



**79-99 Courtney Drive
Upper Coomera Qld 4209**

**Water Supply and Sewerage Network
Hydraulic Analysis**

FINAL Report V9 - 30 May, 2022



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1 INTRODUCTION

1.1 Background

A residential sub-division on 79 to 99 Courtney Drive, Upper Coomera QLD 4209, lots 188-192 on RP173728, is currently in the planning phase of the Development Application (DA) process. The site has an estimated land area of 18.9 hectares and will comprise of 196 residential freehold allotments. The development is located within the Upper Coomera development area.

To support the DA, City of Gold Coast (CoGC) has requested the following works to be submitted, with respect to water supply and sewerage infrastructure.

- A hydraulic modelling assessment of the proposed internal networks, including staging layout and preparation of reticulation schematic plans, to ensure adequate service will be achieved throughout the sub-division.
- A network capacity assessment to determine if the site's additional loading will impact CoGC's existing systems and trigger the need for infrastructure upgrades. Note CoGC completed a sewer modelling study in May, 2017, identifying infrastructure upgrades to service the Upper Coomera development area along Courtney Drive (refer Appendix 1). This study formed the basis for any potential infrastructure upgrades triggered by the subject site.

Morton Urban Solutions Pty Ltd developed a water supply and sewerage reticulation layout plan and service strategy for the proposed development on 79 to 99 Courtney Drive, Upper Coomera (refer to Appendices 2 and 3 for further details). With the adoption of these service plans, H2One Pty Ltd was engaged to undertake the above assessments requested by CoGC, in accordance with the *South East Queensland Water Supply and Sewerage Design and Construction Code* (SEQ WS&S D&C Code) (2020). The outcomes of the study are presented in this report.

1.2 Objectives

The main objectives of the project were as follows.

1. Estimate potable water supply and sewerage demands for the proposed development.
2. With the adoption of CoGC's Local Government Infrastructure Plan (LGIP) hydraulic models, introduce proposed water supply and sewerage infrastructure as per Morton Urban Solutions' service strategy and reticulation schematic plans (refer Appendix 3), and complete a hydraulic analysis to determine if the proposed networks will perform within CoGC's Design Standards.
3. Assess the capacity of CoGC's existing water supply and sewerage networks to determine infrastructure upgrades necessary to achieve the minimum Design Standards, where system performance failures have occurred due to the additional loading of the new development.
4. Issue an RPEQ certified hydraulic assessment report outlining outcomes of the assessment.

1.3 Sewer Catchment System

The development site is located within the SPS PA1 sewerage catchment, at the southern extremity of Courtney Drive. The proposed service strategy consists of constructing a DN225 trunk gravity sewer line along Courtney Drive, which will traverse east through neighbouring properties and connect into the existing DN300 along Richardson Crescent. Two additional connections are proposed on the existing DN150 gravity mains along Mackellar Drive and Gordon Drive.

The development's sewage outfall will be conveyed north-east via DN300, DN375 and DN450 gravity mains along Reserve Road and Clydesdale Drive, and discharge to SPS PA1, approximately 3.3 km east of the subject site. SPS PA1 boosts flow to a downstream catchment (PA9) where wastewater is ultimately transferred to the Pimpama Sewage Treatment Plant (STP).

SPS PA1 currently services an estimated 12,000 EP, which is projected to increase to a maximum of 17,000 EP at the Ultimate planning horizon (2066).

Refer to Appendices 2, 3 and 4 for an overview of the development site and relevant service strategy.

1.4 Water Supply Zone

The development site is proposed to be serviced by the Upper Coomera High Level Zone (HLZ), which is supplied by the Upper Coomera tank (UC03), via a trunk system of DN375, DN300, DN225 and DN200 mains along Skyridge Drive, Heatherdale Drive, Torrington Street and Wimmera Crescent.

The proposed service strategy was discussed with CoGC and consists of constructing a DN200 main, extending from the newly constructed DN200 main running south to north along the existing fire trail from Wimmera Crescent, to Stage 35 of the Highland Reserve development (refer Appendix 5 for further details).

The Upper Coomera tank (UC03) is located to the south-west of the site approximately 4.0 km along the pipe alignment, and is situated at a ground level of RL 97 m AHD. The Upper Coomera tank currently services 3,800 EP, which is estimated to increase to a maximum of 5,600 EP at the ultimate planning horizon.

Refer to Appendices 2, 3 and 6 for an overview of the development site and relevant service strategy.

1.5 Demand Assessment

A demand assessment of the development was undertaken to determine the approximate potable water and sewage demands attributed to the proposed land use type and density. This was calculated using the CoGC's adopted Equivalent Tenement (ET) unit rates and average "per capita" demands for potable water @ 220L/EP/day, and sewage @ 200 L/EP/day and 180 L/EP/day for the 2021-2041 and 2066 planning horizons, respectively. Table 1 shows a summary of the development's demand estimation.

Table 1. Estimated demands for the proposed development

Site Land Use and Density	Demand Rate	ET	EP	Water (kL/day)	Sewage (kL/day)
196 x res. allotments	1 ET / Lot	196.0	546.8	120.3	109.4

Note: Based on 2.79 ET to EP conversion

Prior to the analysis, the demands presented in Table 2 below were introduced to the sewer hydraulic model to account for planned development within the PA1 catchment. These figures were advised by CoGC and consider existing LGIP demands already present in the model.

Table 2. Development demands (EP) introduced to the sewer hydraulic model

Address	Sewer Node ID	2016 to 2066
155 Baileys Mountain Rd, Upper Coomera	S111-00177M	212.3

2 METHODOLOGY

2.1 Design Standards

The design standards of the “*South East Queensland Water Supply and Sewerage Design and Construction Code*” (2020) were utilised for the assessments. A summary of the most relevant requirements are as follows.

Table 3. SEQ WS&S D&C Code provisions relevant to the analysis

	Provision	Specification
Sewerage	ET to EP conversion factor	2.79
	Average Dry Weather Flow (ADWF)	200 L/EP/day - 2021-2041 and 180L/EP/day -2066
	Peak Wet Weather Flow (PWWF)	5 x ADWF
	Single pump capacity	C1 x ADWF (L/s) where; C1 = 3.5 to 5.0 C1 = 15 x (EP) ^{-0.1587}
	Pump station operational storage (m³)	0.9 x Q / N where; Q = Single pump capacity (L/s) N = Number of pump starts per hour, where N = 12 for duty pump motor < 100 kW N = 8 for duty pump motor 100 – 200 kW N = 5 for duty pump motor > 200 kW
	Pump station emergency storage (m³)	4 hours ADWF
	Total pump station capacity (L/s)	PWWF
	Minimum gravity pipe grade	DN150 - 1:100 for first 10 allotments, 1:150 for following allotments DN225 - 1:300
	Minimum ground cover	0.6 m in allotment or pathway 0.9 m in roadway
	Maximum depth of gravity flow (proposed system)	75% pipe diameter
	Maximum depth of gravity flow (existing system)	1.0 m below manhole level
	Maximum rising main flow velocity	3.0 m/s
Water Supply	ET to EP conversion factor	2.73
	Average Day Demand	220 L/EP/day
	Maximum pipe velocity (m/s)	2.5 m/s
	Standard flow minimum network pressure and background demand	22m at the property boundary at PH demand
	Residential fire flow minimum network pressure and background demand	12m at 2/3 PH demand Positive pressure at PH demand Reservoir at Minimum Operating Level (15%)
	Commercial fire flow minimum network pressure and background demand	12m at PH demand
	Fire flows	Residential - 15L/s Commercial/industrial - 30L/s

2.2 Sewer Hydraulic Assessment

The methodology adopted for the sewerage hydraulic modelling assessment is as follows.

2.2.1 Internal Reticulation Layout and Service Strategy

1. CoGC's InfoWater SWMM LGIP hydraulic model (*PI_LGIP_2014*) was adopted for the study.
2. The development's sewer pipe layout was introduced to the base model as a background layer and model elements drawn manually. The following data was subsequently introduced to the model.
 - a. Nominal pipe diameters and minimum pipe grades.
 - b. Manhole invert levels and minimum ground cover, based on ground contours from the proposed finished surface levels presented in Appendix 3.
 - c. Lot demands (EP) based on closest proximity to nodes.
3. A hydraulic analysis was undertaken on the development's internal pipe layout and service strategy, where pipe sizes and grades were systematically adjusted to achieve relevant design requirements.

2.2.2 CoGC Network Capacity Assessment

4. The pump capacity of SPS PA1 was assessed by comparing the PWWF required to service the catchment, pre- and post-development, to available pump capacities presented in CoGC's LGIP report.

If the combined pump capacity was above the catchment's PWWF, relevant design standards were achieved. If it was below the PWWF, upgrades were investigated until compliance was attained.

5. The wet well operational storage of SPS PA1 was subsequently evaluated by comparing the required operational storage capacity, post-development, against wet well volumes between duty pump start/stop levels.

If the wet well's operational storage volume was above the minimum requirement, compliance was achieved. If it was below the minimum requirement, upgrades were investigated until design standards were achieved.

6. The flow depth of gravity mains was assessed from the proposed connection points to SPS PA1, at post-development PWWF. To avoid surcharging from unrelated issues downstream, pumps were deactivated from the model and gravity mains discharged directly to a wet well outlet.

If flow depths could not be maintained within CoGC specifications, pipe augmentations were investigated until design standards were achieved.

7. The emergency storage for the SPS PA1 catchment was assessed by determining the available ADWF network volume between 300 mm below the overflow level (RL 3.04 m - 300 mm) and pump duty start level (RL -2.13 m AHD). This was achieved by calculating the "empty" volume of the network and subtracting the post-development ADWF volume already present in the network.

The available emergency storage was compared against the 4 hour ADWF requirement. If the available storage was above the minimum requirement, compliance was achieved. If it was below the minimum requirement, compliance was not achieved and storage augmentations were investigated.

8. Modelling results were verified and findings reported.

2.3 Water Supply Hydraulic Assessment

The methodology adopted for the water supply hydraulic modelling assessment is as follows.

2.3.1 Internal Reticulation Layout and Service Strategy

1. CoGC's InfoWater LGIP hydraulic model (*Northern v102_WSSIP_2019*) was adopted for the study.
2. The development's water pipe layout was introduced to the base model as a background layer and model elements drawn manually. The following data was subsequently introduced to the model.
 - a. Nominal pipe diameters and relevant Hazen Williams pipe roughness.
 - b. Node/hydrant elevation based on ground contours from the proposed finished surface levels presented in Appendix 3.
 - c. Lot demands (EP) and diurnal patterns based on closest proximity to nodes/hydrants.
 - d. Residential (15 L/s) fire flow allocation applied to all hydrants.
 - e. CoGC advised that the UC03 water supply tank operates at a maximum level of 40% depth (3.0 m). The hydraulic model was adjusted to reflect this.

Note: The "MD_WSSIO19_YEAR_2016" scenario presented the lowest network pressures across all planning horizons, therefore it was adopted for sizing the internal pipe network.

3. A standard flow and fire flow hydraulic analysis was undertaken on the development's internal pipe layout and service strategy, at each development stage. Where required, pipe sizes were systematically increased and/or alignments adjusted to achieve relevant design requirements.

2.3.2 CoGC Network Capacity Assessment

4. A detailed 3 x consecutive Maximum Day (MD) demand standard flow analysis was undertaken on the Upper Coomera HLZ tank, property connection point/s and surrounding network, for both pre- and post-development scenarios. Any deficiencies in the network were investigated and appropriate solutions determined.
5. Residential (15 L/s) and commercial (30 L/s) fire flow allocation was applied to the surrounding network as per the CoGC's Infowater allocation. Hydrants surrounding the site were allocated 15 L/s fire flow, due to the site's significant residential usage.
6. A detailed fire flow analysis was undertaken on the nearest hydrants directly servicing the site and all hydrants within the surrounding network. This was completed for both pre- and post-development scenarios, with a 1 x MD event and supply tanks at MOL (15%). Any deficiencies in the network were investigated and appropriate solutions determined.
7. Modelling results were verified and deliverables prepared.

3 RESULTS

3.1 Sewer Internal Reticulation and Service Strategy

As per the methodology described in Section 2.2 of this report, a hydraulic analysis was undertaken on the proposed service strategy and internal sewer pipe reticulation, as per the layout plan provided by Morton Urban Solutions Pty Ltd.

The proposed pipe infrastructure presented sufficient grade, capacity and ground cover to service the subject site. The sewer hydraulic model pipe layout and raw modelling results is presented in Appendices 7 and 8, respectively. A summary of the proposed pipe network is presented in Table 4.

Table 4. Summary of infrastructure for the proposed sewer service strategy

Description	Location	Diameter (DN)	Length (m)
Sewer reticulation pipe	Within the development site	150	3,160
Sewer trunk pipe	Courtney Drive, neighbouring properties	225	520

The proposed DN225 trunk gravity main will service majority of the Upper Coomera Precinct, therefore pipe sizing was undertaken to accommodate the estimated PWWF from both the subject site and external development. Based on the upper limit of the zoned densities, as per CoGC's City Plan Major Update 2 and 3, and a service level limit of RL 65 m AHD, a PWWF of 17.5 L/s was estimated for the allotments that are likely to connect to the DN225 trunk main (refer Appendix 9 for detailed calculations and schematics).

At 75% d/D flow depth and minimum pipe grade (1:300), a DN225 gravity main provides approximately 23.6 L/s flow rate, therefore the proposed gravity main will have sufficient capacity to incorporate sewage loading from the subject site and relevant external development. It is recommended however that pipe sizing be confirmed at the Operational Works phase of the application process, to ensure sufficient capacity is available as town planning and densities from approved DA's progress.

3.2 Sewer Capacity Assessment

3.2.1 Pumps

A pump capacity assessment was undertaken on SPS PA1 as per the methodology described in Section 2.2 of this report. Refer to Table 5 below for a summary of results.

Table 5. Combined pump flow capacity results (post-development)

Planning Horizon	Capacity Available (kL)	Capacity Required (kL)	Difference (kL)
2016	256.2	155.9	+100.3
2066	256.2	214.3	+41.9

The above results demonstrate that there is sufficient capacity at SPS PA1 to incorporate the site's additional loading across all planning horizons. A pump capacity upgrade is therefore not required.

3.2.2 Wet Well

An assessment on the operational storage capacity of the SPS PA1 wet well was undertaken with the inclusion of the development's estimated loading. Refer to Table 6 below for a summary of results and Appendix 10 for detailed calculations.

Table 6. Operational storage capacity results (post-development)

Planning Horizon	Storage Available (kL)	Storage Required (kL)	Difference (kL)
2016	15.6	8.2	+7.4
2066	15.6	11.3	+4.3

Table 6 shows that the introduction of the site's demand did not adversely impact the operating volume of the SPS PA1 wet well. A storage capacity upgrade is therefore not required.

3.2.3 Gravity Mains

As per the methodology described in Section 2.0 of this report, gravity pipe flow depths were assessed against the CoGC's minimum requirement (1.0 m below manhole level), from the connection points to SPS PA1.

The analysis identified sufficient capacity to incorporate the site's additional loading up to the 2036 planning horizon. However, the 2066 planning horizon demonstrated insufficient pipe capacity at two locations downstream of the site. This necessitated approximately 210 m of DN300 parallel pipe augmentations to achieve the minimum Design Standards at the 2066 planning horizon (pipe ID's MS-PA1-19L1AUG, MS-PA1-20L1AUG, S111-02136ML1AUG, S111-02135ML1AUG and S111-02134ML1AUG). This augmentation was determined in conjunction with the overall pipe augmentation strategy from CoGC's Upper Coomera development area regional planning study (refer Appendix 1).

Refer to Appendix 10 for detailed results and Appendix 11 for the recommended gravity main upgrades.

3.2.4 Emergency Storage

An emergency storage capacity assessment was undertaken on the SPS PA1 catchment, with the inclusion of the additional ADWF from the proposed development (1.5 L/s). Refer to Table 7 below for a summary of results and Appendix 10 for detailed calculations.

Table 7. Emergency storage capacity results (post-development)

Planning Horizon	Storage Available (kL)	Storage Required (kL)	Difference (kL)
2016	514.3	404.8	+109.5
2036	514.3	410.0	+104.2
2066	510.4	539.2	-28.8

Table 7 shows that the SPS PA1 catchment has sufficient emergency storage to incorporate the development's loading up to 2036 planning horizon. The 2066 planning horizon presented insufficient capacity and will therefore require a 28.8 kL storage upgrade to satisfy CoGC's Design Standards.

The subject site is estimated to have contributed 74% towards the storage upgrade, with the remaining component attributed to the approved development at 155 Baileys Mountain Road, Upper Coomera. For the development approval process, it is recommended that CoGC only considers the component of the augmentation attributed to the subject site.

3.3 Water Supply Internal Reticulation and Service Strategy

As per the methodology described in Section 2.3 of this report, a standard flow and fire flow hydraulic analysis was undertaken on the development's internal water supply network, as per the pipe layout and development staging provided by Morton Urban Solutions Pty Ltd.

The proposed pipe network presented a minimum pressure of 32.8 m for peak hour standard flow (J182H) and 13.7 m for 2/3 peak hour fire flow (J196H). This achieved CoGC's minimum Design Standard for both standard flow and 2/3 peak hour fire flow, across all development stages.

The maximum service pressure was observed at 55.9 m at node J210H, based on a ground level of RL 40.0 m. This marginally exceeded CoGC's "target maximum allowable" pressure of 55 m, however was below the "maximum pressure" requirement of 80 m. The existing Coomera HLZ network was also largely observed at pressures exceeding the 55 m target pressure. For these reasons, the resolution of excess pressure was not investigated.

The water supply hydraulic model pipe layout and raw modelling results is presented in Appendices 12-14. A summary of the proposed pipe infrastructure is presented in Table 8.

Table 8. Summary of infrastructure for the proposed water supply service strategy

Description	Location	Diameter (DN)	Length (m)
Water supply reticulation pipe	Within the development site	100	2,460
Water supply reticulation pipe	Within the development site	150	40
Water supply reticulation pipe	Entrance to development site	200	80

Note: The 80 m of DN200 is the approximate pipe length to connect to the newly constructed DN200 main located at the south-east corner of the subject site.

3.4 Water Supply Capacity Assessment

3.4.1 Standard Flow and Fire Flow

As per the methodology described in Section 2.3 of this report, a post-development standard flow and fire flow network analysis was undertaken on all planning horizons. A summary of results is presented in Tables 9 and 10 below.

Table 9. Standard flow network modelling results (post-development)

Provision	Planning Horizon					
	2016	2021	2026	2031	2036	2066
Connection point (CD_1_HY) min. pressure (m)	38.7	39.4	38.9	38.9	38.9	39.4
Network min. pressure (m)	19.7	20.8	20.0	20.0	20.0	20.0
Network min. pressure node ID	HE_11100514189_WTHY					
Network no. failures	2	2	2	2	2	2
Tank min. water level (%)	28%	28%	28%	28%	28%	28%
Max. pipe velocity (m/s)	1.9	2.0	2.0	2.0	2.0	1.8

The above results demonstrate that the network performed within CoGC's design standards, with exception to two minimum pressure failures throughout the network, across all planning horizons.

Further investigation revealed that these deficiencies were existing planning issues that were not triggered, nor significantly exacerbated by the inclusion of the development's loading and occurred across all pre- and post-development scenarios. It is recommended that CoGC investigates further and resolves pre-existing system failures where necessary. These Infrastructure upgrades related to standard flow are not required to service the development.

Refer to Appendix 15 for the modelling results pre- and post-development.

Table 10. Fire flow network modelling results (post-development)

		Planning Horizon					
Scenario		2016	2021	2026	2031	2036	2051
Peak Hour	Site hydrant (CD_1_HY) min. pressure (m)	29.6	30.1	29.7	29.7	29.7	30.7
	Network hydrants min. pressure (m)	13.6	14.6	14.0	14.0	14.0	14.3
	Network hydrant min. pressure node ID	HE_11100010870_WTHY					
	Network hydrants no. failures	0	0	0	0	0	0
2/3 Peak Hour	Site hydrant (CD_1_HY) min. pressure (m)	32.6	32.8	32.8	32.8	32.8	33.4
	Network hydrants min. pressure (m)	14.6	15.0	14.9	15.0	14.9	15.1
	Network hydrant min. pressure node ID	HE_11100010870_WTHY					
	Network hydrants no. failures	0	0	0	0	0	0

Note: Results based on supply reservoirs operating at MOL (15%), peak hour at 7 am and 2/3 peak hour at 7 pm

The above results demonstrate that the network performed within CoGC's fire flow requirements across all planning horizons. Infrastructure upgrades related to standard flow are not required to service the development.

No water supply infrastructure upgrades are therefore required for standard flow and fire flow service. Refer to Appendix 15 for the modelling results pre- and post-development.

4 CONCLUSION

A residential sub-division on 79 to 99 Courtney Drive, Upper Coomera QLD is currently in the planning phase of the Development Application (DA) process. The site has an estimated land area of 18.9 hectares and will comprise of 196 residential freehold allotments. The development is located within the Upper Coomera development area.

To support the DA, City of Gold Coast (CoGC) has requested the following works to be submitted, with respect to water supply and sewerage infrastructure.

- A hydraulic modelling assessment of the proposed internal networks and preparation of reticulation schematic plans, to ensure adequate service will be achieved throughout the sub-division.
- A network capacity assessment to determine if the site's additional loading (546 EP) will impact CoGC's existing systems and trigger the need for infrastructure upgrades.

The hydraulic analysis completed by H2One identified the following outcomes.

- The proposed internal pipe layouts and service strategies achieved CoGC's Design Standards, for both water and sewer.
- CoGC's water supply network has sufficient capacity to incorporate the proposed development and infrastructure upgrades are therefore not required.
- CoGC's sewer network has sufficient capacity to incorporate the proposed development up to the 2036 planning horizon. However, the 2066 planning horizon required the following infrastructure upgrades to service the site's additional loading.
 - 210 m of DN300 parallel gravity mains (refer Appendix 11 for layout plan).
 - 28.8 kL of emergency storage. Note the subject site is estimated to have contributed 74% towards this upgrade, with the remaining component attributed to the approved development at 155 Baileys Mountain Road, Upper Coomera.

It is therefore recommended that CoGC approves the recommended water supply and sewer service strategies presented in Appendix 3, with consideration to the infrastructure upgrades presented above.

Detailed modelling results and layout plans can be observed in Appendices 1 through 15.

5 REFERENCE LIST

CoGC. (2020). *SEQ Water Supply and Sewerage Design and Construction Code*. Gold Coast: City of Gold Coast

CoGC. (2018). *Water and Sewerage Connections Policy Procedure*. Gold Coast: City of Gold Coast

6 APPENDICES

Appendix 1. CoGC Upper Coomera development area hydraulic analysis

Briefing notes

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Subject: Upper Coomera Development Sewerage Network Capacity Assessment

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1. Introduction

The Upper Coomera development area is located in Upper Coomera on both sides of Courtney Drive and on the north-west side of Reserve Road as shown in Figure 1.1 and Figure 1.2. The development area falls within the sewerage pump station catchment (SPS) PA1 which is located within the Pimpama Sewerage Catchment.



Figure 1.1: Upper Coomera Development



The IDM_2013 EPs for the development area was updated based on the increase in densities, which was then used for modelling analysis. Only 2066 planning horizon was modelled to identify required augmentations due to increasing EPs within the development area.

The objectives of the study were to:

- ### 3. Demand Assessment

Upper Coomera Development Sewerage Network Capacity Assessment

Table 3.1: Total EPs within the development area and SPS PA1 catchment 'without' and 'with' the proposed development

	Without Proposed Development						With Proposed Development					
	2016	2021	2026	2031	2036	2066	2016	2021	2026	2031	2036	2066
Development lots	0	0	0	0	0	0	0	1,850	1,850	1,850	1,850	1,850
PA1	10,051	10,473	10,852	11,212	11,388	15,213	10,051	12,323	12,702	13,062	13,238	17,063

Table 3.2 shows the Peak Wet Weather Flow (PWWF) within the development area and SPS PA1 catchment.

Table 3.2: Peak Wet Weather Flow (L/s) to PA1

	Without Proposed Development						With Proposed Development					
	2016	2021	2026	2031	2036	2066	2016	2021	2026	2031	2036	2066
Development lots	0	0	0	0	0	0	0	22.5	22.5	22.5	22.5	22.5
PA1	122.1	127.3	131.9	136.3	138.4	184.9	122.1	149.8	154.4	158.7	160.9	207.4

4. Desired Standards of Service

The design standards of the "South East Queensland Water Supply and Sewerage Design and Construction Code" 2013 (SEQ Code) were utilised for the assessment. A summary of the most relevant requirements is provided in Table 4.1 below.

