2.2	4.00	2.00	\$ 2,092	0.98	\$ 2,050	\$0	\$2,051
SPS 35												\$ 2,200,000		\$2,200,000
SPS 33												\$ 443,240		\$443,240
SPS 42												\$ 123,500		\$123,500

3,306,640

D.4 Victoria Point Costs

MUID	Up Level	Dw Level	Length (mm)	DIA (m)	Avg ELEVAT	ZSCONCAT	AVG DEPTH	DEPTH CLS1	DEPTH CLS2	BASERATE	D_S_F CTR	ADJ_RATE	MH costs	Total
FGM_VP_22	12.53	12.47	40	450	15.6	HDUGOOD SOIL	3.1	4.00	3.00	\$ 31,893	1.15	\$ 36,677	\$0	\$ 36,677
FGM_VP_23	12.47	12.41	35	450	14.8	HDUGOOD SOIL	2.3	4.00	2.00	\$ 22,831	0.98	\$ 22,374	\$0	\$ 22,375
FGM_VP_24	12.24	11.76	150	375	15.3	HDUGOOD SOIL	3.3	4.00	3.00	\$ 123,030	1.15	\$ 141,484	\$ 5,535	\$ 147,020
FGM_VP_25	-2.5	-2.55	15	200	0.0	URBPOOR SOIL	2.5	4.00	2.00	\$ 4,145	0.93	\$ 3,855	\$0	\$ 3,855
FGM_VP_26	-2.35	-2.38	10	200	2.8	RURPOOR SOIL	5.1	4.00	4.00	\$ 5,110	0.93	\$ 4,752	\$ 7,134	\$ 11,887
FGM_VP_27	-2.55	-2.6	5	250	2.8	URBPOOR SOIL	5.3	4.00	4.00	\$ 1,646	0.93	\$ 1,531	\$0	\$ 1,531
SPS138												\$ 95,250		\$ 95,250
SPS68												\$ 95,250		\$ 95,250

413,845

D.5 Mount Cotton Costs

MUID	Up Level	Dw Level	Length (m)	DIA (mm)	Avg ELEV AT	ZSCONCAT	AVG DEPTH	DEPTH CLS1	DEPTH CLS2	BASERATE	D_S_F CTR	ADJ_RATE	MH costs	Total
FRM_MC_01	13.54	14.19	92	225	16.0	RURGOOD SOIL	2.1	4.00	2.00	\$ 29,646	0.93	\$ 27,570	\$ 0	\$ 27,571
FRM_MC_02	14.19	14.63	240	225	16.5	RURGOOD SOIL	2.1	4.00	2.00	\$ 77,760	0.93	\$ 72,316	\$ 0	\$ 72,317
FRM_MC_03	14.63	17.15	720	225	18.0	RURGOOD SOIL	2.2	4.00	2.00	\$ 233,280	0.93	\$ 216,950	\$ 0	\$ 216,950
FRM_MC_04	17.15	32.50	130	225	25.1	URBGGOOD SOIL	0.3	1.00	1.00	\$ 28,990	1.20	\$ 34,788	\$ 0	\$ 34,788

351,626

D.6 Dunwich Costs

No Works currently planned

D.7 Point Lookout Costs

MUID	Up Level	Dw Level	Length	DIA	Avg ELEVAT	ZSCONCAT	AVG DEPTH	DEPTH CLS1	DEPTH CLS2	BASERATE	D_S_F CTR*	ADJ_RATE	MH costs	Total
FGM_PT_01			271	225		URBSAND	2.5	4.00	2.00	\$ 87,804	4.35	\$ 381,896	\$ 13,661	\$ 381,896
FGM_PT_02			400	225		URBSAND	2.5	4.00	2.00	\$ 129,600	4.56	\$ 591,335	\$ 47,814	\$ 591,335
FGM_PT_03			90	225		URBSAND	2.5	4.00	2.00	\$ 29,160	4.66	\$ 135,953	\$ 13,661	\$ 135,953
FGM_PT_04			104	150		URBSAND	2.5	4.00	2.00	\$ 104,000	4.16	\$ 432,912	\$ 6,830	\$ 432,912
FGM_PT_05			65	150		URBSAND	2.5	4.00	2.00	\$ 15,145	4.55	\$ 68,879	\$ 6,830	\$ 68,879
FGM_PT_06			116	150		URBSAND	2.5	4.00	2.00	\$ 27,028	4.86	\$ 131,224	\$ 20,491	\$ 131,224
FGM_PT_07			195	150		URBSAND	2.5	4.00	2.00	\$ 45,435	4.70	\$ 213,467	\$ 27,322	\$ 213,467
FGM_PT_08			271	150		URBSAND	2.5	4.00	2.00	\$ 63,143	5.07	\$ 320,168	\$ 61,475	\$ 320,168
FGM_PT_09			114	150		URBSAND	2.5	4.00	2.00	\$ 26,562	4.61	\$ 122,484	\$ 13,661	\$ 122,484
FGM_PT_10			131	150		URBSAND	2.5	4.00	2.00	\$ 30,523	4.54	\$ 138,712	\$ 13,661	\$ 138,712
FGM_PT_11			209	150		URBSAND	2.5	4.00	2.00	\$ 48,697	4.94	\$ 240,492	\$ 40,983	\$ 240,492
FRM_PT_01			1570	225		URBSAND	1.0	4.00	1.00	\$ 667,250	4.29	\$ 2,863,000	\$ 0	\$ 2,863,000
SPS 69												\$ 50,000		\$ 50,000
SPS 70												\$ 50,000		\$ 50,000
SPS 71												\$ 4,380,000		\$ 4,380,000
SPS 72												\$ 50,000		\$ 50,000
SPS 103												\$ 50,000		\$ 50,000

* Increased factor rates has allowed for the augmentations being on the island

10,220,522

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