Table 4.1: SEQ Code provisions relevant to sewerage network analysis

Parameters	Specification
Average Dry Weather Flow (ADWF)	210 L/EP/day
Peak Wet Weather Flow (PWWF)	5 x ADWF
Single Pump Capacity (L/s)	$C1 \times \text{ADWF}$ where; $C1 = 3.5$ to 5.0 , $C1 = 15 \times (\text{EP})^{-0.1587}$
Pump station operational storage (m ³)	$0.9 \times Q/N$ where; Q = Single pump (duty) capacity (L/s) N – Number of pump starts per hour, where N = 12 for duty pump motor < 100 kW N = 8 for duty pump motor 100 – 200 kW N = 5 for duty pump motor > 200 kW
Pump station emergency storage (m ³)	4 hours ADWF
Total pump station capacity (L/s)	PWWF
Maximum depth of gravity flow (proposed system)	75% pipe full
Maximum depth of gravity flow (existing system)	1.0 m below manhole lid level.
Maximum rising main flow velocity (m/s)	3.0
Minimum rising main flow velocity (m/s)	0.75

5. Sewerage Network Modelling

The methodology adopted for the sewerage network analysis is as follows:

- Gold Coast Water and Waste's (GCWW) latest Local Government Infrastructure Planning (LGIP) InfoSWM Pimpama sewerage catchment network model (PI_LGIP_2014) was adopted for the analysis of 2066 planning horizon. The development area's updated demand was placed into the model at relevant manholes for 2066 planning horizon.
- An analysis was carried out for SPS PA1 upstream and further downstream network to identify pumps capacities.
- The new operational volume and emergency storage volume requirements were calculated using Table 4.1 loadings and compared with available volumes.
- Rising main capacity was assessed for existing and future pumps capacity requirements.
- The flow depth of gravity mains were assessed with Table 4.1 loadings within the SPS PA1 catchment. If the flow depths could not be maintained within the Council Specifications, augmentations were proposed to meet the requirements.
- Modelling results were then verified and findings reported.

6. Sewerage Network Capacity Assessment without the Proposed Development

6.1 Gravity Sewers

As per the methodology described in section 5, existing gravity sewer flow depths were assessed against the Council's minimum requirement (1.0 m below manhole lid level) from the development area to SPS PA1.

Modelling analysis results indicate that the existing gravity sewers from the proposed development connection manhole SAP ID: 00000009000149097 up to SPS PA1 would be adequate for 2066 PWWF demand without the proposed development load (Figure 6.1). It can be seen that five gravity sections between manholes 00000009000221749 and 00000009000225835, and two gravity sections between manholes 00000009000144477 and 0000000900024658 would have exceeded pipe capacity but not breach Council's maximum depth of gravity flow criteria (1m below manhole lid level).



The single and dual pumps capacities of existing PA1 pumps are 180 L/s and 260 L/s, respectively. The 2066 PWWF inflow to PA1 is 185 L/s. There is no surcharge at immediate upstream gravity pipes of the station (Figure 6.1).

SPS PA1 discharges through 375 mm diameter rising main. In 2066, the velocity in the rising main would be 1.6 m/s for single pump operation and 2.4 m/s for dual pumps operation, which would satisfy both maximum and minimum rising main velocity criteria in the SEQ Code.

The available operating wet well volume of PA1 is 13.2 m³. The required operational volume for PA1 is 13.5 m³ for existing pumps. Since PA1 pump capacity would not be required to be upgraded up to 2066, then the existing operational volume would not need to be changed.

Upper Coomera Development Sewerage Network Capacity Assessment

6.5 Emergency Storage

Available current emergency storage volume of PA1 is 278 m³, which is not adequate for any planning horizon. Additional emergency storage volume is proposed to be constructed in two stages:

Stage 1 – construction of additional 128 m³ storage by 2017

Stage 2 – construction of additional 134 m³ storage by 2032.

The spare capacity of emergency storage (after upgrade) at PA1 is shown in Table 6.1.

Table 6.1: Emergency storage requirements (kL) for SPS PA1

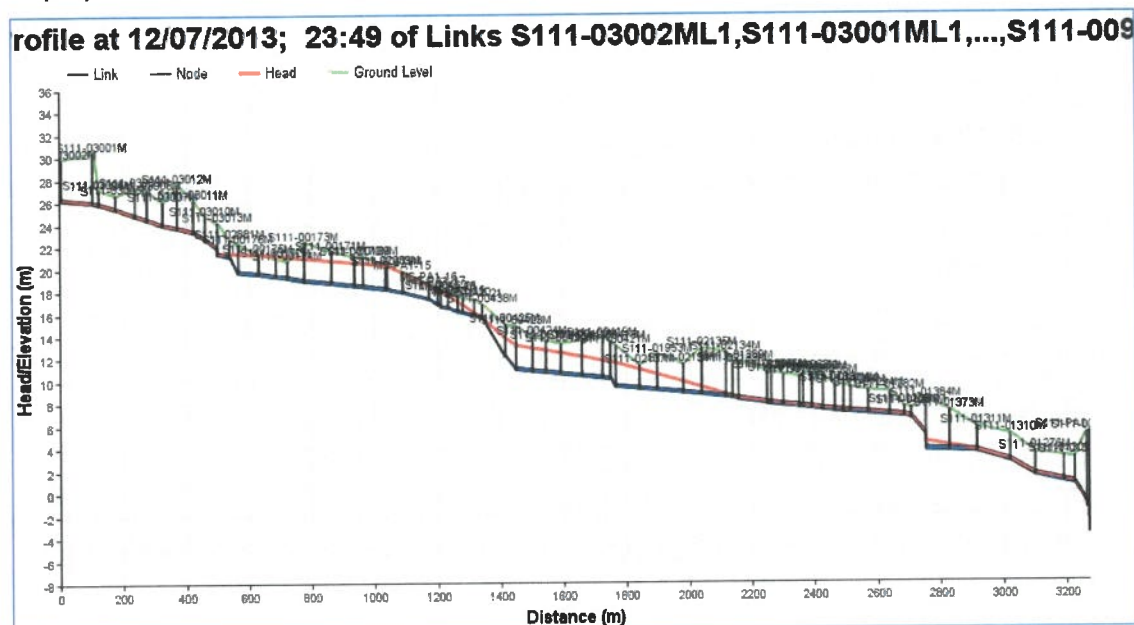
Parameter	Emergency Storage Volume (kL)					
	2016	2021	2026	2031	2036	2066
Available storage	278	406	406	406	540	536
Required storage	352	367	380	392	399	532
Spare Capacity	-74	39	26	14	141	4

Hence available PA1 emergency storage volume would be adequate up to 2066.

7. Sewerage Network Assessment with Proposed Development Demand

7.1 Gravity Sewers

The existing gravity sewers from the proposed development connection manhole 000000009000149097 up to SPS PA1 would not be adequate for 2066 PWWF demand with the proposed development load (Figure 7.1).



As seen from above Figure 7.1, several gravity sewer sections do not have adequate capacity to deliver 2066 PWWF and spills would occur at 5 manholes.

Further modelling and analysis has identified that following gravity sections (Table 7.1 and Figure 7.2) will need to be augmented with additional 300 mm diameter pipes to satisfy SEQ design criteria of 75% depth of flow for new sewers.

Table 7.1: Existing Gravity Sections Requiring Augmentation to accommodate the Proposed Development

Pipe SAP ID	Length (m)	Existing Main Diameter (mm)	Required Additional Main Diameter (mm)
000000009000221835	85.5	225	300
000000009000140434	26.7	225	300
000000009000221864	6.9	225	300
000000009000221870	21.7	225	300
000000009000105682	29.2	225	300
000000009000140311	13.8	225	300
000000009000140318	35.4	225	300
000000009000105695	23.5	225	300
000000009000221746	78.0	300	300
000000009000146844	57.5	300	300
000000009000146291	85.9	300	300
000000009000146840	60.0	300	300
000000009000027992	79.9	300	300
000000009000225832	18.6	300	300
Total	622.3		

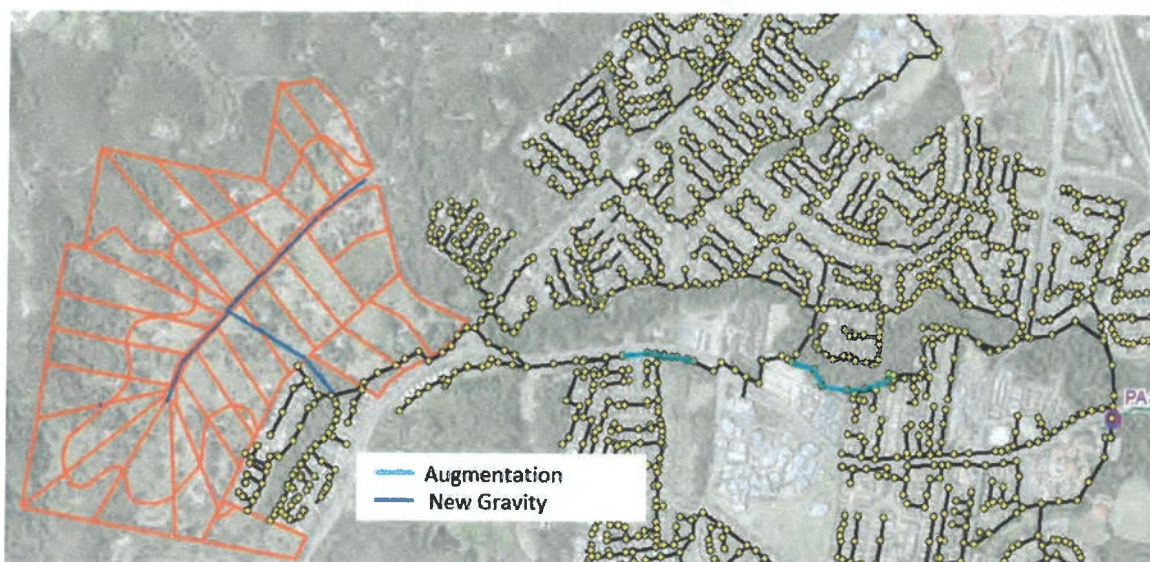


Figure 7.2: Required gravity sewers augmentation between development connection manhole 000000009000149097 and SPS PA1 (2066 Planning Horizon)

Hence existing PA1 operational volume is adequate until 2066 with the proposed development.

7.5 Emergency Storage

Since existing storage volume within PA1 catchment is not adequate for any planning horizon, additional storage volumes would be constructed to cater the demand from verified EPs. Table 6.2 shows the required emergency storage with proposed development.

Table 6.2: Emergency storage requirements (kL) for SPS PA1

Parameter	Emergency Storage Volume (kL)					
	2016	2021	2026	2031	2036	2066
Available storage	278	406	406	406	540	536
Required storage	352	431	445	457	463	597
Spare Capacity	-74	-25	-39	-51	+77	-61

The proposed development would require an additional emergency storage volume of 61 kL and available storage volume does not have adequate capacity to service this development.

Hence additional 61 kL of emergency storage would have to be constructed before development connection to service the proposed development up to 2066 planning horizon.

8. Summary of Augmentations

The following augmentations in Table 8.1 were identified to connect the proposed Upper Coomera developments to the Council's sewerage network. This is due to increase in densities in the proposed developments area.

Table 8.1: Required Augmentations within PA1 sewerage catchment

SPS Catchment	Infrastructure Augmentations	Infrastructure Size	Augmentation Year
PA1		623 m length of DN300 – Existing gravity sewer augmentations	Before development connection
		1370 m length of DN225 – New gravity sewers within Proposed Development	
	Gravity Sewers	20 new manholes – Within Proposed Development	
	Emergency Storage	61 m ³	Before development connection

9. Costing

Table 9.1 shows the total capital cost for the proposed augmentations. Cardno unit rates (2013) were used for the cost estimates. Adjustments were made for current year (2017). The overheads (20%) and contingencies (30%) were applied to base cost to calculate the total cost.

Table 9.1: Cost for Required Augmentations

SPS Catchment	Infrastructure Augmentations	Total Cost (\$)
PA1	Gravity Sewer Main – Existing gravity sewer mains augmentation	
	New gravity sewer mains in the development area	
	New Manholes in the development area	
	Emergency Storage	
Sub total		
	Overheads @ 20%	
Total		
	Contingency @ 30%	
Grand Total (2012 Dollars)		
Grand Total (Adjusted to 2017 Dollars)		

Note that pipe solution is adopted for emergency storage cost calculation.

10. Conclusions

The Upper Coomera development area would trigger the following augmentations requirements within PA1 sewerage catchment:

- Additional 243 m length of 300 mm gravity sewers from manhole 000000009000105826 to manhole 000000009000140368.
- Additional 380 m length of 300 mm gravity sewers from manhole 000000009000221749 to manhole 000000009000225830.
- New 1370 m length of 225 mm gravity sewers within the proposed development area.
- New 20 manholes within the proposed development area.
- Additional 61 kL of emergency storage at SPS PA1.
- Total capital cost of augmentations within PA1 catchment is [REDACTED].

Appendix 2. Proposed development layout

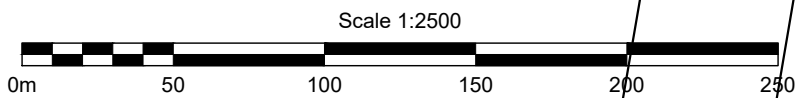
Residential Lots	196
Open Space Lots (Environmental)	4
Open Space Lots (Drainage)	5
Open Space Lots (Recreation)	2
Total Lots	207

Precinct Density

CSE Precinct

LOT SIZE MIX

	Size	Number	%
	400m ² - 449m ²	94	48%
	450m ² - 499m ²	55	28%
	500m ² - 599m ²	21	11%
	600m ² - 699m ²	13	7%
	700m ² +	13	7%



Sheet	of
1	6

PO Box 5021, GCMC QLD 9726

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mail@bennettandbennett.com.au

Surveying, Town Planning & Spatial Services
GOLD COAST | BRISBANE | SUNSHINE COAST | IPSWICH

www.bennettandbennett.com.au

NOTES:

1. Drawn to scale on an A3 sheet.
2. All dimensions and areas are subject to final survey and approval by G.C.C.C.
3. Dimensions shown are to the nearest decimeter.

A	Original Issue	DJR	05/11/20
Issue	Revision	Int	Date

Title:

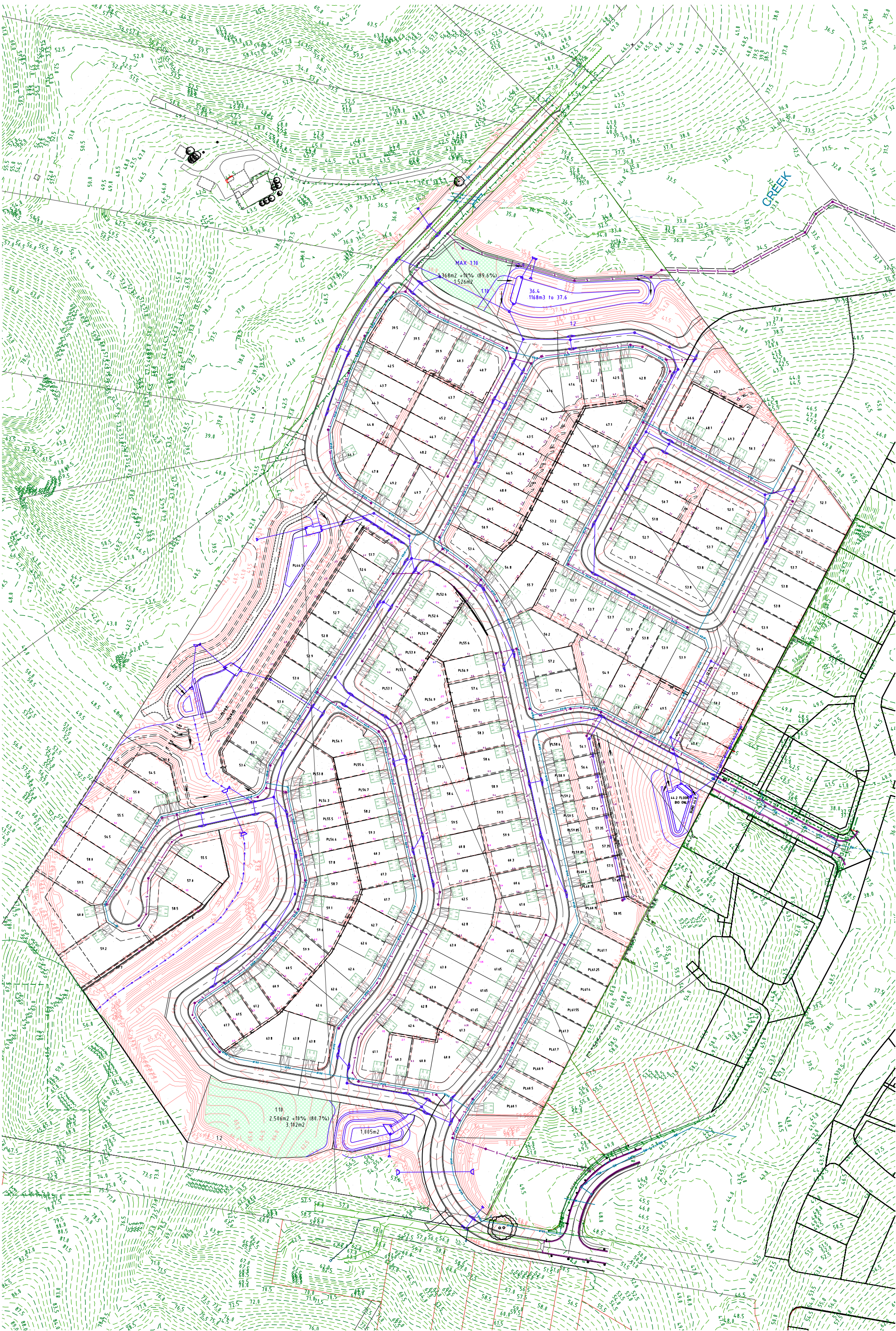
Plan of Proposed Subdivision Overall

Courtney Drive, Upper Coomera
(Described as Lots 188-192 on
RP173728)

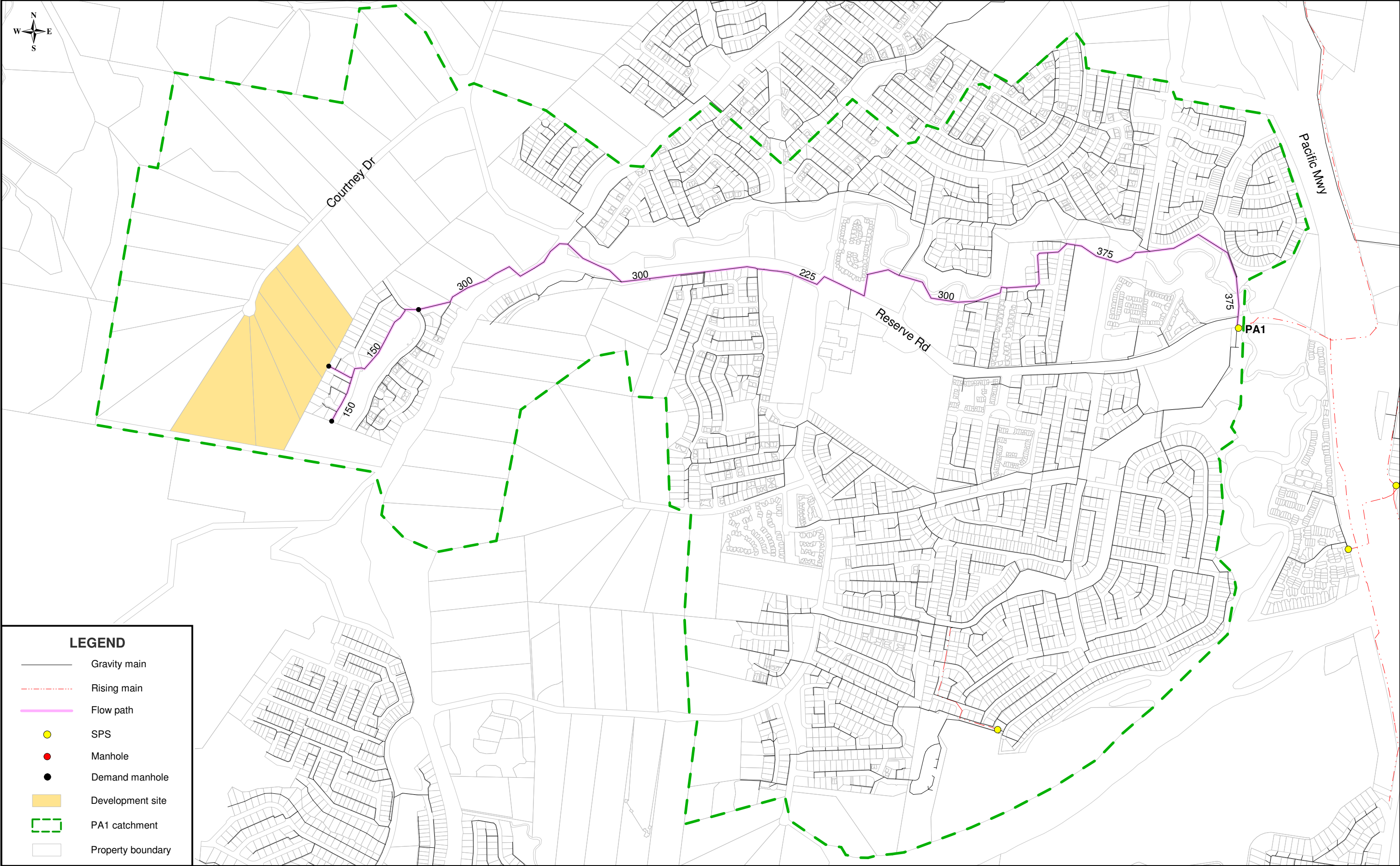
Client: **GALLERY HOMES**

Locality:	UPPER COOMERA		
Local Gov:	GCCC	Prepared By:	DJR
Surveyed By:		Approved:	----
Date Created:	05/11/2020	Scale:	1:2500
Comp File:			
Plan No:	171101_021_PRO		

Appendix 3. Proposed water supply and sewerage reticulation layout plans



Appendix 4. Development site and SPS PA1 sewer catchment



Gravity main

Rising main

Flow path

SPS

Manhole

Demand manhole

Development site

PA1 catchment

Property boundary

H2ONE Important Notice! This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground. H2One Pty Ltd gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. H2One Pty Ltd PO Box 290 IPSWICH QLD 4305 P: 07 5463 9538 E: info@H2One.com.au W: h2one.com.au	DESIGNED: D Colledge DRAWN: D Colledge CHECKED: J May APPROVED: J May CLIENT PM:	NOTE: DESIGN NOT TO BE AMENDED WITHOUT H2ONE PTY LTD ACCEPTANCE C REVISED ISSUE - 17 APR 2019 B REVISED ISSUE - 21 SEP 2018 A ORIGINAL ISSUE - 15 MAY 2018	H2ONE PM: J May No. REVISION APPROVED	DATUM: HORIZ: MGA94 (ZONE 56) HEIGHT: AHD SCALE: 0 200 400 Metres SURVEYED BY / DATE: SURVEY CHECKED:	H2ONE REFERENCES PROJECT NO: 1804245 FILE REFERENCE: CAD FILE:	CITY OF GOLD COAST CITY OF GOLD COAST PO BOX 5042, GCMC QLD 9729	79-99 Courtney Dr Upper Coomera QLD 4209 Water Supply and Sewerage Hydraulic Analysis Appendix 4. Development site and SPS PA1 sewer catchment	ORIGINAL ISSUE DATE: MAY, 2018 DATE SCANNED: DRG No: REV:
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Appendix 5. Proposed water supply service strategy discussed with CoGC

RE: Water & Sewer capacity for COM/2019/82 - 79-99 Courtney Drive, UPPER COOMERA

JOHNSON Mark <MJOHNSON@goldcoast.qld.gov.au>

Wed 7/08/2019 2:27 PM

To: David Colledge <davidcolledge@H2One.com.au>**Cc:** Joshua May <JoshuaMay@H2One.com.au>; SAHA Uttam <USAHA@goldcoast.qld.gov.au>

📎 2 attachments (3 MB)

116415_36F-signed.pdf; 116415_37D -signed.pdf;

David,

Following on from our previous dialog, an option to consider and investigate further, is the possibility for the development proposal to be supplied from the Upper Coomera Reservoir (UC03), with Bottom Elevation of 97m compared with Peanba Reservoir (CP01) bottom elevation of 84m.

Directly south of 97 & 99 Courtney drive, a DN200mm dia water main was constructed from Wimmera Cres, along the existing fire trail to service stage 35 of the Highland Reserve development. I've provide a screen shot outlining in red (design attached), the approximate location of the water main, please note the newly constructed water main as highlighted, is yet to be accepted on-maintenance by the City. However the water main is likely to be accepted, prior to commencement of works for your development.



Regards,

Mark Johnson

Executive Coordinator
Development Services
Gold Coast Water and Waste
City of Gold Coast

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PO Box 5042 Gold Coast Mail Centre Qld 9726
cityofgoldcoast.com.au

CITY OF
GOLD COAST.

From: David Colledge [mailto:davidcolledge@H2One.com.au]**Sent:** Wednesday, 7 August 2019 12:28 PM**To:** JOHNSON Mark**Cc:** Joshua May**Subject:** Re: Water & Sewer capacity for COM/2019/82 - 79-99 Courtney Drive, UPPER COOMERA

Hi Mark,

Just touching base to see how the water servicing options for above site are going? If you'd like to discuss over the phone feel free to contact myself on the details below.

Thanks

David Colledge
Water and Sewer Network Modeller
H2One Pty Ltd
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M +61 (0)408 859 594
W H2One.com.au

PO Box 290, Ipswich QLD 4305



From: JOHNSON Mark <MJOHNSON@goldcoast.qld.gov.au>

Sent: Friday, 2 August 2019 1:47 PM

To: Joshua May <JoshuaMay@H2One.com.au>; SAHA Uttam <USAHA@goldcoast.qld.gov.au>

Cc: Development Assessment <GCWDA@goldcoast.qld.gov.au>; JOSEPH Dominic <DJOSEPH@goldcoast.qld.gov.au>; JAHAN Syeda <SJAHAN@goldcoast.qld.gov.au>; Ashley Nankervis <ashley.n@galleryhomes.com.au>; Nicole Webb <nwebb@zoneplanning.com.au>; David Colledge <davidcolledge@H2One.com.au>

Subject: RE: Water & Sewer capacity for COM/2019/82 - 79-99 Courtney Drive, UPPER COOMERA

David,

We are currently investigating other alternate solutions to service the development and will require some more time, to ensure all other possible solutions have been investigated. Please note, Consideration of a booster zone would be our last course of action, should an alternative viable option cannot be achieved. As discussed, we will try to have some information/options provided to you by next COB Wednesday.

Should further information be required, please don't hesitate to contact me.

Regards,

Mark Johnson

Executive Coordinator
Development Services
Gold Coast Water and Waste
City of Gold Coast

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PO Box 5042 Gold Coast Mail Centre Qld 9726
cityofgoldcoast.com.au



From: Joshua May [mailto:JoshuaMay@H2One.com.au]

Sent: Thursday, 1 August 2019 1:28 PM

To: JOHNSON Mark; SAHA Uttam

Cc: Development Assessment; JOSEPH Dominic; JAHAN Syeda; Ashley Nankervis; Nicole Webb; David Colledge

Subject: Re: Water & Sewer capacity for COM/2019/82 - 79-99 Courtney Drive, UPPER COOMERA

Importance: High

This email originates from outside of the City of Gold Coast. If suspicious send it to spam@goldcoast.qld.gov.au

Hi Mark and Uttam,

Thanks for the information below.

The team and I have reviewed/discussed the field pressure logging results and proposed RL 55 m service limit. This will have a major impact on the design of the development, as excavation to reduce the existing levels to RL 60 m is already excessive. In addition, majority of the lots are in excess of the RL 55 m benchmark (refer attached).

Therefore, to meet the minimum design standards the only possible solution is a High Level Zone (HLZ) VSD booster pump set. *Could you please advise what's involved to seek approval for this service strategy?* A response at your earliest convenience would be appreciated.

Feel free to call David or myself if you'd like to discuss.

Thanks

Joshua May
BEng (hon) RPEQ
Principal Water and Sewer Engineer

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PO Box 290, Ipswich QLD 4305



From: SAHA Uttam <USAHA@goldcoast.qld.gov.au>
Sent: Tuesday, 30 July 2019 2:18 PM
To: Joshua May <JoshuaMay@H2One.com.au>; David Colledge <davidcolledge@H2One.com.au>
Cc: Development Assessment <GCWDA@goldcoast.qld.gov.au>; JOSEPH Dominic <DJOSEPH@goldcoast.qld.gov.au>; JOHNSON Mark <MJOHNSON@goldcoast.qld.gov.au>; JAHAN Syeda <SJAHAN@goldcoast.qld.gov.au>
Subject: RE: Water & Sewer capacity for COM/2019/82 - 79-99 Courtney Drive, UPPER COOMERA

Hi David,

With reference to my email (date: 20/06/19) below and attached IR Item 31, the following are the summary of our telephone conversation this morning.

- As the theoretical modelling identified that the existing networks are border line to meet the servicing standards of above development, we have monitored the pressure at three locations of proposed connection points to validate the concern. If above development were approved without this validation, the GCWW would be at risk to maintain the servicing standards.
- Refer to Table below for the minimum and maximum pressures recorded from the loggers. Based on the recorded logger data, the minimum HGL for three connections becomes 81m. It is to be noted that this HGL is representative of 2019 AD scenario. The servicing pressure for the entire network would drop in the future due to competing demand growth. As a result, HGL value at the Courtney Drive's three connections would drop further below 81m in the future. This has not accounted the consideration of MDMM and MD scenario. As per SEQ Code, the servicing standards should be assessed based on 2066 MD scenario.
- Considering above reason, 55m finished elevation can be serviced for above development in the current state of network as outlined in my previous email.

Loggers data were collected between 07/06/19 and 18/06/19 for the three connections. As requested, I am providing the loggers' raw data as well as attached Excel spreadsheet.

I understand that you will be sending the loggers data to the developer to convince them. I hope that above information clarifies your query.

Regards Uttam

From: JOSEPH Dominic
Sent: Tuesday, 30 July 2019 9:05 AM
To: 'JoshuaMay@H2One.com.au'
Cc: SAHA Uttam; Development Assessment
Subject: Water & Sewer capacity for COM/2019/82 - 79-99 Courtney Drive, UPPER COOMERA

Hi Joshua,

How are you?

Below are comments provided by Uttam.

Can you please review and respond to his queries below. Thank you.

Kind Regards

Dominic Joseph
Senior Development Engineer
Water and Waste
City of Gold Coast

T: (07)5582 8707
PO Box 5042 Gold Coast Mail Centre Qld 9729
cityofgoldcoast.com.au



From: SAHA Uttam
Sent: Thursday, 20 June 2019 9:22 AM
To: JOHNSON Mark; JOSEPH Dominic; DARWIN Nick
Cc: JAHAN Syeda; CACHO Michael; SUBRAMANIAM Subra; HUNTING Mark
Subject: Water & Sewer capacity for COM/2019/82 - 79-99 Courtney Drive, UPPER COOMERA

Hi Mark and Dominic,

With reference to our recent meeting, I had concern whether the existing water network can support above development approval. We have monitored the pressure at three locations of proposed connection points to validate the concern.

My understanding initial connection to existing mains in Gordon Dr for Stage 1 and Mackellar Drive for Stage 2. Another connection is likely along Courtney Drive & Baileys Mountain Rd.

The following are the interpretation based on logger data and modelling:

- Figure 4 shows the location of three loggers at Gordon Dr, Mackellar Dr and Reserve Rd (some hydrants near Baileys Mountain Rd roundabout are buried). The Reserve Rd monitored pressure should be considered as representative of Baileys Mountain Rd connection.
- As can be seen from Table 1, the model based HGL over predicts the HGL by 6m as compared to actual field data. Therefore, logger data is adopted to calculate the minimum elevation that can be serviced for the Courtney Dr development.
- The pressure reducing valve (PRV9003) located at the corner of Days Rd and Old Coach Rd was removed physically. Therefore, the supply to the Courtney Dr is coming from the Peanba potable water reservoir (TWL = 94m, bottom level of reservoir = 84m). The minimum HGL of ~81m obtained from pressure data is possibly the lowest level can be achieved from the system in its current state.
- Considering 22m minimum servicing standard, the possible servicing elevation becomes 59m (=81-22). There should be head loss through Courtney Dr reticulation network. So, 55m finished elevation can be serviced now in the current state of network. It is to be noted that the servicing pressure/ HGL would drop in the future.
- The elevations for some part of the lots (#79, #89, #91, #97, #99) are well above 55m. Therefore, developer has to satisfy the servicing connection requirement.

Conclusion: The existing networks in their current state are not adequate to service the entire lots. The developer has to demonstrate how it can be achieved.

Recommendation: Send this email to the consultant to manage the expectation of above development.

Regards Uttam

Table 1: Statistical pressure record and model based data

				Model based minimum HGL (m) in 2021AD
	minimum	maximum	average	
Pressure (m) at Reserve Rd (source: Figure 2-a)	50.43	60.88	55.08	
HGL (m) at Reserve Rd (elevation = 31.3m)	81.73	92.18	86.38	87.4
Pressure (m) at Gordon Rd (source: Figure 1-a)	32.48	46.83	38.33	
HGL (m) at Gordon Dr (elevation = 49m)	81.48	95.83	87.33	87.3
Pressure (m) at Mackellar Dr (source: Figure 3-a)	40.58	54.87	46.28	
HGL (m) at Mackellar Dr (elevation = 41m)	81.58	95.87	87.28	87.3

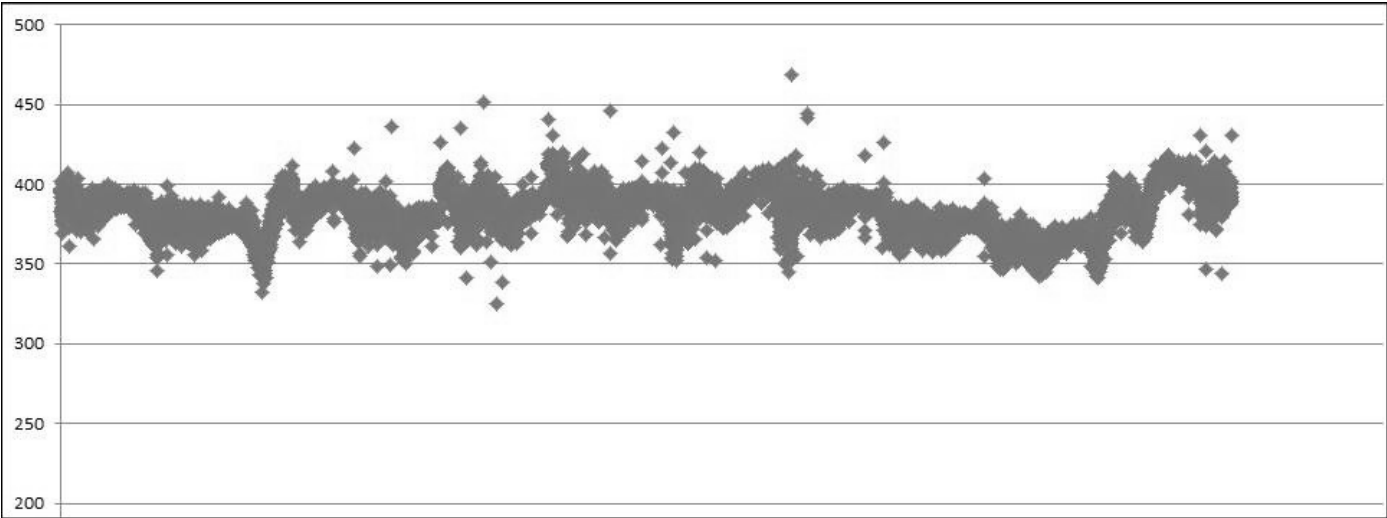


Figure 1-a: Logger's pressure record in kPa (between 07/06/19 and 18/06/19) at the end hydrant of Gordon Drive DN150 water main

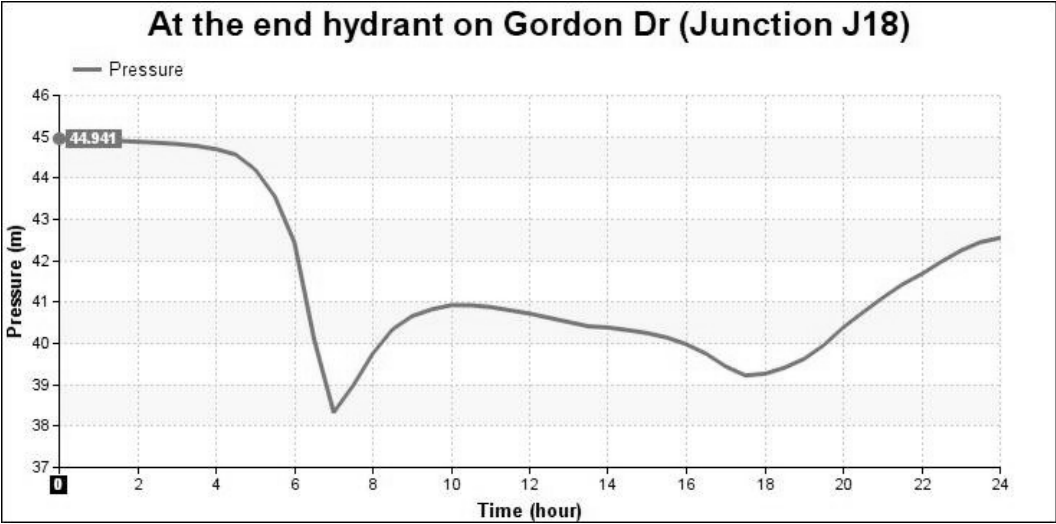


Figure 1-b: Model (version 99; 2021 AD) based pressure (in meter) data at the end hydrant of Gordon Drive DN150 water main

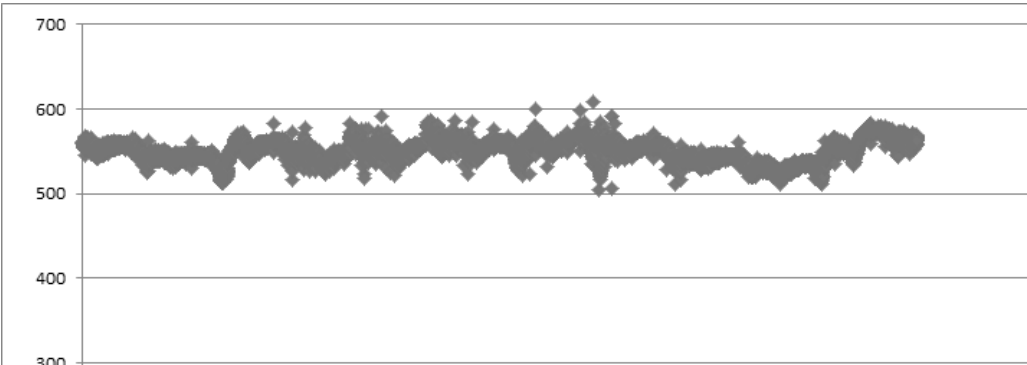


Figure 2-a: Logger's pressure record in kPa (between 07/06/19 and 18/06/19) at the hydrant on Reserve Rd DN200 water main

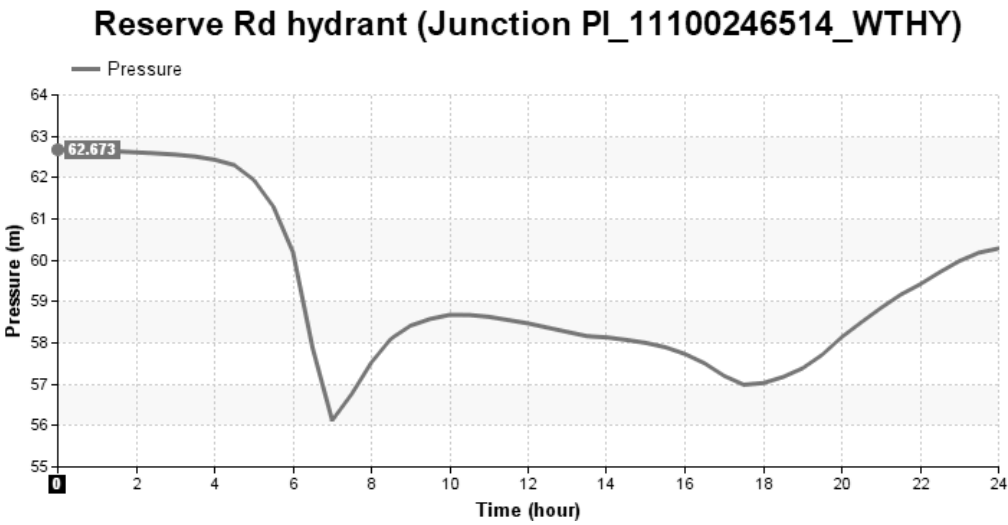


Figure 2-b: Model (version 99; 2021 AD) based pressure (in meter) data at the hydrant on Reserve Rd DN200 water main

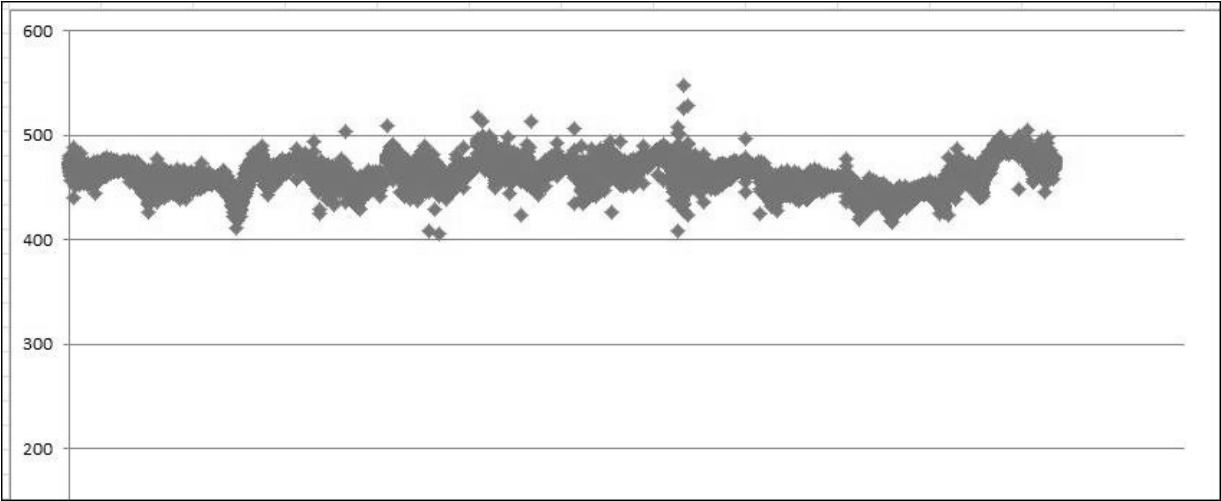


Figure 3-a: Logger's pressure record in kPa (between 07/06/19 and 18/06/19) at the hydrant on Mackellar Dr DN100 water main

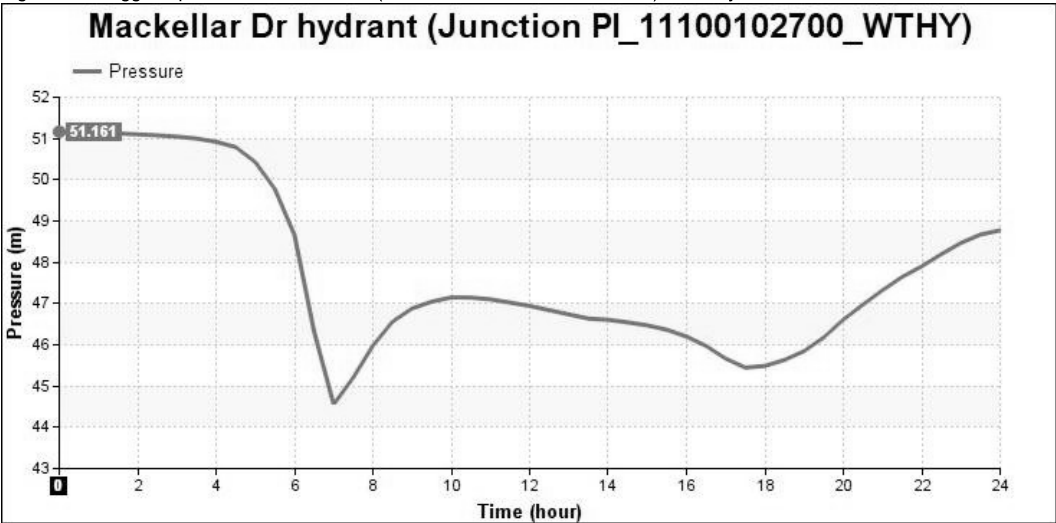


Figure 3-b: Model (version 99; 2021 AD) based pressure (in meter) data at the hydrant on Mackellar Dr DN100 water main

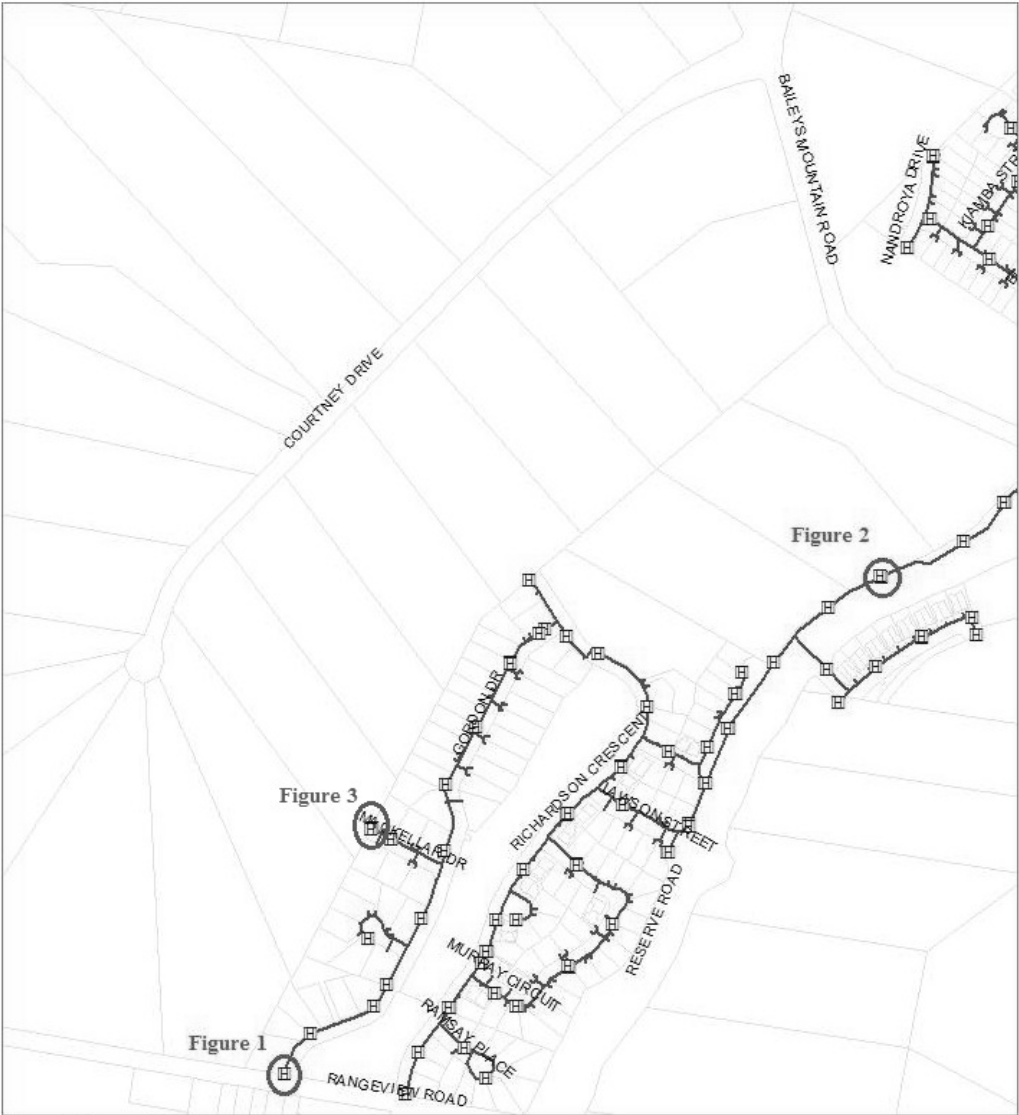


Figure 4: Logger location

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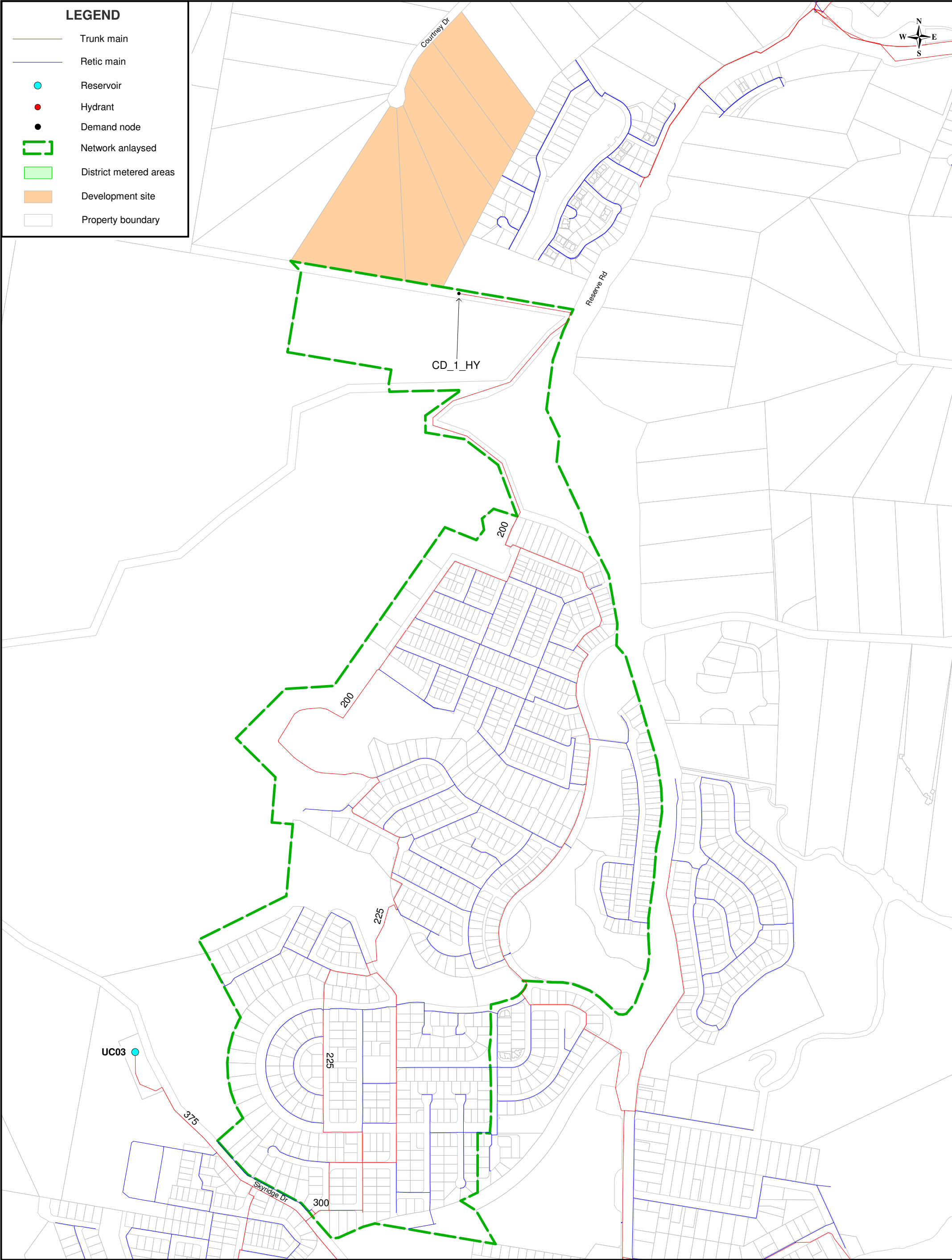
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Appendix 6. Development site and Upper Coomera HLZ water supply system



Appendix 7. Sewer hydraulic model pipe layout

Appendix 8. Modelling results for sewer reticulation layout

Nodes				
Node ID	IL (RL m)	SL (RL m)	Depth to IL (m)	Demand (EP)
JCT-14	55.080	57.551	2.471	10.32
JCT-16	32.600	34.000	1.400	0
JCT-18	27.470	29.000	1.530	0
JCT-20	28.230	29.000	0.770	0
JCT-22	31.075	33.000	1.925	0
JCT-24	57.773	59.003	1.230	0
JCT-26	51.150	52.200	1.050	0
MH1	45.950	47.000	1.050	0
MH10	58.100	60.374	2.274	10.32
MH100	45.880	46.930	1.050	0
MH101	47.605	48.655	1.050	10.32
MH102	47.928	48.978	1.050	10.32
MH103	51.362	52.412	1.050	10.32
MH104	51.623	53.316	1.693	10.32
MH105	52.430	53.480	1.050	10.32
MH106	52.513	53.563	1.050	10.32
MH107	50.918	51.968	1.050	10.32
MH11	59.522	60.572	1.050	10.32
MH12	58.210	60.759	2.549	0
MH13	58.654	60.822	2.168	10.32
MH14	58.780	60.849	2.069	10.32
MH18	59.030	60.080	1.050	10.32
MH19	57.900	58.950	1.050	10.32
MH2	49.000	50.000	1.000	0
MH20	55.050	56.100	1.050	10.32
MH21	53.303	54.353	1.050	0
MH22	49.275	50.325	1.050	10.32
MH23	45.881	46.931	1.050	0
MH24	41.998	43.048	1.050	0
MH25	53.748	54.798	1.050	10.32
MH26	54.594	55.644	1.050	0
MH27	54.950	56.190	1.240	0
MH29	55.129	57.713	2.584	0
MH3	57.750	58.881	1.131	0
MH30	55.374	56.486	1.112	0
MH31	55.460	56.510	1.050	10.32
MH32	52.449	53.499	1.050	10.32
MH33	60.938	61.988	1.050	10.32
MH34	59.540	62.195	2.655	10.32
MH35	60.327	62.148	1.821	0
MH36	59.820	62.306	2.486	0
MH37	59.920	62.276	2.356	10.32
MH38	60.895	61.945	1.050	10.32
MH39	60.707	61.757	1.050	0
MH4	57.830	59.301	1.471	10.32
MH40	60.140	61.190	1.050	10.32
MH41	53.864	54.914	1.050	0
MH42	53.372	54.422	1.050	10.32
MH43	53.770	54.820	1.050	0
MH44	52.906	53.956	1.050	10.32
MH45	51.446	52.496	1.050	0
MH46	51.845	52.895	1.050	10.32
MH47	52.302	53.352	1.050	0
MH48	52.443	53.493	1.050	10.32
MH49	52.623	53.673	1.050	10.32
MH5	58.155	59.205	1.050	10.32
MH50	56.796	57.846	1.050	0
MH51	57.670	58.720	1.050	10.32
MH52	59.647	60.697	1.050	0
MH53	59.980	61.030	1.050	10.32
MH54	60.350	61.400	1.050	0
MH55	61.634	62.684	1.050	0

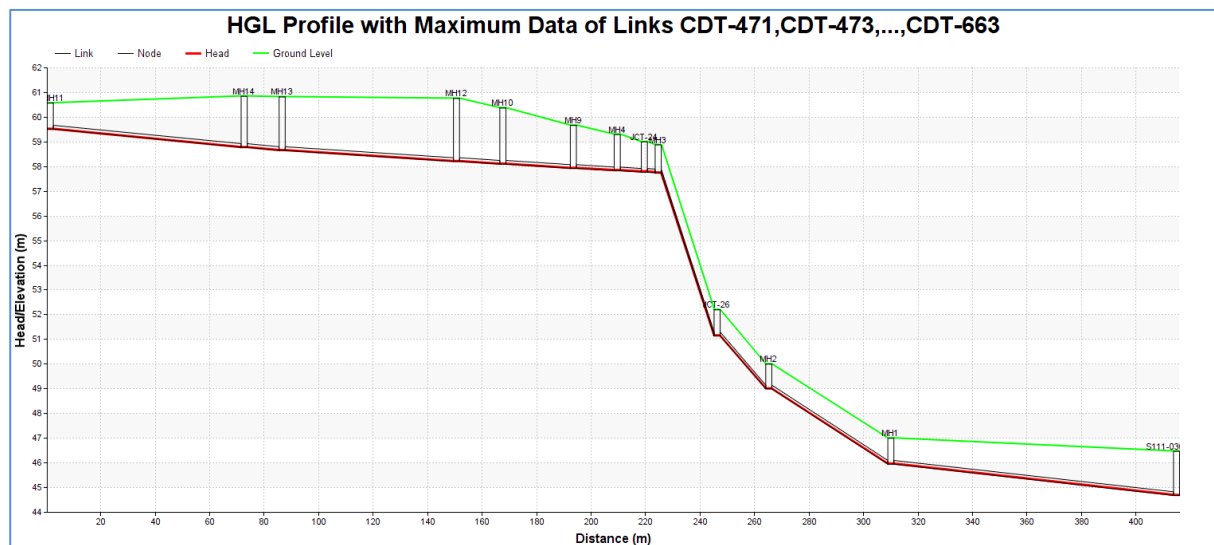
MH56	62.010	63.060	1.050	10.32
MH57	57.719	58.769	1.050	10.32
MH58	57.450	58.500	1.050	0
MH59	56.301	57.351	1.050	0
MH6	59.123	61.215	2.092	0
MH60	58.008	59.058	1.050	10.32
MH61	53.813	54.863	1.050	10.32
MH62	53.273	54.323	1.050	0
MH63	53.177	54.227	1.050	0
MH64	53.636	54.686	1.050	10.32
MH65	50.550	51.666	1.116	0
MH66	51.293	52.343	1.050	10.32
MH67	50.651	51.701	1.050	10.32
MH68	54.063	55.113	1.050	10.32
MH69	53.235	54.285	1.050	0
MH7	59.166	61.675	2.509	10.32
MH70	52.556	53.606	1.050	0
MH71	50.412	52.361	1.949	10.32
MH72	50.361	51.606	1.245	0
MH73	47.906	48.956	1.050	10.32
MH74	47.447	48.497	1.050	10.32
MH75	44.131	45.181	1.050	0
MH76	43.333	44.383	1.050	10.32
MH77	42.204	43.254	1.050	0
MH78	40.828	41.878	1.050	10.32
MH79	39.413	40.463	1.050	0
MH8	59.310	61.933	2.623	0
MH80	39.650	40.700	1.050	0
MH81	39.219	40.269	1.050	10.32
MH82	39.113	40.163	1.050	0
MH83	38.064	39.114	1.050	10.32
MH84	37.937	39.188	1.251	0
MH85	38.639	39.689	1.050	0
MH86	39.140	40.190	1.050	10.32
MH87	37.813	38.912	1.099	0
MH88	37.585	38.710	1.125	0
MH89	37.241	38.366	1.125	0
MH9	57.930	59.669	1.739	0
MH90	36.675	37.800	1.125	0
MH91	36.216	37.664	1.448	0
MH92	35.525	36.650	1.125	0
MH93	34.475	35.600	1.125	0
MH94	32.875	34.000	1.125	0
MH95	32.700	34.000	1.300	0
MH96	40.912	41.962	1.050	10.32
MH97	40.987	42.037	1.050	0
MH98	41.350	42.400	1.050	0
MH99	42.273	43.323	1.050	10.32

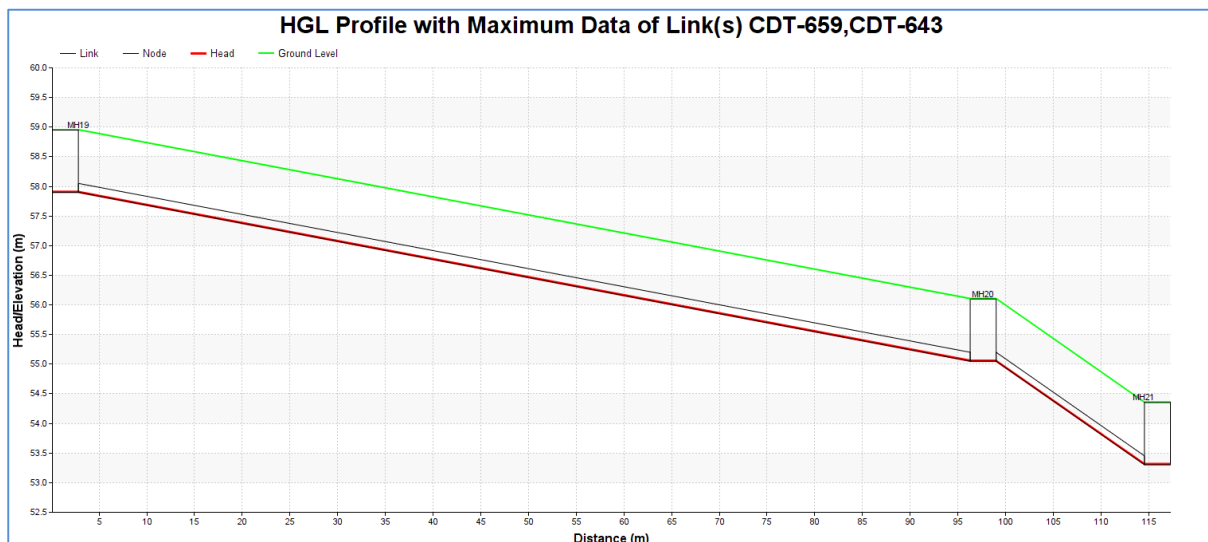
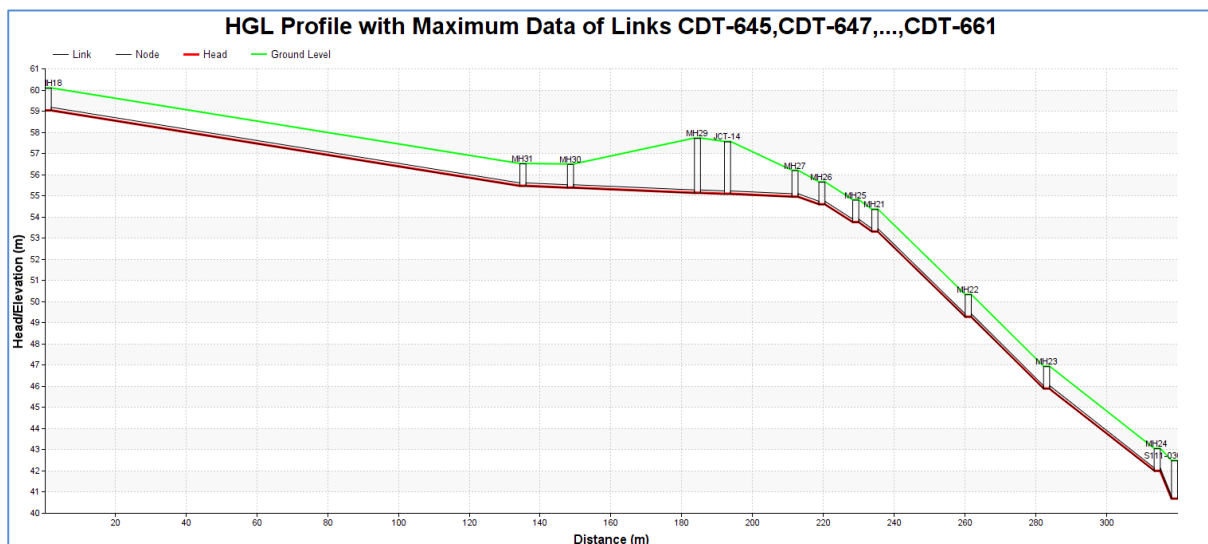
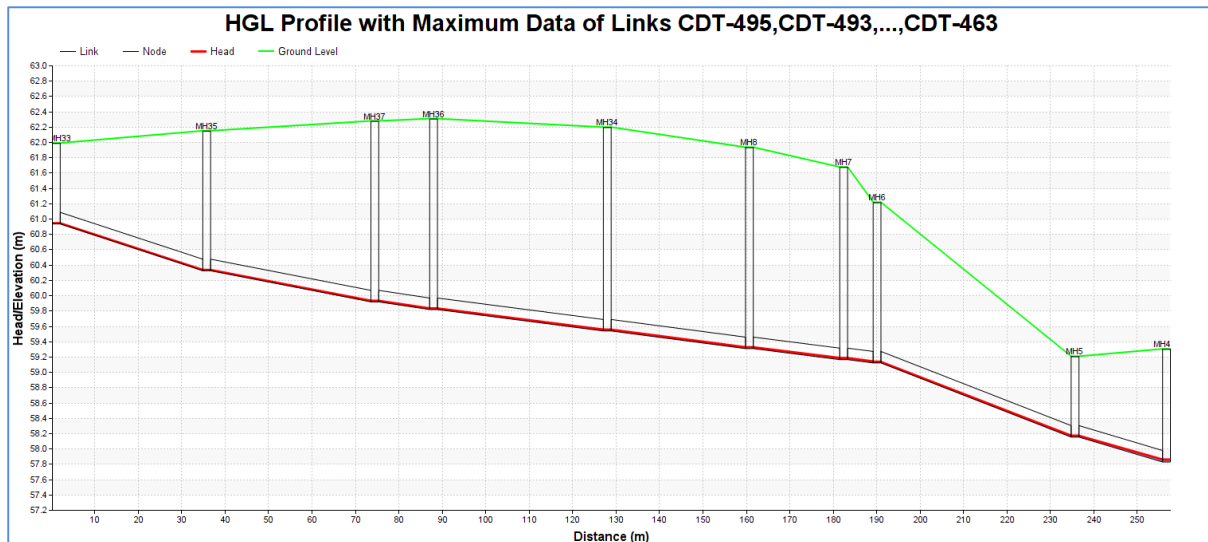
Pipes

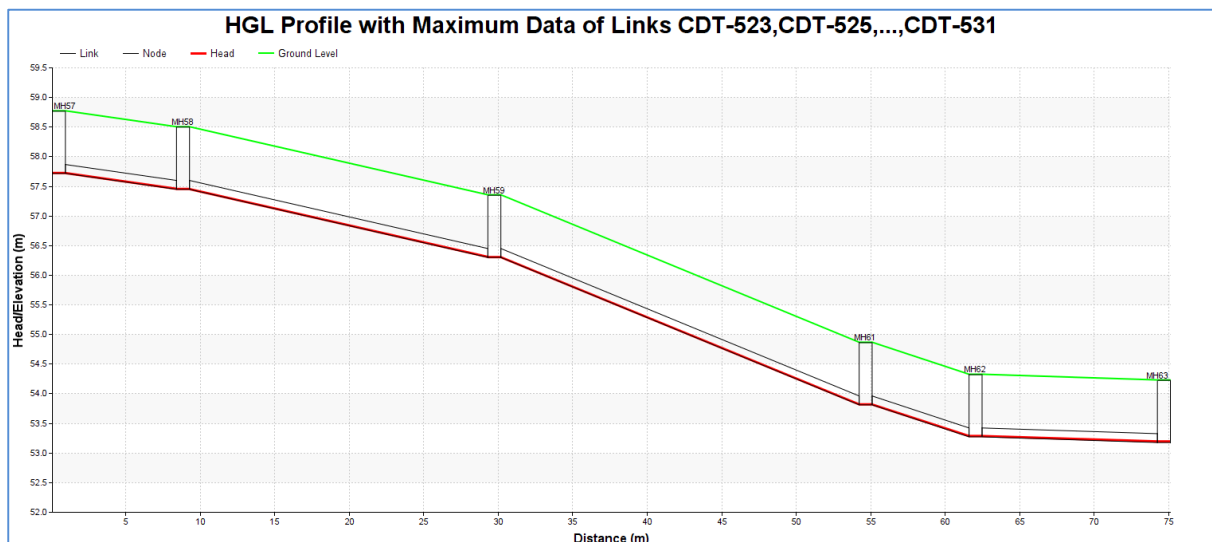
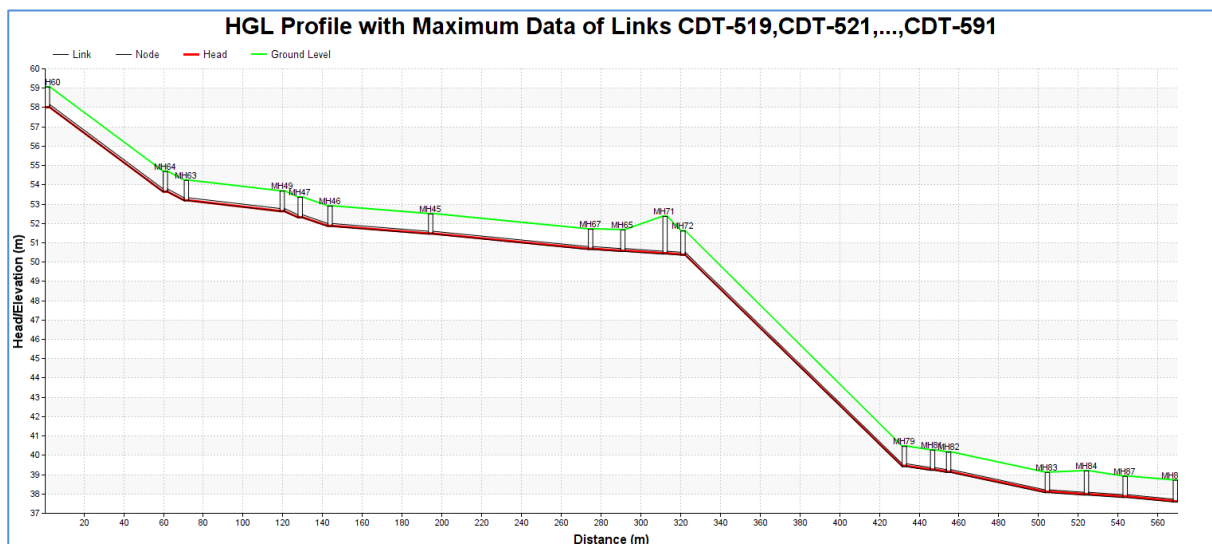
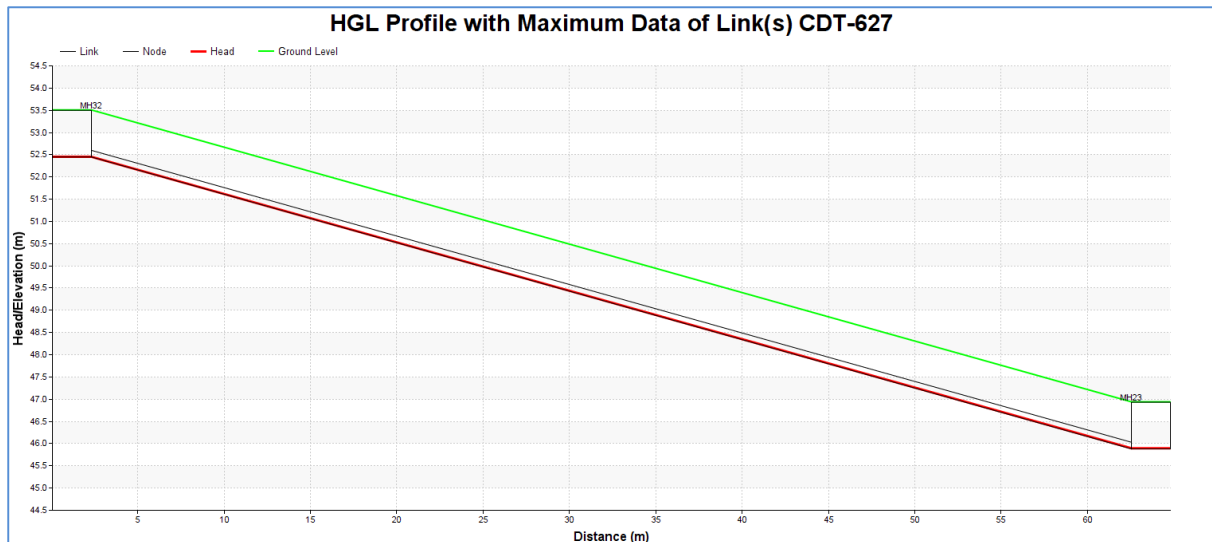
Pipe ID	Diam. (mm)	Length (m)	Manning	US IL (RL m)	DS IL (RL m)	Grade (%)	PWWF (L/s)	d/D (%) @ PWWF
CDT-455	150	45.8	0.0130	49.000	45.950	6.67	1.3	15.7
CDT-457	150	20.9	0.0130	57.750	51.150	33.32	1.3	9.5
CDT-459	150	8.3	0.0130	57.830	57.773	0.69	1.3	24.2
CDT-461	150	14.9	0.0130	57.930	57.830	0.67	0.5	17.5
CDT-463	150	20.7	0.0130	58.155	57.830	1.57	0.6	16.9
CDT-465	150	25.4	0.0130	58.100	57.930	0.67	0.5	13.7
CDT-467	150	15.9	0.0130	58.210	58.100	0.69	0.4	12.8
CDT-469	150	66.5	0.0130	58.654	58.210	0.67	0.4	11.9
CDT-471	150	74.2	0.0130	59.522	58.780	1.00	0.1	7.7
CDT-473	150	12.6	0.0130	58.780	58.654	1.00	0.3	10.5
CDT-481	150	47.1	0.0130	59.123	58.155	2.05	0.5	11.4
CDT-483	150	6.3	0.0130	59.166	59.123	0.68	0.5	12.5
CDT-485	150	21.4	0.0130	59.310	59.166	0.67	0.4	13.3
CDT-487	150	33.3	0.0130	59.540	59.310	0.69	0.4	11.9
CDT-489	150	41.1	0.0130	59.820	59.540	0.68	0.3	10.8
CDT-491	150	12.6	0.0130	59.920	59.820	0.79	0.3	9.6

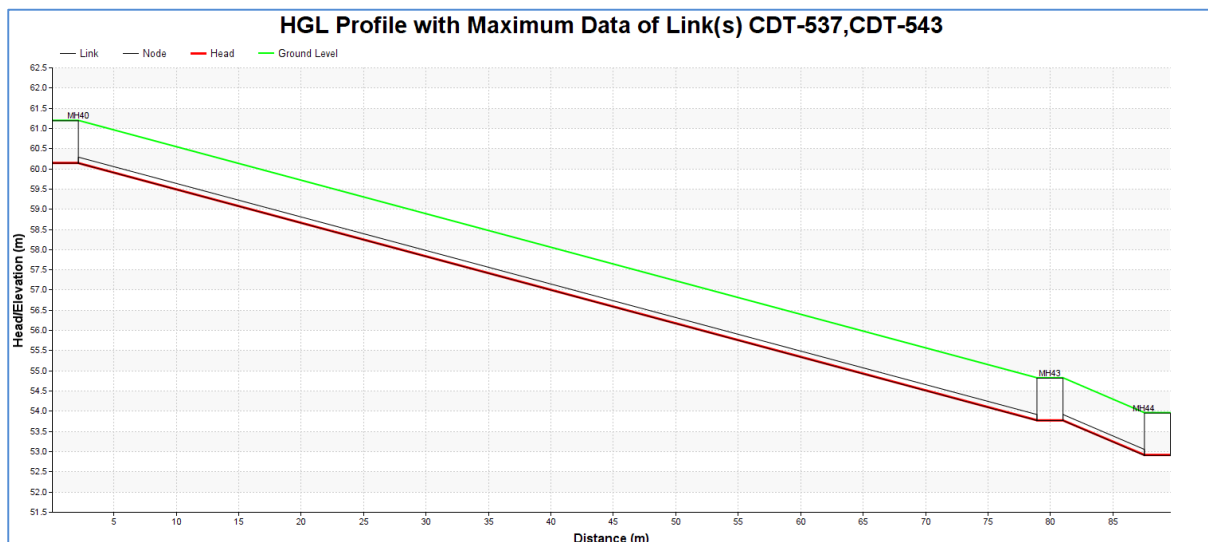
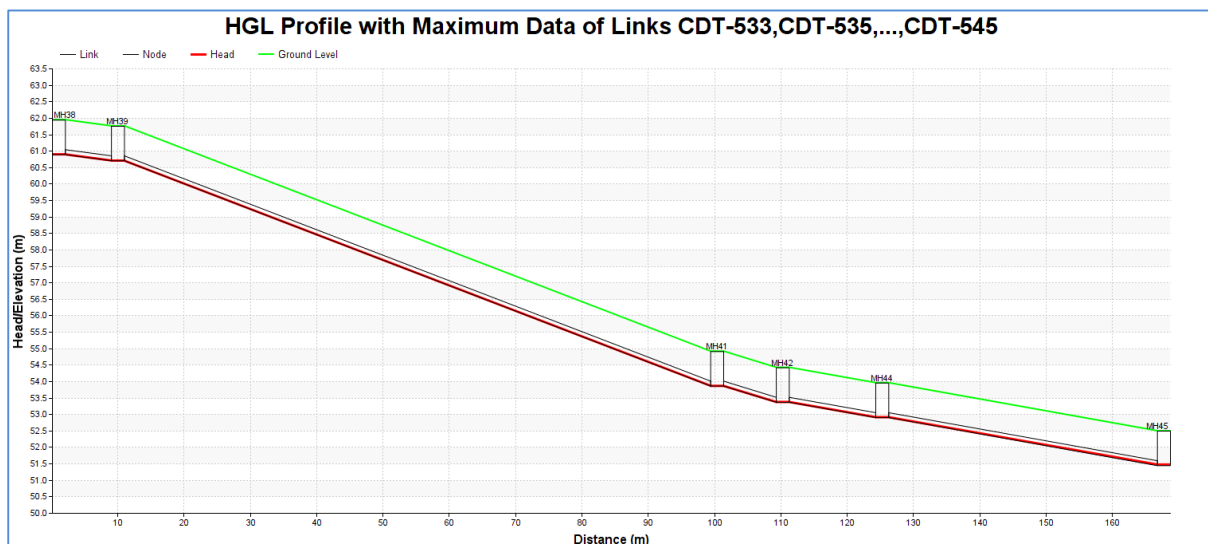
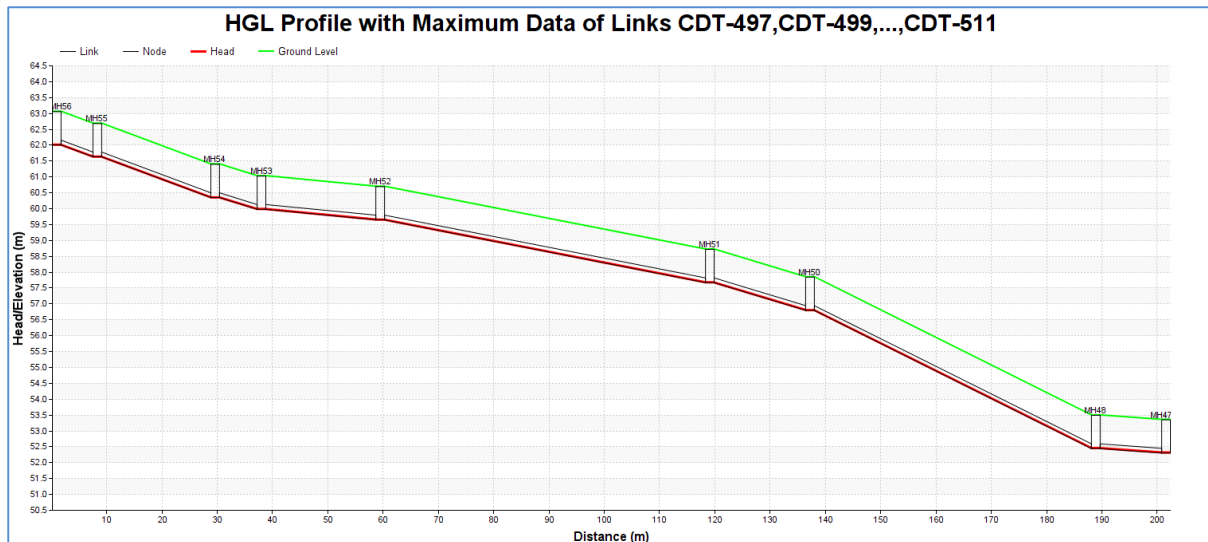
CDT-493	150	39.7	0.0130	60.327	59.920	1.02	0.1	7.9
CDT-495	150	35.3	0.0130	60.938	60.327	1.73	0.1	6.0
CDT-497	150	6.2	0.0130	62.010	61.634	6.07	0.1	4.4
CDT-499	150	21.3	0.0130	61.634	60.350	6.05	0.1	4.3
CDT-501	150	7.3	0.0130	60.350	59.980	5.06	0.1	6.5
CDT-503	150	21.4	0.0130	59.980	59.647	1.56	0.3	7.6
CDT-505	150	62.5	0.0130	59.647	57.670	3.17	0.3	7.2
CDT-507	150	17.8	0.0130	57.670	56.796	4.91	0.4	7.1
CDT-509	150	53.9	0.0130	56.796	52.443	8.10	0.4	9.3
CDT-511	150	12.0	0.0130	52.443	52.302	1.18	0.5	12.9
CDT-513	150	13.8	0.0130	52.302	51.845	3.31	1.1	17.2
CDT-515	150	7.4	0.0130	52.623	52.302	4.37	0.6	11.7
CDT-517	150	49.5	0.0130	53.177	52.623	1.12	0.5	11.2
CDT-519	150	61.4	0.0130	58.008	53.636	7.13	0.1	5.1
CDT-521	150	9.0	0.0130	53.636	53.177	5.09	0.3	9.4
CDT-523	150	8.0	0.0130	57.719	57.450	3.35	0.1	4.8
CDT-525	150	21.6	0.0130	57.450	56.301	5.34	0.1	4.2
CDT-527	150	25.9	0.0130	56.301	53.813	9.66	0.1	4.7
CDT-529	150	7.0	0.0130	53.813	53.273	7.74	0.3	7.5
CDT-531	150	12.7	0.0130	53.273	53.177	0.76	0.3	11.1
CDT-533	150	7.5	0.0130	60.895	60.707	2.52	0.1	4.8
CDT-535	150	95.1	0.0130	60.707	53.864	7.21	0.1	4.2
CDT-537	150	82.6	0.0130	60.140	53.770	7.74	0.1	3.8
CDT-539	150	8.5	0.0130	53.864	53.372	5.78	0.1	5.5
CDT-541	150	14.0	0.0130	53.372	52.906	3.32	0.3	8.0
CDT-543	150	7.0	0.0130	53.770	52.906	12.41	0.1	6.4
CDT-545	150	43.6	0.0130	52.906	51.446	3.35	0.5	16.3
CDT-547	150	52.0	0.0130	51.845	51.446	0.77	1.3	22.0
CDT-549	150	62.3	0.0130	51.293	50.550	1.19	0.1	16.6
CDT-551	150	84.2	0.0130	51.446	50.651	0.94	1.8	24.9
CDT-553	150	15.1	0.0130	50.651	50.550	0.67	1.9	26.8
CDT-555	150	20.5	0.0130	50.550	50.412	0.67	2.0	30.6
CDT-557	150	7.3	0.0130	50.412	50.361	0.70	2.3	24.5
CDT-561	150	117.4	0.0130	50.361	39.413	9.37	2.3	21.9
CDT-563	150	80.2	0.0130	47.906	39.219	10.90	0.1	17.5
CDT-565	150	12.9	0.0130	39.413	39.219	1.50	3.4	30.0
CDT-567	150	6.3	0.0130	39.219	39.113	1.68	3.6	29.4
CDT-569	150	7.3	0.0130	39.650	39.413	3.23	1.1	21.3
CDT-571	150	51.0	0.0130	39.113	38.064	2.06	3.6	32.6
CDT-573	150	18.8	0.0130	38.064	37.937	0.68	3.8	39.3
CDT-575	150	41.0	0.0130	47.447	44.131	8.11	0.1	4.1
CDT-577	150	14.0	0.0130	44.131	43.333	5.72	0.1	5.7
CDT-579	150	36.0	0.0130	43.333	42.204	3.13	0.3	6.5
CDT-581	150	24.2	0.0130	42.204	40.828	5.69	0.3	6.4
CDT-583	150	24.3	0.0130	40.828	39.140	6.96	0.4	7.4
CDT-585	150	6.8	0.0130	39.140	38.639	7.38	0.5	7.6
CDT-587	150	7.2	0.0130	38.639	37.937	9.85	0.5	24.1
CDT-589	150	18.6	0.0130	37.937	37.813	0.67	4.3	41.2
CDT-591	150	24.8	0.0130	37.813	37.585	0.92	4.3	33.0
CDT-593	225	12.7	0.0130	37.585	37.241	2.71	4.3	19.1
CDT-595	225	69.6	0.0130	37.241	36.675	0.81	4.3	22.7
CDT-597	225	45.8	0.0130	36.675	36.216	1.00	4.3	17.8
CDT-599	225	7.5	0.0130	36.216	35.525	9.24	4.3	14.6
CDT-601	150	53.7	0.0130	40.912	39.650	2.35	1.1	14.5
CDT-603	150	7.2	0.0130	40.987	40.912	1.04	1.0	16.7
CDT-605	150	16.4	0.0130	41.350	40.987	2.22	1.0	16.2
CDT-607	150	7.3	0.0130	42.273	41.350	12.77	1.0	11.9
CDT-609	150	34.5	0.0130	45.880	42.273	10.52	0.9	9.3
CDT-611	150	17.3	0.0130	47.605	45.880	10.05	0.6	8.6
CDT-613	150	12.9	0.0130	47.928	47.605	2.50	0.3	7.6
CDT-615	150	45.0	0.0130	51.362	47.928	7.65	0.1	5.6
CDT-617	150	78.6	0.0130	51.623	47.605	5.12	0.3	7.0
CDT-619	150	80.6	0.0130	52.430	51.623	1.00	0.1	6.3
CDT-621	150	74.7	0.0130	52.513	50.918	2.14	0.1	5.7
CDT-623	150	101.1	0.0130	50.918	45.880	4.99	0.3	7.7
CDT-625	225	43.1	0.0130	35.525	34.475	2.44	4.3	16.3
CDT-627	150	64.8	0.0130	52.449	45.881	10.19	0.1	6.9

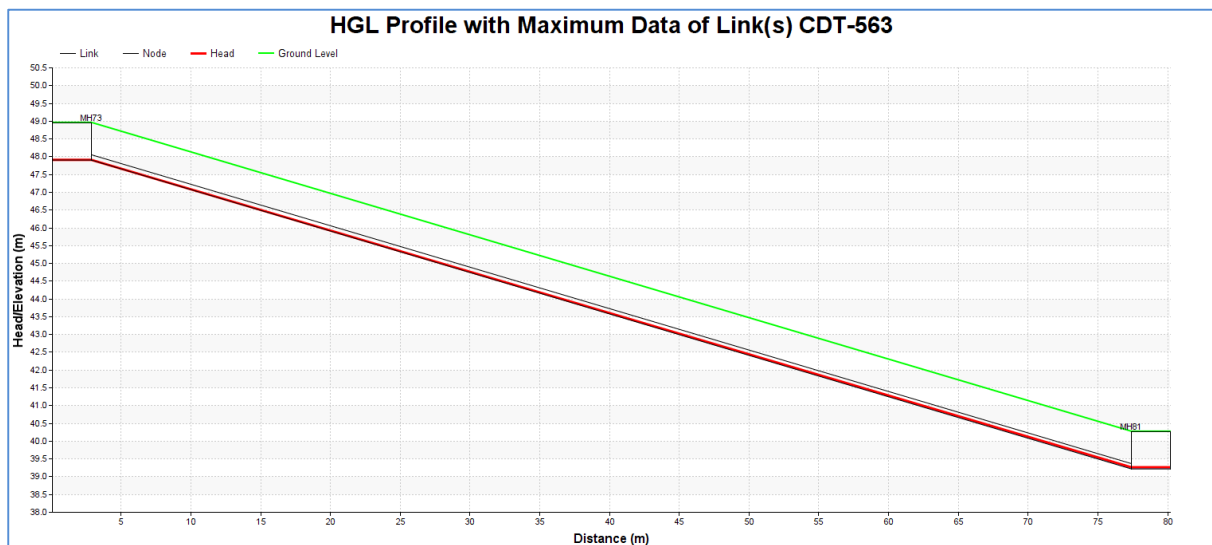
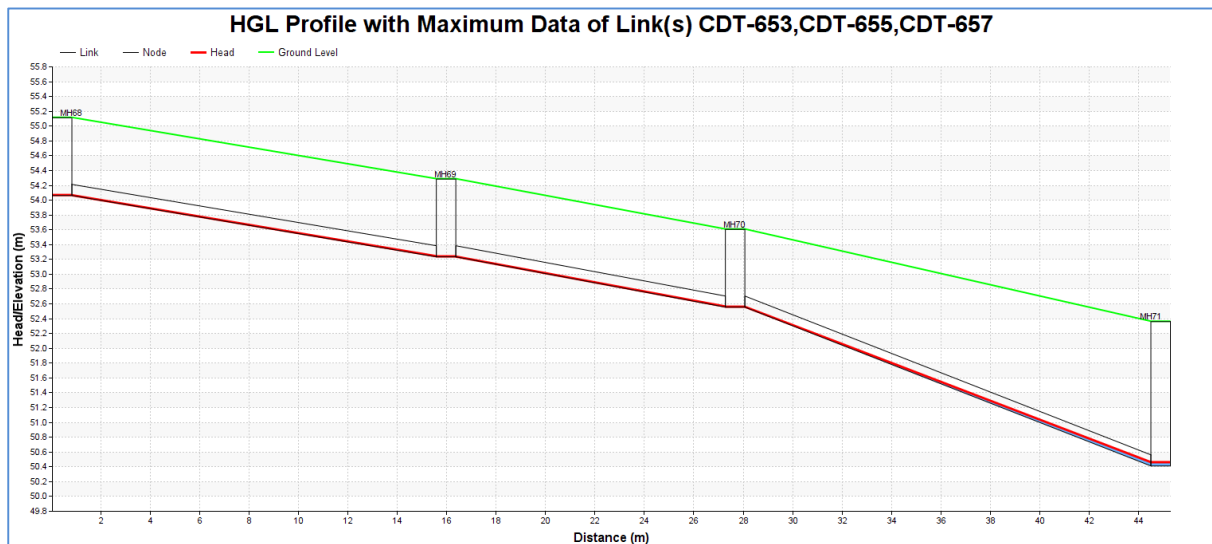
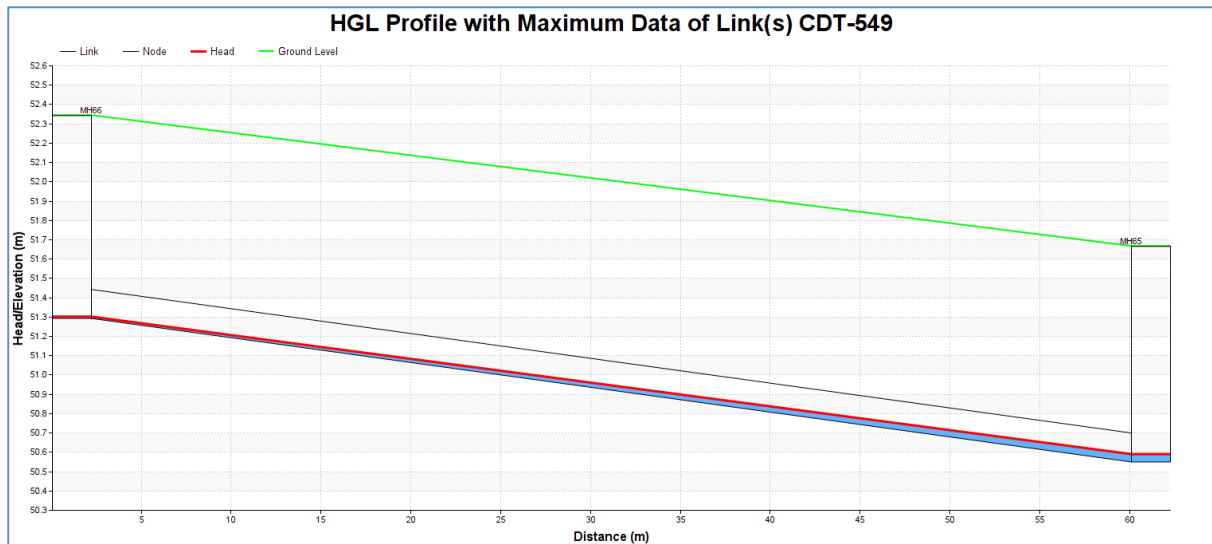
CDT-629	150	31.8	0.0130	45.881	41.998	12.32	1.0	8.6
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CDT-633	150	26.5	0.0130	53.303	49.275	15.37	0.8	8.2
CDT-635	150	4.0	0.0130	53.748	53.303	11.31	0.5	7.4
CDT-637	150	8.4	0.0130	54.594	53.748	10.08	0.4	6.6
CDT-639	150	6.3	0.0130	54.950	54.594	5.64	0.4	6.9
CDT-643	150	16.7	0.0130	55.050	53.303	10.51	0.3	6.5
CDT-645	150	142.3	0.0130	59.030	55.460	2.51	0.1	7.5
CDT-647	150	12.6	0.0130	55.460	55.374	0.68	0.3	9.8
CDT-649	150	18.7	0.0130	55.080	54.950	0.70	0.4	10.2
CDT-651	150	36.7	0.0130	55.374	55.129	0.67	0.3	9.8
CDT-653	150	15.9	0.0130	54.063	53.235	5.22	0.1	4.5
CDT-655	150	11.7	0.0130	53.235	52.556	5.79	0.1	4.1
CDT-657	150	17.7	0.0130	52.556	50.412	12.22	0.1	18.8
CDT-659	150	100.6	0.0130	57.900	55.050	2.84	0.1	5.1
CDT-661	150	3.4	0.0130	41.998	40.680	41.86	1.0	8.6
CDT-663	150	110.4	0.0130	45.950	44.680	1.15	1.3	18.1
CDT-665	225	48.6	0.0130	34.475	32.875	3.29	4.3	17.4
CDT-667	225	12.8	0.0130	32.875	32.700	1.37	4.3	21.2
CDT-669	150	7.3	0.0130	55.129	55.080	0.67	0.3	11.4
CDT-671	225	12.4	0.0130	32.700	32.600	0.81	4.3	21.6
CDT-673	225	117.0	0.0130	32.600	31.075	1.30	4.3	18.7
CDT-675	225	29.7	0.0130	27.470	26.311	3.91	4.3	24.7
CDT-677	225	10.0	0.0130	28.230	27.470	7.61	4.3	13.8
CDT-679	225	109.5	0.0130	31.075	28.230	2.60	4.3	15.1
CDT-681	150	3.1	0.0130	57.773	57.750	0.75	1.3	17.7
CDT-683	150	18.0	0.0130	51.150	49.000	12.03	1.3	11.4

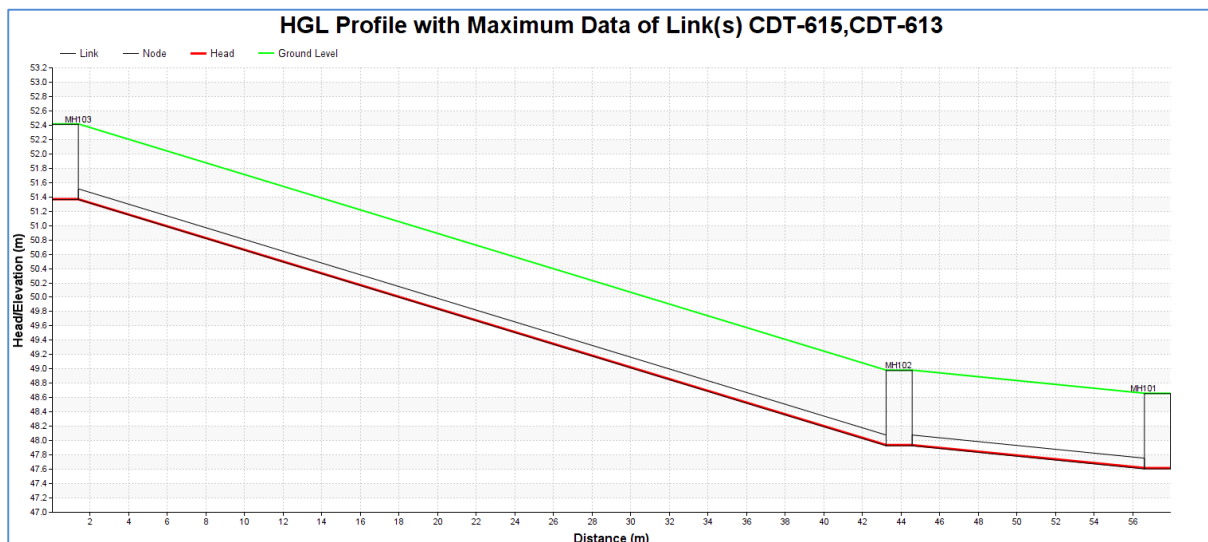
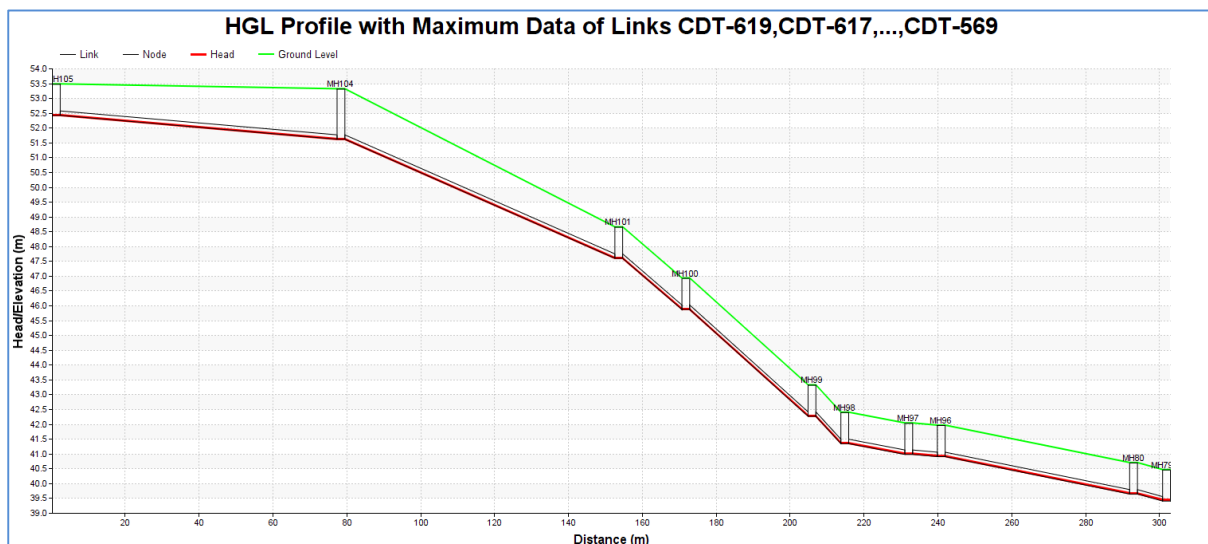
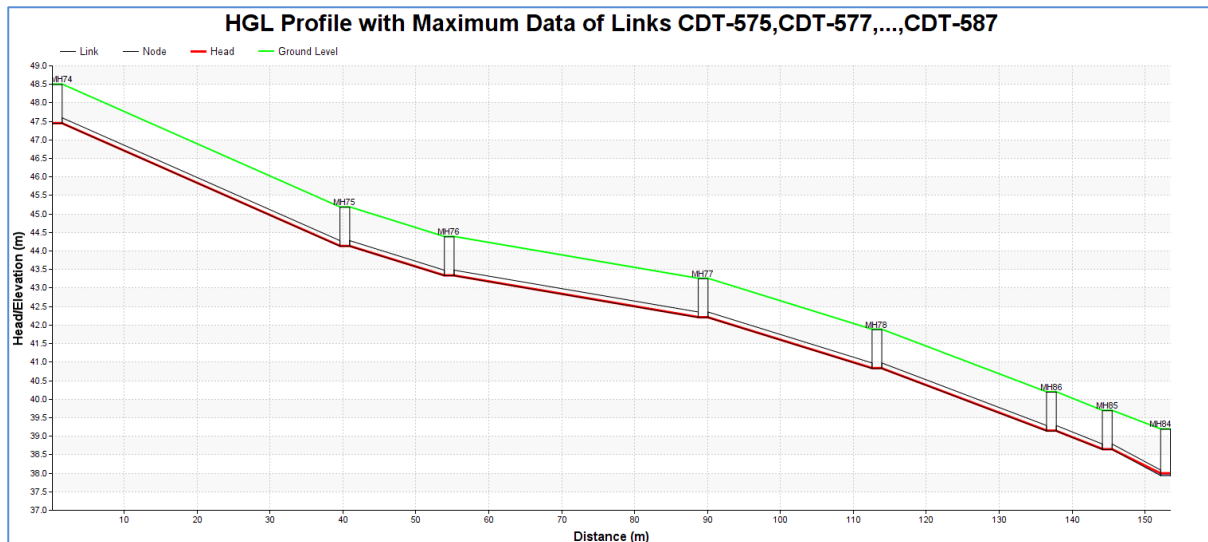


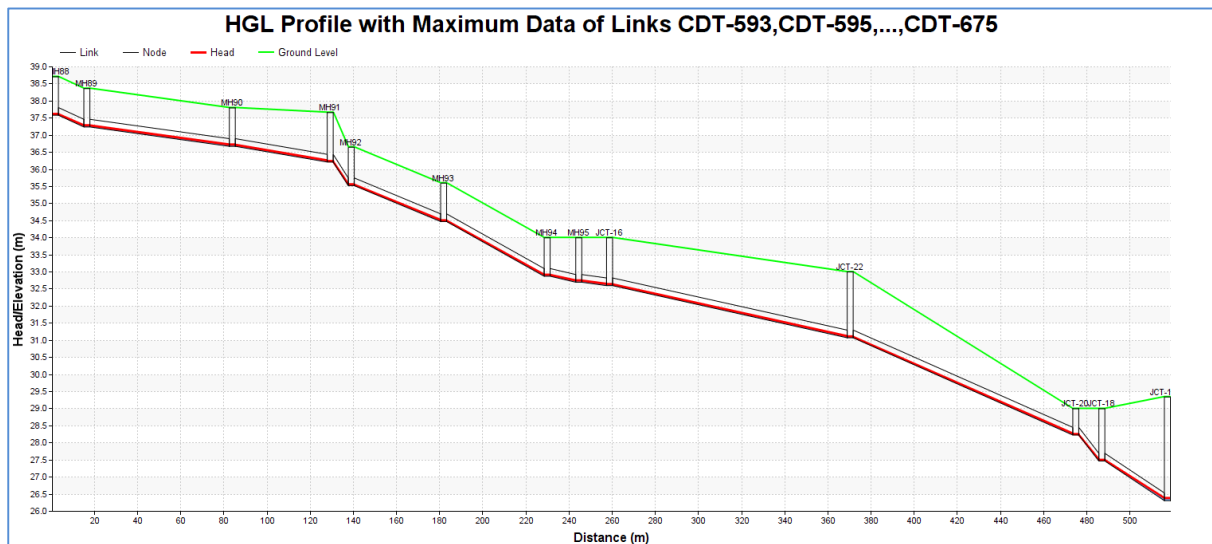
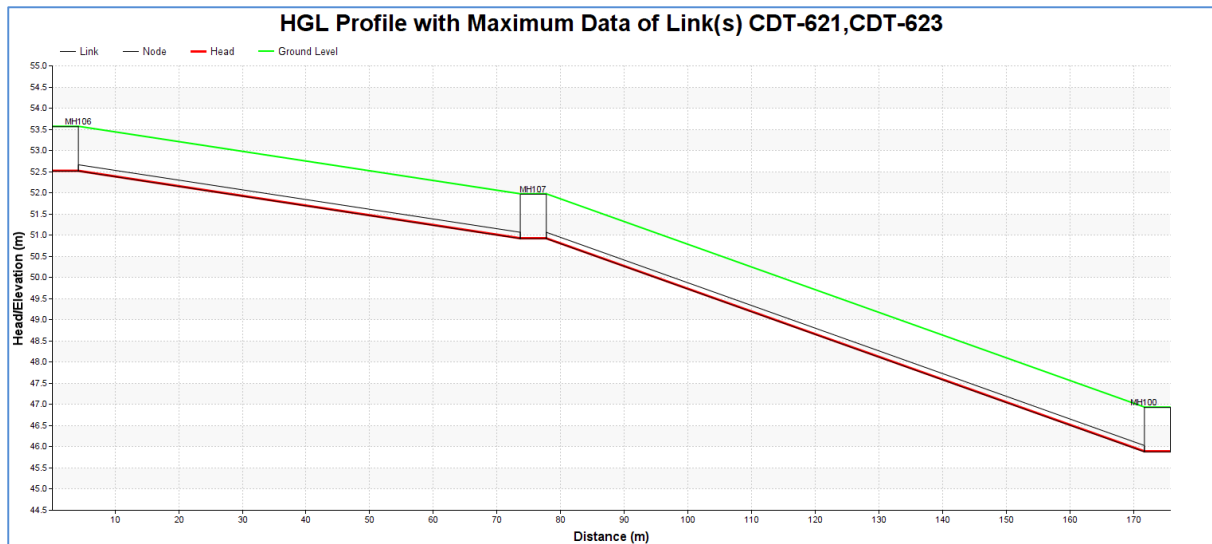












Appendix 9. Calculation for sizing of DN225 sewer trunk main



- 19 to 23 dwellings per net hectare, where located in sub-precinct Courtney North-east;
- 13 to 17 dwellings per net hectare, where located in sub-precinct Courtney South-east; and
- 11 to 14 dwellings per net hectare, where located in sub-precinct Courtney West.



The above figure shows the developable area (black outline), external to the subject site, that is likely to be serviced by the proposed DN225 gravity main (refer Appendix 3 for details of DN225 gravity main). This boundary was based on an upper service limit of RL 65 m and contour levels that grade to the proposed trunk main. The surface levels for the allotments to the north-east grade to a connection on the existing DN300 gravity main along Reserve Road, and was therefore excluded from the pipe sizing calculations. A summary of the calculations and assumptions are presented below.

Subject Site

- 196 ET (conservatively adopted entire site loading)
- 546.8 EP
- 1.3 L/s ADWF
- 6.7 L/s PWWF

Area A

- 208,400 m² x 75% developable area (assumed)
- 14 ET/Ha density zoning (assumed upper limit)
- 218.8 ET
- 597.4 EP
- 1.5 L/s ADWF
- 7.3 L/s PWWF

Area B

- 60,100 m² x 85% developable area (assumed)
- 20 ET/Ha (based on average between CNE and CSE density zoning. This was adopted as approximately half of the site was located across the two different zonings)
- 102.2 ET
- 278.9 EP
- 0.7 L/s ADWF
- 3.4 L/s PWWF

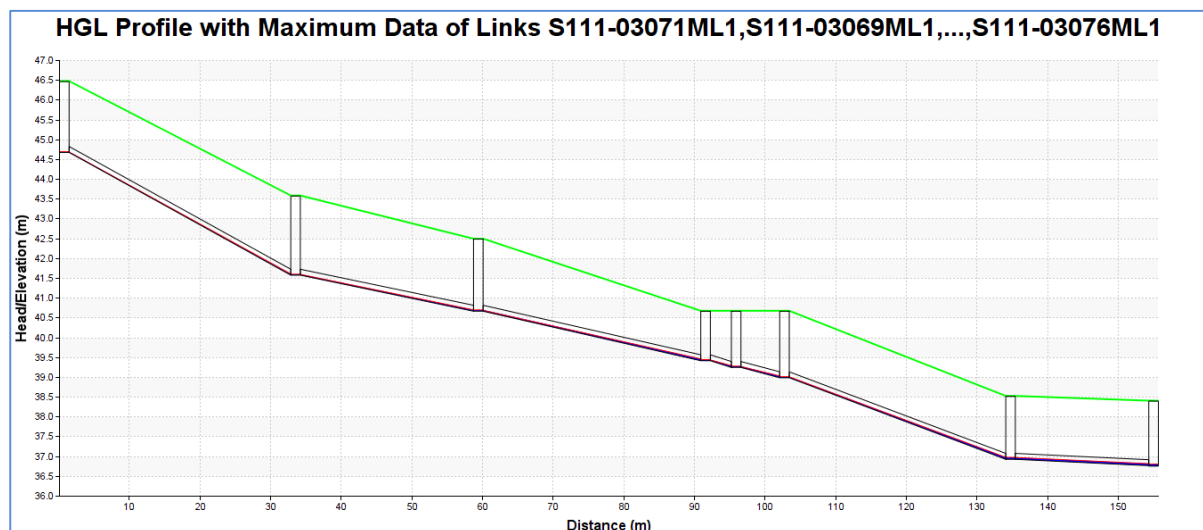
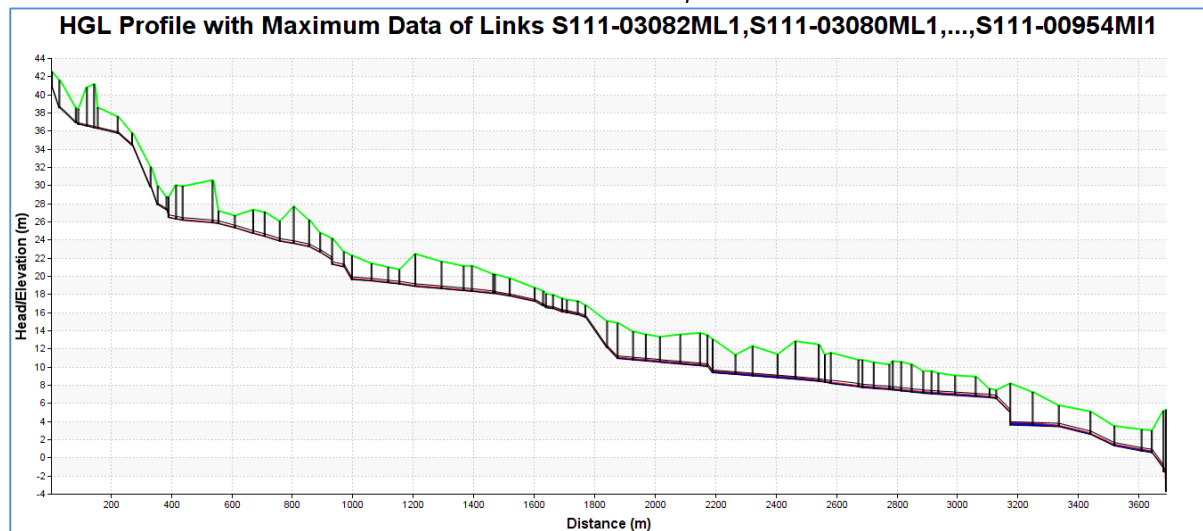
TOTAL

- 3.5 L/s ADWF
- 17.5 L/s PWWF

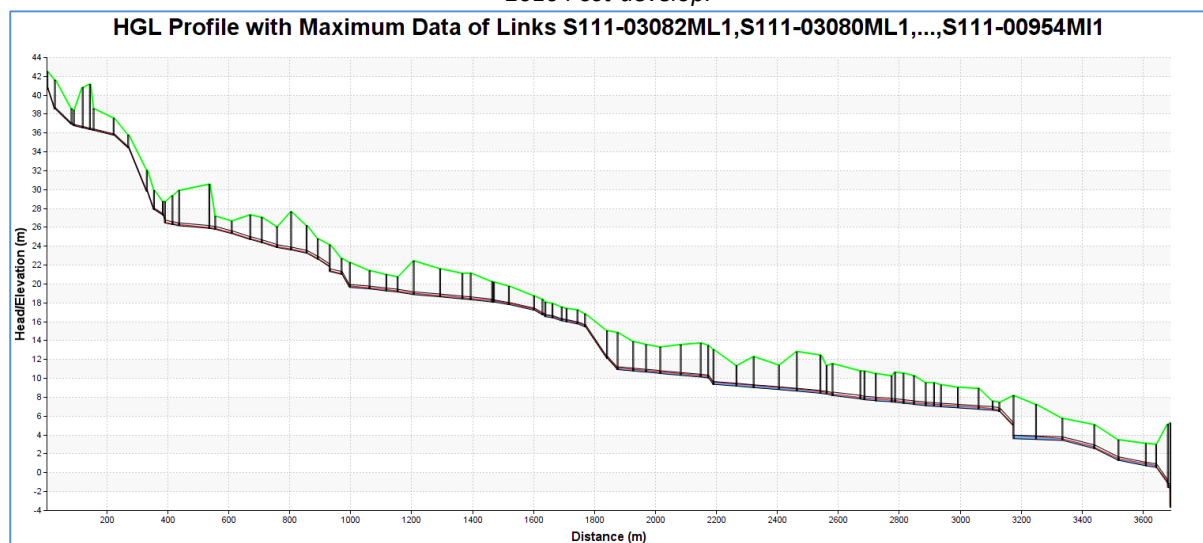
Appendix 10. Modelling results for sewer network capacity assessment

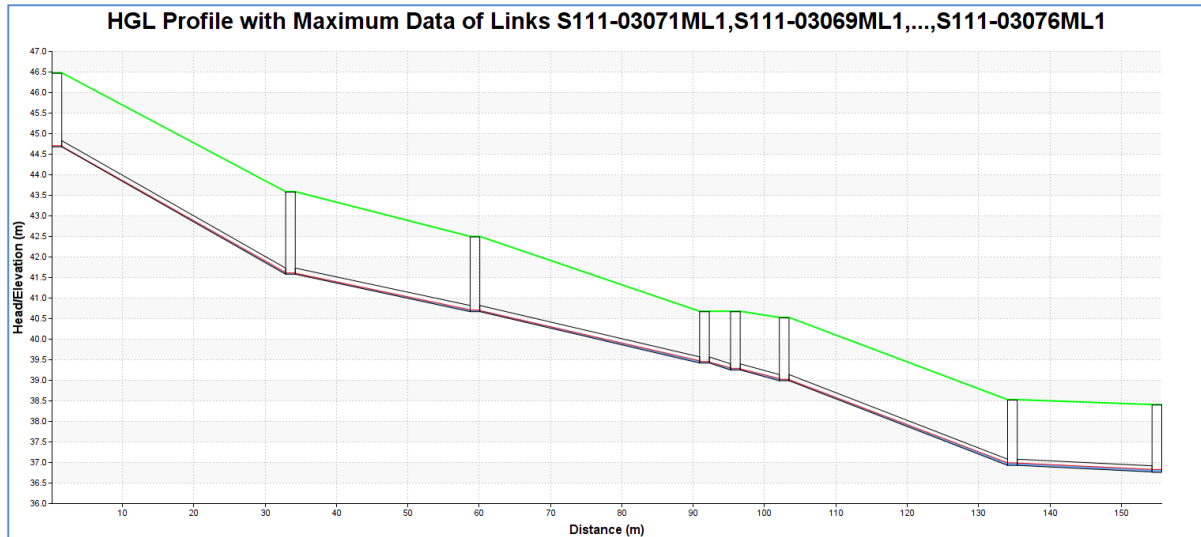
Gravity Mains

2016 Pre-develop.

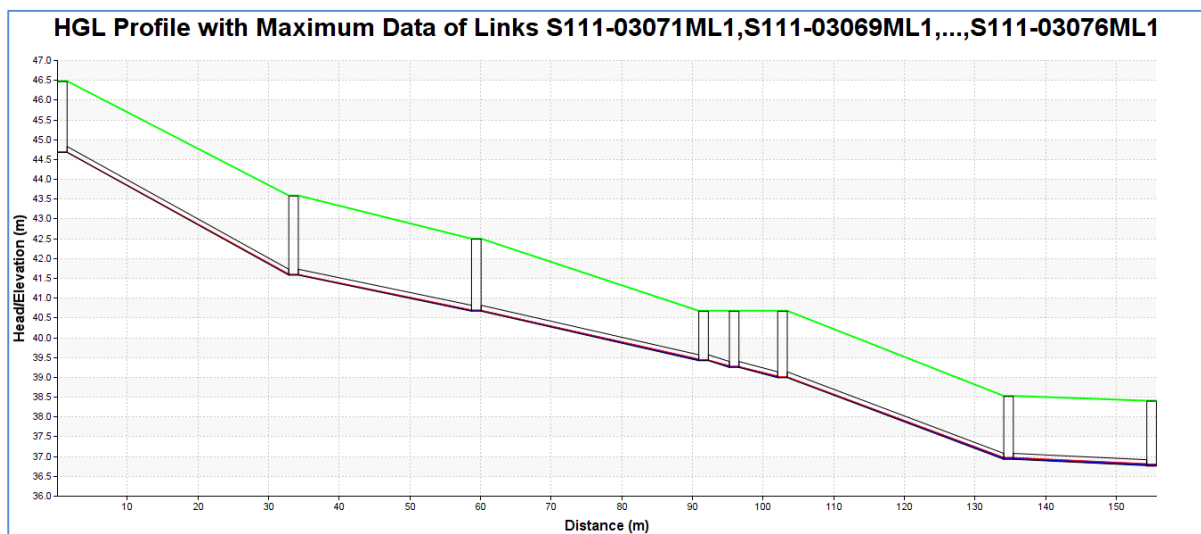
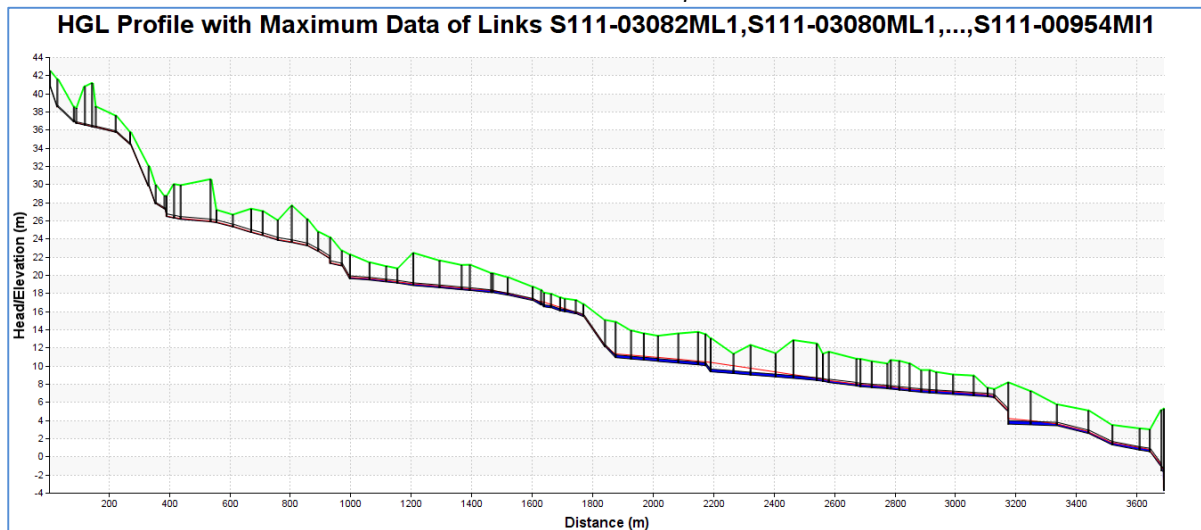


2016 Post-develop.

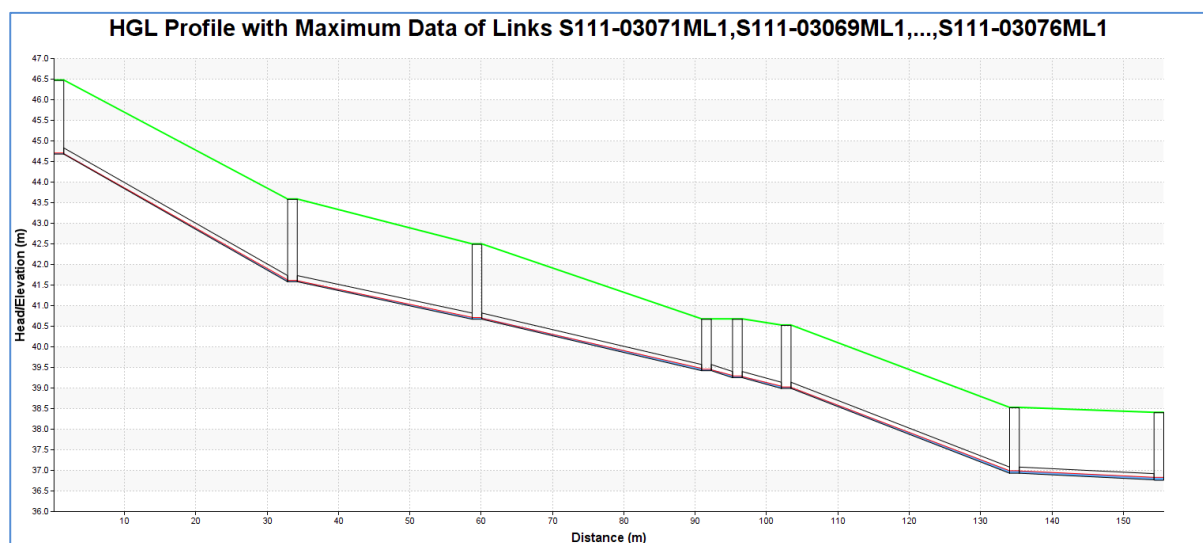
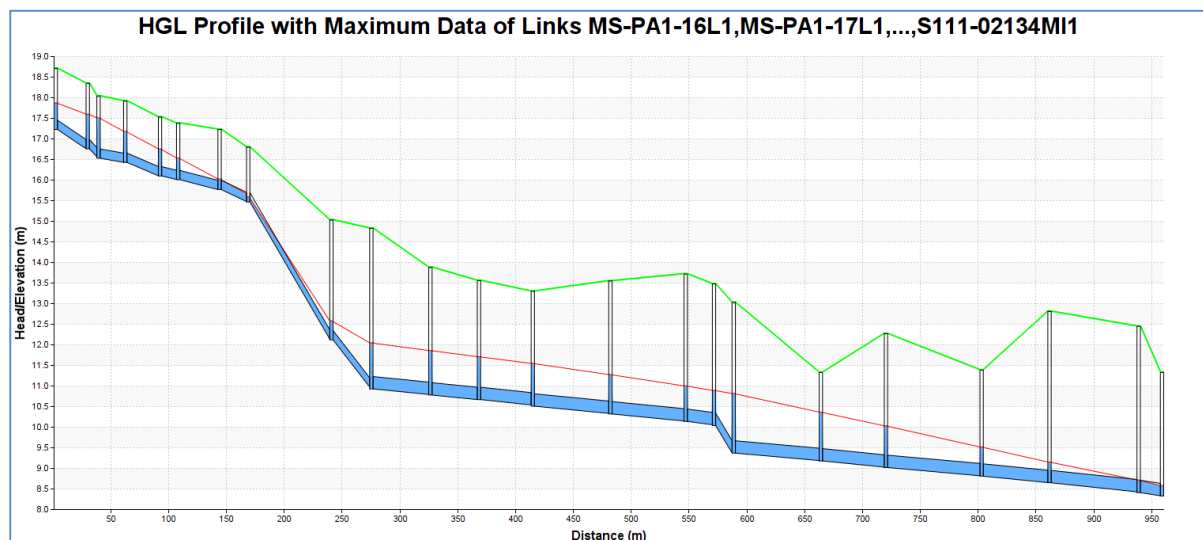
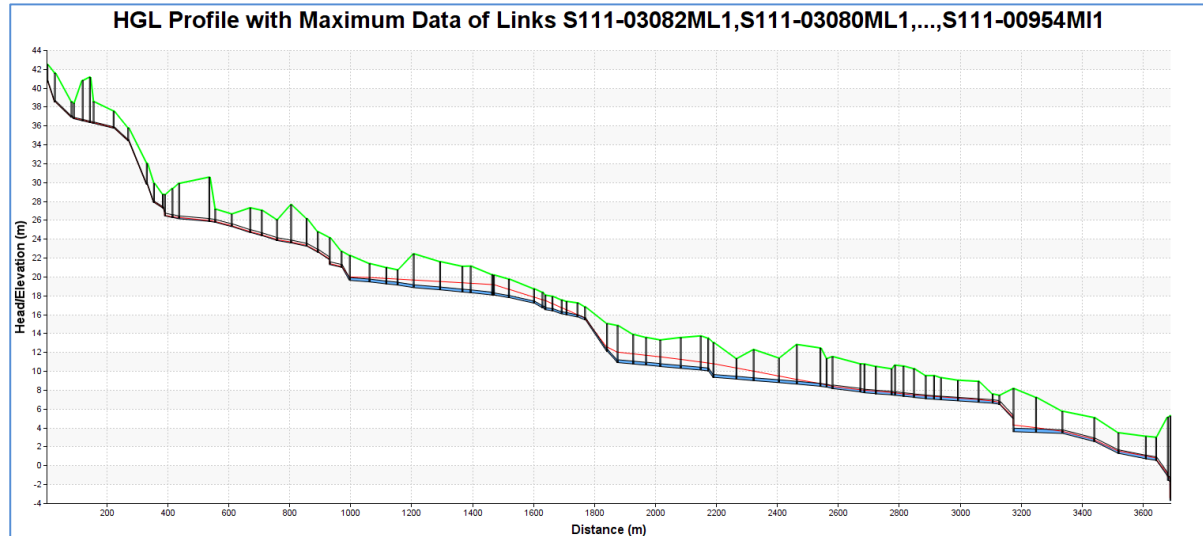




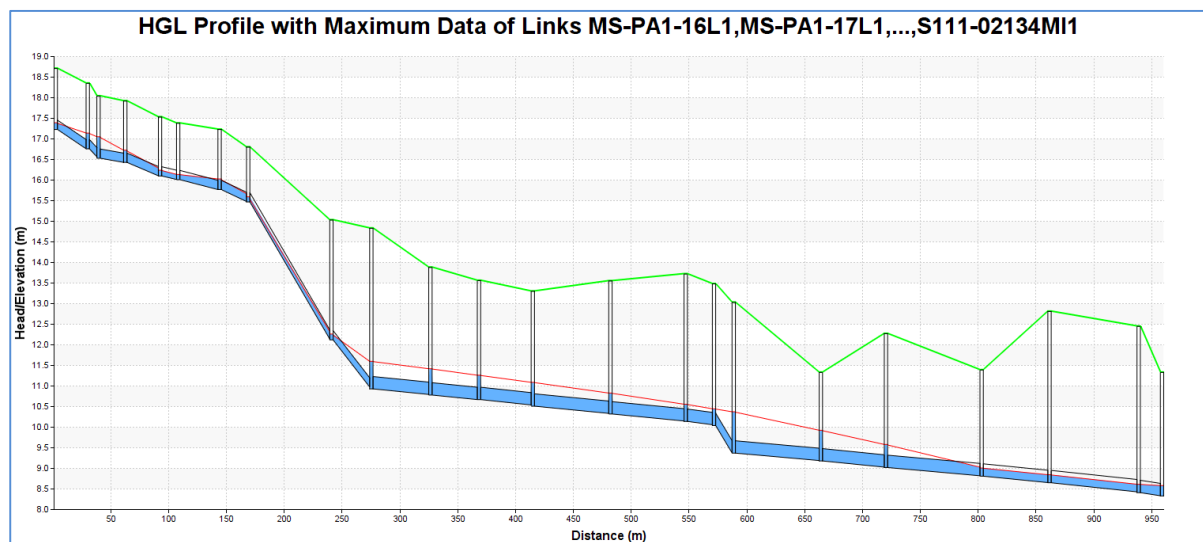
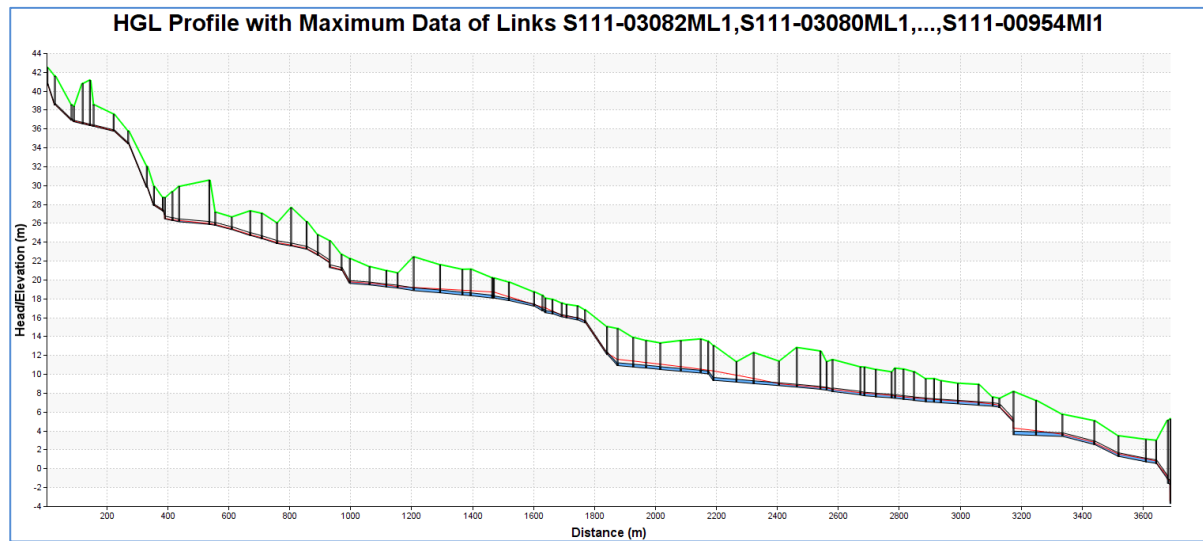
2066 Pre-develop.



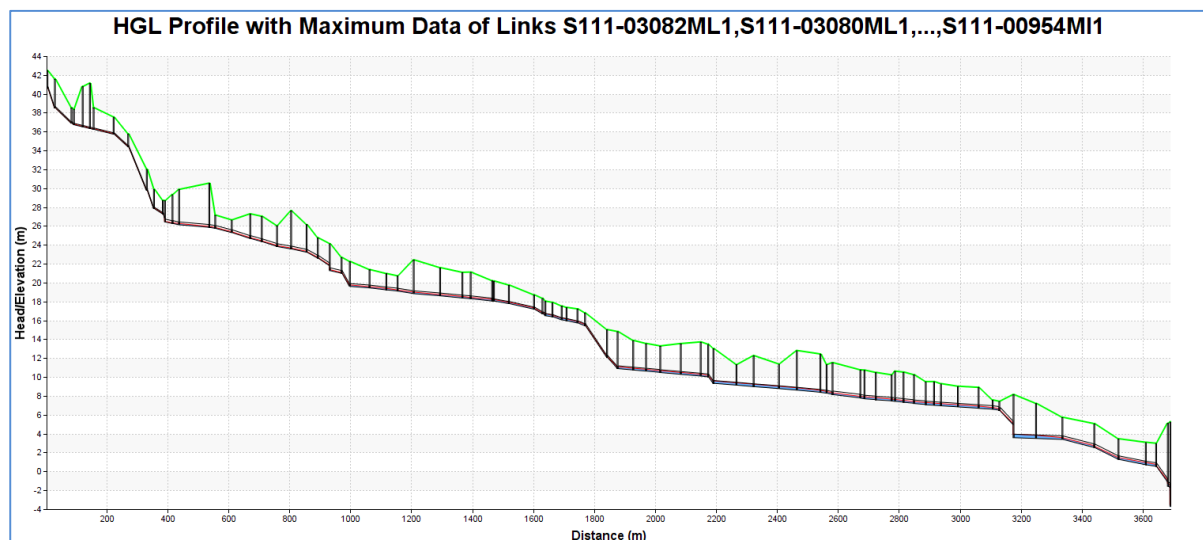
2066 Post-develop.

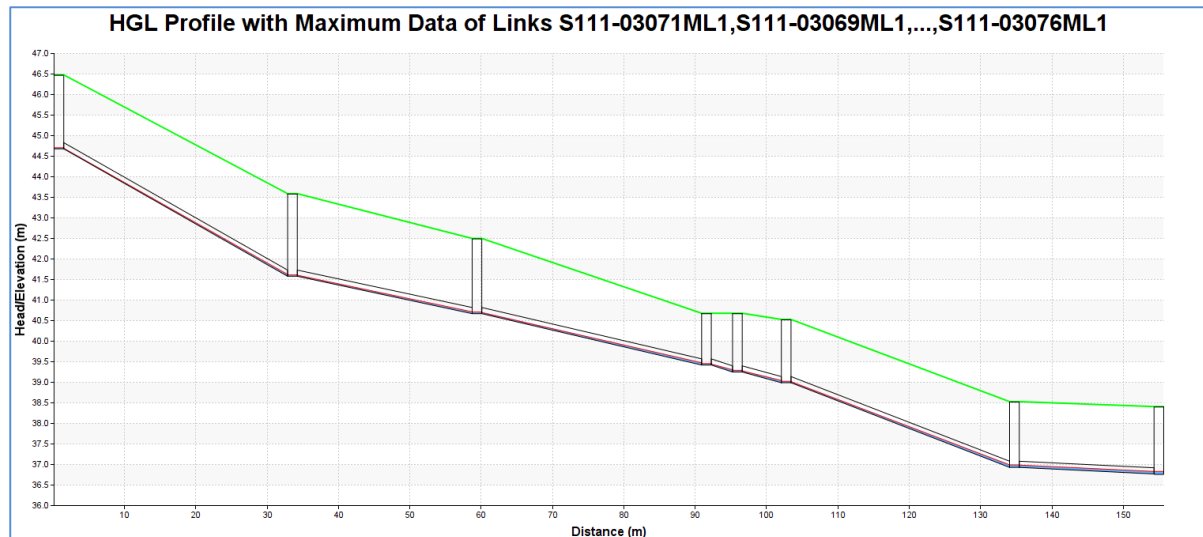


2066 Post-develop. and DN300 Gravity Main Augmentation



2036 Post-develop.





Pipe ID	Dia. (mm)	2016, Post-develop.		2036, Post-develop.		2066, Post-develop.	
		Flow (L/s)	d/D (%)	Flow (L/s)	d/D (%)	Flow (L/s)	d/D (%)
S111-03082ML1	150	1.0	12%	1.0	12%	1.0	12%
S111-03080ML1	150	1.0	13%	1.0	13%	1.0	13%
S111-03078ML1	150	1.0	25%	1.0	25%	1.0	25%
S111-03079ML1	150	5.6	46%	5.6	46%	5.6	46%
S111-03081ML1	150	5.6	46%	5.6	46%	5.6	46%
S111-03084ML1	150	5.6	46%	5.6	46%	5.6	46%
S111-03083ML1	150	5.6	41%	5.6	41%	5.6	41%
S111-03085ML1	150	5.6	32%	5.6	32%	5.6	32%
S111-03086ML1	150	5.6	26%	5.6	26%	5.6	26%
S111-03089ML1	150	7.4	37%	7.4	37%	7.4	37%
S111-03090ML1	150	7.4	37%	7.4	37%	7.4	37%
S111-03091ML1	150	7.4	27%	7.4	27%	7.4	27%
S111-02998ML1	300	7.4	24%	7.4	24%	7.4	24%
GM139	300	12.4	35%	12.4	35%	12.4	35%
S111-03002ML1	300	17.4	39%	17.4	39%	17.4	39%
S111-03001ML1	300	17.4	35%	17.4	35%	17.4	35%
S111-03006ML1	300	17.4	31%	17.4	31%	17.4	31%
S111-03005ML1	300	17.4	29%	17.4	29%	17.4	29%
S111-03009ML1	300	17.4	30%	17.4	30%	17.4	30%
S111-03008ML1	300	17.4	29%	17.4	29%	17.4	29%
S111-03007ML1	300	17.4	34%	17.4	34%	17.4	34%
S111-03012ML1	300	17.4	32%	17.4	32%	17.4	32%
S111-03011ML1	300	17.4	25%	17.4	25%	17.4	25%
S111-03010ML1	300	17.4	24%	17.4	24%	17.4	24%
S111-03013ML1	300	17.4	28%	17.4	28%	17.4	28%
S111-02881ML1	300	17.4	37%	17.4	37%	17.4	59%
S111-00176MI1	300	23.7	48%	23.7	49%	28.0	100%
S111-00175MI1	300	24.1	46%	25.7	48%	39.9	100%
S111-00172MI1	300	24.1	45%	25.7	47%	40.1	100%
S111-00174MI1	300	24.1	44%	25.7	46%	39.8	100%
S111-00173MI1	300	24.1	49%	25.7	51%	40.8	100%
S111-00171MI1	300	24.1	49%	25.7	51%	39.7	100%
S111-00170MI1	300	24.1	48%	25.7	50%	40.0	100%
S111-00169MI1	300	24.2	51%	25.7	53%	41.3	100%
S111-02389MI1	300	25.5	54%	27.1	57%	42.8	100%
S111-00179ML1	225	26.0	66%	27.6	69%	43.4	100%
MS-PA1-15L1	225	26.2	62%	27.7	64%	43.5	100%
MS-PA1-16L1	225	26.2	46%	27.7	47%	43.5	100%
MS-PA1-17L1	225	26.2	62%	27.8	66%	43.6	100%
S111-00462ML1	225	33.5	81%	35.0	82%	52.1	100%

MS-PA1-18L1	225	33.5	73%	35.0	76%	52.1	100%
MS-PA1-19L1	225	33.5	83%	35.0	87%	52.1	100%
MS-PA1-20L1	225	33.5	73%	35.0	76%	52.1	100%
MS-PA1-21L1	225	33.5	62%	35.0	64%	52.1	92%
S111-00438MI1	225	33.5	41%	35.0	42%	54.3	77%
S111-00425MI1	225	33.5	54%	35.0	56%	54.3	100%
S111-00423MI1	300	33.5	60%	35.1	62%	55.9	100%
S111-00424MI1	300	33.5	63%	35.1	65%	55.9	100%
S111-02381MI1	300	34.4	59%	36.0	61%	56.9	100%
S111-00422MI1	300	34.8	64%	36.5	66%	57.5	100%
S111-00420MI1	300	36.8	64%	38.5	66%	60.5	100%
S111-00419MI1	300	36.8	56%	38.5	57%	60.5	100%
S111-00418MI1	300	36.8	56%	38.5	58%	61.1	100%
S111-00421MI1	300	46.8	81%	48.4	85%	71.9	100%
S111-02137MI1	300	46.8	82%	48.4	85%	71.9	100%
S111-01953MI1	300	47.4	82%	49.0	86%	72.9	100%
S111-02136MI1	300	47.4	81%	49.0	84%	72.9	100%
S111-02135MI1	300	47.9	74%	49.6	76%	73.6	98%
S111-02134MI1	300	47.9	65%	49.6	67%	73.7	91%
S111-02133MI1	300	47.9	58%	49.6	59%	73.7	78%
S111-01289MI1	375	48.1	46%	49.7	47%	73.8	62%
S111-01266MI1	375	48.7	52%	50.4	53%	74.5	71%
S111-01265MI1	375	48.7	56%	50.4	57%	74.5	75%
S111-01264MI1	375	48.9	55%	50.6	56%	74.6	73%
S111-01258MI1	375	48.9	53%	50.6	54%	74.6	70%
S111-01263MI1	375	48.9	51%	50.6	52%	74.6	68%
S111-01262MI1	375	49.2	51%	50.9	52%	75.0	69%
S111-01256MI1	375	49.3	54%	51.0	56%	75.0	76%
S111-01331MI1	375	49.6	60%	51.2	61%	75.3	83%
S111-01314MI1	375	50.0	60%	51.7	62%	75.7	83%
S111-01284MI1	375	50.0	60%	51.7	61%	75.7	81%
S111-01294MI1	375	50.2	59%	51.8	60%	75.9	79%
S111-01282MI1	375	50.2	54%	51.8	55%	75.9	71%
S111-01283MI1	375	50.2	47%	51.8	48%	75.9	59%
S111-01281MI1	375	50.2	27%	51.8	28%	75.9	34%
S111-01384MI1	375	68.7	94%	70.4	95%	101.4	100%
S111-01373MI1	375	68.7	69%	70.4	70%	101.4	80%
S111-01311MI1	375	68.8	47%	70.5	48%	101.5	60%
S111-01310MI1	375	68.8	44%	70.5	45%	101.5	56%
S111-01276MI1	375	77.8	57%	79.5	58%	112.1	75%
S111-01309MI1	375	77.8	59%	79.5	60%	112.1	75%
S111-01302MI1	375	85.0	34%	86.7	34%	119.6	41%
S111-00954MI1	450	155.6	54%	158.3	55%	214.5	66%
S111-03071ML1	150	3.1	20%	3.1	20%	3.1	20%
S111-03069ML1	150	3.1	25%	3.1	25%	3.1	25%
S111-03072ML1	150	4.6	26%	4.6	26%	4.6	26%
S111-00932NL1	150	4.6	26%	4.6	26%	4.6	26%
S111-03073ML1	150	4.6	26%	4.6	26%	4.6	26%
S111-00931NL1	150	4.6	32%	4.6	32%	4.6	32%
S111-03076ML1	150	4.6	41%	4.6	41%	4.6	41%

		2066, Post-develop + DN300 Aug.	
Pipe ID	Dia. (mm)	Flow (L/s)	d/D (%)
S111-03082ML1	150	1.0	12%
S111-03080ML1	150	1.0	13%
S111-03078ML1	150	1.0	25%
S111-03079ML1	150	5.6	46%
S111-03081ML1	150	5.6	46%
S111-03084ML1	150	5.6	46%
S111-03083ML1	150	5.6	41%
S111-03085ML1	150	5.6	32%

S111-03086ML1	150	5.6	26%
S111-03089ML1	150	7.4	37%
S111-03090ML1	150	7.4	37%
S111-03091ML1	150	7.4	27%
S111-02998ML1	300	7.4	24%
GM139	300	12.4	35%
S111-03002ML1	300	17.4	39%
S111-03001ML1	300	17.4	35%
S111-03006ML1	300	17.4	31%
S111-03005ML1	300	17.4	29%
S111-03009ML1	300	17.4	30%
S111-03008ML1	300	17.4	29%
S111-03007ML1	300	17.4	34%
S111-03012ML1	300	17.4	32%
S111-03011ML1	300	17.4	25%
S111-03010ML1	300	17.4	24%
S111-03013ML1	300	17.4	28%
S111-02881ML1	300	17.4	38%
S111-00176MI1	300	27.8	58%
S111-00175MI1	300	39.7	64%
S111-00172MI1	300	39.7	60%
S111-00174MI1	300	39.7	78%
S111-00173MI1	300	40.7	100%
S111-00171MI1	300	39.8	100%
S111-00170MI1	300	40.0	100%
S111-00169MI1	300	41.4	100%
S111-02389MI1	300	45.6	100%
S111-00179ML1	225	46.0	100%
MS-PA1-15L1	225	44.1	89%
MS-PA1-16L1	225	43.6	86%
MS-PA1-17L1	225	43.9	100%
S111-00462ML1	225	52.1	100%
MS-PA1-18L1	225	52.1	92%
MS-PA1-19L1	225	22.3	59%
MS-PA1-19L1AUG	300	29.8	45%
MS-PA1-20L1	225	22.5	78%
MS-PA1-20L1AUG	300	29.6	64%
MS-PA1-21L1	225	52.1	92%
S111-00438MI1	225	54.3	55%
S111-00425MI1	225	54.4	82%
S111-00423MI1	300	56.1	100%
S111-00424MI1	300	56.2	100%
S111-02381MI1	300	57.0	100%
S111-00422MI1	300	57.6	100%
S111-00420MI1	300	60.6	100%
S111-00419MI1	300	60.6	100%
S111-00418MI1	300	61.4	100%
S111-00421MI1	300	72.0	100%
S111-02137MI1	300	72.0	100%
S111-01953MI1	300	73.0	85%
S111-02136MI1	300	36.5	65%
S111-02136ML1AUG	300	36.5	65%
S111-02135MI1	300	36.8	63%
S111-02135ML1AUG	300	36.8	63%
S111-02134MI1	300	36.8	75%
S111-02134ML1AUG	300	36.8	75%
S111-02133MI1	300	73.7	78%
S111-01289MI1	375	73.8	62%
S111-01266MI1	375	74.5	71%
S111-01265MI1	375	74.5	75%
S111-01264MI1	375	74.6	73%
S111-01258MI1	375	74.6	70%

S111-01263MI1	375	74.6	68%
S111-01262MI1	375	75.0	69%
S111-01256MI1	375	75.0	76%
S111-01331MI1	375	75.3	83%
S111-01314MI1	375	75.7	83%
S111-01284MI1	375	75.7	81%
S111-01294MI1	375	75.9	79%
S111-01282MI1	375	75.9	71%
S111-01283MI1	375	75.9	59%
S111-01281MI1	375	75.9	34%
S111-01384MI1	375	101.4	100%
S111-01373MI1	375	101.4	80%
S111-01311MI1	375	101.5	60%
S111-01310MI1	375	101.5	56%
S111-01276MI1	375	112.1	75%
S111-01309MI1	375	112.1	75%
S111-01302MI1	375	119.6	41%
S111-00954MI1	450	214.5	66%

Operational Storage

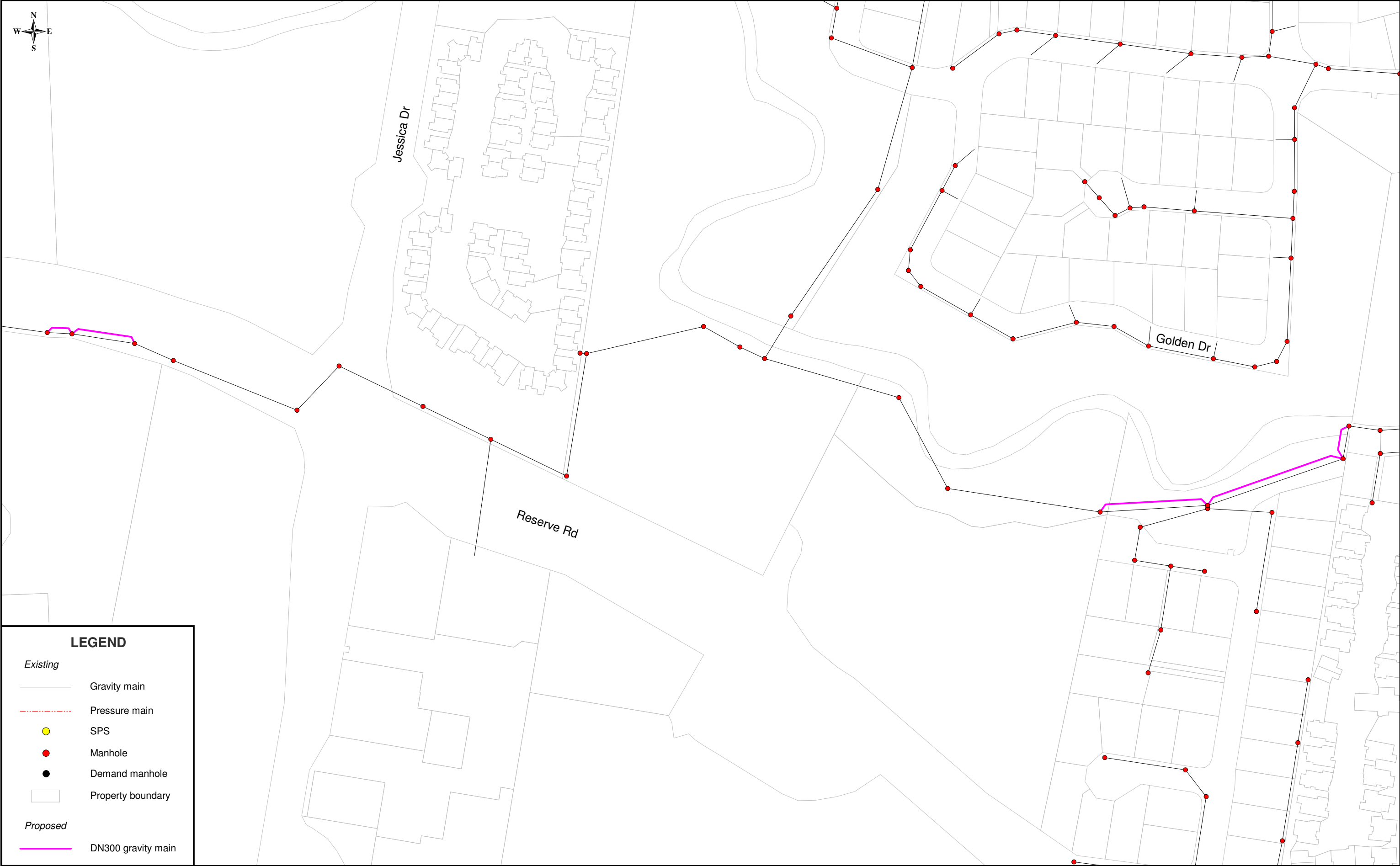
		2016, Post-develop.	2066, Post-develop.
Single Pump Capacity Required	C1	3.5	3.5
	ADWF (L/s)	31.2	42.9
	Q (L/s)	109.1	150.0
Operational Storage Capacity Required	Duty Flow (L/s)	109.1	150.0
	Duty Head (m)	NA	NA
	Pump Efficiency (%)	NA	NA
	Duty Power (kW)	30.0	30.0
	No. pump starts (n)	12.0	12.0
Operational Storage Capacity Available	OSCR (kL)	8.2	11.3
	Duty Start (m)	1.55	1.55
	Duty Stop (m)	0.31	0.31
	Duty Height (m)	1.24	1.24
	WW Diam. (m)	4.0	4.0
	OSCA (kL)	15.6	15.6
OUTCOME	Difference (kL)	+7.4	+4.3
	Pass / Fail	PASS	PASS

Emergency Storage

	Pipe ID	US IL (m)	DS IL (m)	Length (m)	Length Below OF (m)	Slope (%)	Diam. (m)	Radius (m)	d/D (%)	Pipe Flow Depth (m)	Pipe Wetted Area (m)	Empty Vol. Below OF (m³)	ADWF Vol. Below OF (m³)	ES Vol. (m³)
2016 Pre-develop.	S111-00954MI1	- 1.53	- 1.65	5.4	5.4	0.0223	0.450	0.23	20.3%	0.091	0.0231	0.9	0.1	0.7
	S111-01276MI1	1.31	0.76	93.3	93.3	0.0059	0.375	0.19	21.9%	0.082	0.0179	10.3	1.7	8.6
	S111-01302MI1	0.55	- 1.07	38.2	38.2	0.0425	0.375	0.19	14.2%	0.053	0.0096	4.2	0.4	3.8
	S111-01309MI1	0.74	0.59	33.2	33.2	0.0047	0.375	0.19	23.1%	0.087	0.0193	3.7	0.6	3.0
	S111-01310MI1	2.57	1.33	82.1	82.1	0.0151	0.375	0.19	16.4%	0.062	0.0118	9.1	1.0	8.1
2016 Post-develop.	S111-01311MI1	3.43	2.59	109.2	19.4	0.0077	0.375	0.19	19.1%	0.072	0.0147	2.1	0.3	1.9
	S111-00954MI1	- 1.53	- 1.65	5.4	5.4	0.0223	0.450	0.23	20.9%	0.094	0.0241	0.9	0.1	0.7
	S111-01276MI1	1.31	0.76	93.3	93.3	0.0059	0.375	0.19	23.1%	0.087	0.0193	10.3	1.8	8.5
	S111-01302MI1	0.55	- 1.07	38.2	38.2	0.0425	0.375	0.19	14.9%	0.056	0.0103	4.2	0.4	3.8
	S111-01309MI1	0.74	0.59	33.2	33.2	0.0047	0.375	0.19	24.4%	0.092	0.0209	3.7	0.7	3.0
2066 Pre-develop.	S111-01310MI1	2.57	1.33	82.1	82.1	0.0151	0.375	0.19	17.5%	0.066	0.0130	9.1	1.1	8.0
	S111-01311MI1	3.43	2.59	109.2	19.4	0.0077	0.375	0.19	20.3%	0.076	0.0161	2.1	0.3	1.8
	S111-00954MI1	- 1.53	- 1.65	5.4	5.4	0.0223	0.450	0.23	24.3%	0.109	0.0299	0.9	0.2	0.7
	S111-01276MI1	1.31	0.76	93.3	93.3	0.0059	0.375	0.19	26.7%	0.100	0.0237	10.3	2.2	8.1
	S111-01302MI1	0.55	- 1.07	38.2	38.2	0.0425	0.375	0.19	17.0%	0.064	0.0125	4.2	0.5	3.7
2066 Post-develop.	S111-01309MI1	0.74	0.59	33.2	33.2	0.0047	0.375	0.19	28.4%	0.107	0.0258	3.7	0.9	2.8
	S111-01310MI1	2.57	1.33	82.1	82.1	0.0151	0.375	0.19	20.8%	0.078	0.0166	9.1	1.4	7.7
	S111-01311MI1	3.43	2.59	109.2	19.4	0.0077	0.375	0.19	23.7%	0.089	0.0200	2.1	0.4	1.8
	S111-00954MI1	- 1.53	- 1.65	5.4	5.4	0.0223	0.450	0.23	24.8%	0.112	0.0307	0.9	0.2	0.7
	S111-01276MI1	1.31	0.76	93.3	93.3	0.0059	0.375	0.19	27.8%	0.104	0.0251	10.3	2.3	8.0
2066 Post-develop.	S111-01302MI1	0.55	- 1.07	38.2	38.2	0.0425	0.375	0.19	17.6%	0.066	0.0131	4.2	0.5	3.7
	S111-01309MI1	0.74	0.59	33.2	33.2	0.0047	0.375	0.19	29.5%	0.111	0.0272	3.7	0.9	2.8
	S111-01310MI1	2.57	1.33	82.1	82.1	0.0151	0.375	0.19	21.7%	0.081	0.0177	9.1	1.5	7.6
	S111-01311MI1	3.43	2.59	109.2	19.4	0.0077	0.375	0.19	24.7%	0.093	0.0212	2.1	0.4	1.7

	2016	2036	2066
LGIP ES Available (kL)	277.7	277.7	273.8
LGIP ES Upgrade (kL)	236.9	236.9	236.9
Site ADWF ES Reduction (kL)	-0.34	-0.34	-0.31
ES Required (kL)	-404.8	-410.0	-539.2
Difference (kL)	+109.5	+104.2	-28.8
Pass / Fail	Pass	Pass	Fail

Appendix 11. Recommended sewer parallel gravity main upgrade



H2One Pty Ltd
PO Box 290
IPSWICH QLD 4305

P: 07 5463 9538
E: info@H2One.com.au
W: h2one.com.au

DESIGNED: D Colledge	NOTE: DESIGN NOT TO BE AMENDED WITHOUT H2ONE PTY LTD ACCEPTANCE		
DRAWN: D Colledge			
CHECKED: J May			
APPROVED: J May			
CLIENT PM:			
H2ONE PM: J May	No.	REVISION	APPROVED

DATUM:
HORIZ: MGA94 (ZONE 56)
HEIGHT: AHD

SCALE:

0 40 80
Metres

SURVEYED BY / DATE: SURVEY CHECKED:

H2ONE REFERENCES	
PROJECT NO: 1804245	CITY OF GOLD COAST PO BOX 5042, GCMC QLD 9729
FILE REFERENCE:	
CAD FILE:	

CITY OF GOLD COAST
PO BOX 5042, GCMC QLD 9729

**79-99 Courtney Dr
Upper Coomera QLD 4209
Water Supply and Sewerage
Hydraulic Analysis**

Appendix 11. Recommended sewer
parallel gravity mains upgrade

ORIGINAL ISSUE DATE: MAY, 2018	
DATE SCANNED:	
DRG No:	REV:

Important Notice!
This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground.

H2One Pty Ltd gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.

Appendix 12. Water supply hydraulic model pipe layout

Appendix 13. Water supply hydraulic model staging pipe layout



H2ONE H2One Pty Ltd PO Box 290 IPSWICH Q 4305 P: 07 5463 9538 E: Info@H2One.com.au W: h2One.com.au Important Notice! This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground. H2One Pty Ltd gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data.	DESIGNED: D Colledge	NOTE: DESIGN NOT TO BE AMENDED WITHOUT H2ONE PTY LTD ACCEPTANCE			DATUM: HORIZ: MGA94 (ZONE 56) HEIGHT: AHD		CITY OF GOLDCOAST	79-99 Courtney Dr Upper Coomera QLD 4209 Water Supply and Sewerage Hydraulic Analysis	NOV, 2020				
	DRAWN: D Colledge									PROJECT NO: 1804245	DATE SCANNED:		
	CHECKED: J May				SCALE: 03570  Metres	FILE REF:							
	APPROVED: J May	C	REVISED ISSUE - 19 NOV 2020		SURVEYED BY / DATE:	SURVEY CHECKED:			CAD FILE:	CITY OF GOLD COAST PO BOX 5042, GCMC QLD 9729	Appendix 13. Water supply hydraulic model staging pipe layout	DRG No:	REV:
	CLIENT PM:	B	REVISED ISSUE - 26 OCT 2020										
	H2ONE PM: J May	A	ORIGINAL ISSUE - 4 NOV 2019										
	No.	REVISION	APPROVED										

Appendix 14. Modelling results for water supply reticulation layout

Pipes

Develop. Stage	ID	Diameter (DN)	HW Co-efficient	Length (m)	SF PH Flow Rate (L/s)	SF PH Velocity (m/s)	SF PH Head Loss (m/km)
Stage 1	P13708	200	110	80.4	1.5	0.05	0.03
	P13710	150	100	39.2	1.4	0.08	0.12
	P13712	100	100	40.8	0.5	0.06	0.12
	P13714	100	100	46.7	0.4	0.05	0.08
	P13762	100	100	40.2	0.1	0.01	0.01
	P13764	100	100	80.9	0.3	0.04	0.05
	P13766	100	100	57.8	0.1	0.01	0.01
	P13772	100	100	69.2	0.5	0.06	0.12
	P13774	100	100	58.6	0.6	0.08	0.18
	P13776	100	100	53.0	0.7	0.09	0.23
	P13778	100	100	76.7	0.8	0.10	0.30
	P13792	100	100	65.0	0.2	0.03	0.02
Stage 2	P13794	100	100	35.8	0.1	0.01	0.01
	P13800	100	100	31.3	0.1	0.01	0.01
	P13708	200	110	80.4	2.2	0.07	0.00
	P13710	150	100	39.2	2.1	0.12	0.01
	P13712	100	100	40.8	1.0	0.13	0.02
	P13714	100	100	46.7	0.9	0.12	0.02
	P13732	100	100	55.0	0.2	0.03	0.00
	P13734	100	100	59.4	0.1	0.02	0.00
	P13736	100	100	34.5	0.1	0.01	0.00
	P13762	100	100	40.2	0.1	0.01	0.00
	P13764	100	100	80.9	0.3	0.04	0.00
	P13766	100	100	57.8	0.3	0.03	0.00
	P13768	100	100	64.2	0.2	0.02	0.00
	P13770	100	100	13.1	0.1	0.01	0.00
	P13772	100	100	69.2	0.7	0.09	0.01
	P13774	100	100	58.6	0.8	0.10	0.02
	P13776	100	100	53.0	0.9	0.11	0.02
	P13778	100	100	76.7	1.0	0.13	0.03
	P13784	100	100	66.4	0.5	0.07	0.01
	P13786	100	100	76.7	0.4	0.05	0.01
Stage 3	P13788	100	100	25.5	0.6	0.08	0.00
	P13792	100	100	65.0	0.8	0.10	0.02
	P13794	100	100	35.8	0.7	0.09	0.01
	P13796	100	100	24.7	0.1	0.01	0.00
	P13800	100	100	31.3	0.1	0.01	0.00
	P13708	200	110	80.4	2.9	0.09	0.09
	P13710	150	100	39.2	2.8	0.16	0.41
	P13712	100	100	40.8	1.6	0.20	1.03
	P13714	100	100	46.7	1.5	0.19	0.91
	P13716	100	100	60.8	0.7	0.09	0.22
	P13718	100	100	38.2	0.6	0.08	0.16
	P13720	100	100	47.5	0.5	0.06	0.12
	P13722	100	100	54.7	0.4	0.05	0.08
	P13724	100	100	72.1	0.3	0.04	0.04
	P13726	100	100	71.3	0.2	0.03	0.02
	P13728	100	100	74.8	0.1	0.01	0.01
	P13730	100	100	38.6	0.0	0.00	0.00
	P13732	100	100	55.0	0.1	0.01	0.00
	P13734	100	100	59.4	0.0	0.00	0.00
	P13736	100	100	34.5	0.1	0.01	0.01
	P13762	100	100	40.2	0.1	0.01	0.01
	P13764	100	100	80.9	0.3	0.04	0.05
	P13766	100	100	57.8	0.4	0.05	0.08
	P13768	100	100	64.2	0.3	0.04	0.05
	P13770	100	100	13.1	0.2	0.03	0.02
	P13772	100	100	69.2	0.8	0.10	0.30
	P13774	100	100	58.6	0.9	0.12	0.37
	P13776	100	100	53.0	1.0	0.13	0.45
	P13778	100	100	76.7	1.1	0.14	0.54

	P13784	100	100	66.4	0.4	0.05	0.08
	P13786	100	100	76.7	0.3	0.04	0.05
	P13788	100	100	25.5	0.5	0.06	0.12
	P13792	100	100	65.0	0.7	0.09	0.22
	P13794	100	100	35.8	0.6	0.08	0.17
	P13796	100	100	24.7	0.1	0.02	0.01
	P13800	100	100	31.3	0.1	0.01	0.01
Stage 4	P13708	200	110	80.4	4.6	0.11	0.13
	P13710	150	100	39.2	4.5	0.20	0.61
	P13712	100	100	40.8	2.5	0.25	1.54
	P13714	100	100	46.7	2.4	0.24	1.39
	P13716	100	100	60.8	1.1	0.11	0.34
	P13718	100	100	38.2	1.0	0.10	0.27
	P13720	100	100	47.5	0.9	0.09	0.21
	P13722	100	100	54.7	0.8	0.07	0.16
	P13724	100	100	72.1	0.7	0.06	0.11
	P13726	100	100	71.3	0.2	0.03	0.02
	P13728	100	100	74.8	0.1	0.01	0.01
	P13730	100	100	38.6	0.4	0.02	0.02
	P13732	100	100	55.0	1.0	0.06	0.10
	P13734	100	100	59.4	0.9	0.05	0.07
	P13736	100	100	34.5	0.6	0.06	0.10
	P13738	100	100	59.4	0.4	0.03	0.03
	P13740	100	100	57.4	0.3	0.01	0.00
	P13742	100	100	79.2	0.1	0.01	0.00
	P13744	100	100	126.8	0.6	0.04	0.05
	P13746	100	100	16.9	0.0	0.02	0.02
	P13762	100	100	40.2	0.1	0.01	0.01
	P13764	100	100	80.9	0.9	0.04	0.05
	P13766	100	100	57.8	0.6	0.09	0.22
	P13768	100	100	64.2	0.5	0.08	0.16
	P13770	100	100	13.1	0.1	0.02	0.02
	P13772	100	100	69.2	1.6	0.14	0.52
	P13774	100	100	58.6	1.7	0.15	0.61
	P13776	100	100	53.0	1.8	0.17	0.71
	P13778	100	100	76.7	1.9	0.18	0.82
	P13784	100	100	66.4	0.9	0.08	0.16
	P13786	100	100	76.7	0.8	0.06	0.12
	P13788	100	100	25.5	1.0	0.09	0.22
	P13792	100	100	65.0	1.2	0.11	0.35
	P13794	100	100	35.8	1.1	0.10	0.28
	P13796	100	100	24.7	0.3	0.01	0.00
	P13800	100	100	31.3	0.7	0.01	0.01
	P13802	100	100	25.2	0.5	0.07	0.14
Stage 5	P13708	200	110	80.4	4.6	0.15	0.21
	P13710	150	100	39.2	4.5	0.26	1.00
	P13712	100	100	40.8	2.5	0.32	2.37
	P13714	100	100	46.7	2.4	0.31	2.20
	P13716	100	100	60.8	1.1	0.14	0.55
	P13718	100	100	38.2	1.0	0.13	0.46
	P13720	100	100	47.5	0.9	0.12	0.38
	P13722	100	100	54.7	0.8	0.11	0.31
	P13724	100	100	72.1	0.7	0.09	0.24
	P13726	100	100	71.3	0.2	0.03	0.02
	P13728	100	100	74.8	0.1	0.01	0.01
	P13730	100	100	38.6	0.4	0.05	0.09
	P13732	100	100	55.0	1.0	0.13	0.43
	P13734	100	100	59.4	0.9	0.11	0.35
	P13736	100	100	34.5	0.6	0.08	0.19
	P13738	100	100	59.4	0.4	0.05	0.09
	P13740	100	100	57.4	0.3	0.04	0.04
	P13742	100	100	79.2	0.1	0.02	0.01
	P13744	100	100	126.8	0.6	0.07	0.15
	P13746	100	100	16.9	0.0	0.00	0.00
	P13748	100	100	119.4	0.4	0.06	0.10
	P13750	100	100	88.1	0.2	0.02	0.02
	P13752	100	100	27.7	0.2	0.03	0.02

	P13754	100	100	98.6	0.0	0.01	0.00
	P13756	100	100	86.6	0.2	0.02	0.02
	P13758	100	100	98.5	0.2	0.03	0.03
	P13762	100	100	40.2	0.1	0.01	0.01
	P13764	100	100	80.9	0.9	0.12	0.38
	P13766	100	100	57.8	0.6	0.08	0.17
	P13768	100	100	64.2	0.5	0.06	0.12
	P13770	100	100	13.1	0.1	0.02	0.01
	P13772	100	100	69.2	1.6	0.21	1.09
	P13774	100	100	58.6	1.7	0.22	1.22
	P13776	100	100	53.0	1.8	0.23	1.35
	P13778	100	100	76.7	1.9	0.25	1.50
	P13784	100	100	66.4	0.9	0.11	0.33
	P13786	100	100	76.7	0.8	0.10	0.26
	P13788	100	100	25.5	1.0	0.12	0.40
	P13792	100	100	65.0	1.2	0.15	0.58
	P13794	100	100	35.8	1.1	0.14	0.49
	P13796	100	100	24.7	0.3	0.04	0.05
	P13798	100	100	43.5	0.6	0.08	0.18
	P13800	100	100	31.3	0.7	0.09	0.24
	P13802	100	100	25.2	0.5	0.07	0.14

Note 1: "SF" is "standard flow" and "PH" is "peak hour"

Note 2: Peak hour occurred at 7 am.

Nodes

Develop. Stage	ID	Demand (EP)	RL AHD (m)	SF PH Demand (L/s)	SF PH Pressure (m)	Fire Flow (L/s)	FF 2/3 PH Pressure (m)
Stage 1	J174H	12.0	57.5	0.1	38.8	15	32.4
	J176H	12.0	59.5	0.1	36.7	15	29.9
	J178H	12.0	59.2	0.1	36.9	15	28.0
	J180H	12.0	62.3	0.1	33.7	15	23.2
	J206H	12.0	55.9	0.1	40.0	15	26.0
	J224H	12.0	48.1	0.1	47.8	15	32.2
	J226H	12.0	57.7	0.1	38.2	15	24.9
	J228H	12.0	42.9	0.1	53.0	15	34.7
	J230H	12.0	61.3	0.1	34.8	15	24.7
	J232H	12.0	60.8	0.1	35.2	15	23.7
	J234H	12.0	59.4	0.1	36.6	15	24.0
	J246H	12.0	62.3	0.1	33.7	15	20.8
Stage 2	J250H	12.0	61.9	0.1	34.1	15	21.7
	J254H	12.0	49.6	0.1	46.3	15	30.2
	J174H	12.0	57.5	0.1	38.8	15	32.4
	J176H	12.0	59.5	0.1	36.7	15	29.9
	J178H	12.0	59.2	0.1	36.9	15	28.0
	J180H	11.5	62.3	0.1	33.7	15	23.2
	J198H	11.5	52.5	0.1	43.4	15	31.0
	J200H	11.5	52.2	0.1	43.7	15	30.7
	J202H	12.0	51.1	0.1	44.8	15	31.3
	J206H	12.0	55.9	0.1	40.0	15	26.0
	J224H	12.0	48.1	0.1	47.8	15	32.2
	J226H	12.0	57.7	0.1	38.2	15	24.9
	J228H	12.0	42.9	0.1	53.0	15	34.7
	J230H	12.0	61.3	0.1	34.8	15	24.7
	J232H	12.0	60.8	0.1	35.2	15	23.7
	J234H	11.5	59.4	0.1	36.6	15	24.0
	J238H	11.5	51.9	0.1	44.0	15	30.5
	J240H	11.5	57.1	0.1	38.8	15	25.7
	J242H	12.0	61.8	0.1	34.2	15	21.1
	J246H	12.0	62.3	0.1	33.7	15	20.8
Stage 3	J250H	11.5	61.9	0.1	34.1	15	21.7
	J252H	12.0	52.7	0.1	43.2	15	30.4
	J254H	11.5	49.6	0.1	46.3	15	30.2
Stage 3	J256H	12.0	48.4	0.1	47.5	15	32.8
	J174H	12.0	57.5	0.1	38.8	15	32.4
	J176H	12.0	59.5	0.1	36.7	15	29.9
	J178H	12.0	59.2	0.1	36.9	15	28.0

	J180H	12.0	62.3	0.1	33.7	15	23.2
	J182H	12.0	63.2	0.1	32.8	15	20.3
	J184H	12.0	61.3	0.1	34.7	15	21.5
	J186H	12.0	60.2	0.1	35.8	15	22.1
	J188H	12.0	58.0	0.1	37.9	15	24.1
	J192H	12.0	53.3	0.1	42.6	15	29.2
	J194H	12.0	55.0	0.1	40.9	15	22.8
	J196H	12.0	59.1	0.1	36.8	15	13.7
	J198H	11.5	52.5	0.1	43.4	15	31.0
	J200H	11.5	52.2	0.1	43.7	15	30.7
	J202H	11.5	51.1	0.1	44.8	15	31.3
	J206H	12.0	55.9	0.1	40.0	15	26.0
	J224H	12.0	48.1	0.1	47.8	15	32.2
	J226H	12.0	57.7	0.1	38.2	15	24.9
	J228H	12.0	42.9	0.1	53.0	15	34.7
	J230H	12.0	61.3	0.1	34.8	15	24.7
	J232H	12.0	60.8	0.1	35.2	15	23.7
	J234H	12.0	59.4	0.1	36.6	15	24.0
	J238H	11.5	51.9	0.1	44.0	15	30.5
	J240H	11.5	57.1	0.1	38.8	15	25.7
	J242H	11.5	61.8	0.1	34.2	15	21.1
	J246H	12.0	62.3	0.1	33.7	15	20.8
	J250H	12.0	61.9	0.1	34.1	15	21.7
	J252H	11.5	52.7	0.1	43.2	15	30.4
	J254H	12.0	49.6	0.1	46.3	15	30.2
	J256H	11.5	48.4	0.1	47.5	15	32.8
Stage 4	J174H	12.0	57.5	0.1	38.8	15	32.4
	J176H	12.0	59.5	0.1	36.7	15	29.9
	J178H	12.0	59.2	0.1	36.9	15	28.0
	J180H	12.0	62.3	0.1	33.7	15	23.2
	J182H	12.0	63.2	0.1	32.8	15	20.3
	J184H	12.0	61.3	0.1	34.7	15	21.5
	J186H	12.0	60.2	0.1	35.8	15	22.1
	J188H	12.0	58.0	0.1	37.9	15	24.1
	J192H	12.0	53.3	0.1	42.6	15	29.2
	J194H	12.0	55.0	0.1	40.9	15	22.8
	J196H	12.0	59.1	0.1	36.8	15	13.7
	J198H	11.5	52.5	0.1	43.4	15	31.0
	J200H	11.5	52.2	0.1	43.7	15	30.7
	J202H	11.5	51.1	0.1	44.8	15	31.3
	J204H	15.6	46.5	0.1	49.4	15	34.1
	J206H	12.0	55.9	0.1	40.0	15	26.0
	J208H	15.6	43.6	0.1	52.3	15	36.2
	J210H	15.6	40.0	0.1	55.9	15	39.7
	J212H	15.6	40.6	0.1	55.3	15	39.9
	J224H	12.0	48.1	0.1	47.8	15	32.2
	J226H	12.0	57.7	0.1	38.2	15	24.9
	J228H	12.0	42.9	0.1	53.0	15	34.7
	J230H	12.0	61.3	0.1	34.8	15	24.7
	J232H	12.0	60.8	0.1	35.2	15	23.7
	J234H	12.0	59.4	0.1	36.6	15	24.0
	J236H	15.6	40.6	0.1	55.3	15	40.3
	J238H	11.5	51.9	0.1	44.0	15	30.5
	J240H	11.5	57.1	0.1	38.8	15	25.7
Stage 5	J242H	11.5	61.8	0.1	34.2	15	21.1
	J246H	12.0	62.3	0.1	33.7	15	20.8
	J250H	12.0	61.9	0.1	34.1	15	21.7
	J252H	11.5	52.7	0.1	43.2	15	30.4
	J254H	12.0	49.6	0.1	46.3	15	30.2
	J256H	11.5	48.4	0.1	47.5	15	32.8
	J174H	12.0	57.5	0.1	38.8	15	32.4
	J176H	12.0	59.5	0.1	36.7	15	29.9
	J178H	12.0	59.2	0.1	36.9	15	28.0
	J180H	12.0	62.3	0.1	33.7	15	23.2
	J182H	12.0	63.2	0.1	32.8	15	20.3
	J184H	12.0	61.3	0.1	34.7	15	21.5
	J186H	12.0	60.2	0.1	35.8	15	22.1

	J188H	12.0	58.0	0.1	37.9	15	24.1
	J192H	12.0	53.3	0.1	42.6	15	29.2
	J194H	12.0	55.0	0.1	40.9	15	22.8
	J196H	12.0	59.1	0.1	36.8	15	13.7
	J198H	11.5	52.5	0.1	43.4	15	31.0
	J200H	11.5	52.2	0.1	43.7	15	30.7
	J202H	11.5	51.1	0.1	44.8	15	31.3
	J204H	15.6	46.5	0.1	49.4	15	34.1
	J206H	12.0	55.9	0.1	40.0	15	26.0
	J208H	15.6	43.6	0.1	52.3	15	36.2
	J210H	15.6	40.0	0.1	55.9	15	39.7
	J212H	15.6	40.6	0.1	55.3	15	39.9
	J214H	25.1	46.8	0.2	49.0	15	32.5
	J216H	25.1	51.9	0.2	43.9	15	26.1
	J218H	25.1	49.4	0.2	46.4	15	26.8
	J220H	25.1	53.4	0.2	42.4	15	24.6
	J222H	25.1	53.6	0.2	42.2	15	25.8
	J224H	12.0	48.1	0.1	47.8	15	32.2
	J226H	12.0	57.7	0.1	38.2	15	24.9
	J228H	12.0	42.9	0.1	53.0	15	34.7
	J230H	12.0	61.3	0.1	34.8	15	24.7
	J232H	12.0	60.8	0.1	35.2	15	23.7
	J234H	12.0	59.4	0.1	36.6	15	24.0
	J236H	15.6	40.6	0.1	55.3	15	40.3
	J238H	11.5	51.9	0.1	44.0	15	30.5
	J240H	11.5	57.1	0.1	38.8	15	25.7
	J242H	11.5	61.8	0.1	34.2	15	21.1
	J246H	12.0	62.3	0.1	33.7	15	20.8
	J250H	12.0	61.9	0.1	34.1	15	21.7
	J252H	11.5	52.7	0.1	43.2	15	30.4
	J254H	12.0	49.6	0.1	46.3	15	30.2
	J256H	11.5	48.4	0.1	47.5	15	32.8

Note 1: Red text denotes minimum pressure (critical pressure point) within the network.

Note 2: Peak hour occurred at 7 am and 2/3 peak hour at 7 pm.

Appendix 15. Modelling results for water supply network capacity assessment

Standard Flow

Provision	2016		2021		2026		2031		2036		2066	
	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.
Connection point (CD_1_HY) min. pressure (m)	38.7	40.0	39.4	40.7	38.9	40.1	38.9	40.1	38.9	40.1	39.4	39.9
Network min. pressure (m)	19.7	19.8	20.8	20.8	20.0	20.1	20.0	20.1	20.0	20.1	20.0	19.6
Network no. failures	2	2	2	2	2	2	2	2	2	2	2	2
Tank min. water level (%)	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%	28%
Max. pipe velocity (m/s)	1.9	1.4	2.0	1.6	2.0	1.6	2.0	1.6	2.0	1.6	1.8	1.4
Network min. pressure ID	HE_11100514189_WTHY											

Fire Flow

Scenario		2016		2021		2026		2031		2036		2066	
		Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.	Post-develop.	Pre-develop.
Peak Hour	Site hydrant (CD_1_HY) min. pressure (m)	29.6	32.7	30.1	33.3	29.7	32.9	29.7	32.9	29.7	32.8	30.7	32.7
	Network hydrant min. pressure (m)	13.6	13.9	14.6	15.0	14.0	14.4	14.0	14.4	14.0	14.3	14.3	13.9
	Network hydrant no. failures	0	0	0	0	0	0	0	0	0	0	0	0
	Min. pressure node ID	HE_11100010870_WTHY											
2/3 Peak Hour	Site hydrant (CD_1_HY) min. pressure (m)	32.6	34.5	32.8	34.6	32.8	34.2	32.8	34.2	32.8	34.2	33.4	35.0
	Network hydrant min. pressure (m)	14.6	14.8	15.0	15.2	14.9	14.6	15.0	14.6	14.9	14.6	15.1	15.3
	Network hydrants no. failures	0	0	0	0	0	0	0	0	0	0	0	0
	Min. pressure node ID	HE_11100010870_WTHY											

Note: Peak hour occurred at 7 am and 2/3 peak hour occurred at 7 pm.