WAIMAKARIRI DISTRICT COUNCIL

REPORT FOR DECISION

FILE NO and TRIM NO:	CON202137-02 / 230224025812
REPORT TO:	WOODEND- SEFTON COMMUNITY BOARD
DATE OF MEETING:	11 April 2023
AUTHOR(S):	Teifion Matthews, Project Engineer Jason Recker, Stormwater and Waterways Manger
SUBJECT:	Recommendation for proposed upcoming works at Norton Place, Woodend
ENDORSED BY: (for Reports to Council, Committees or Boards)	General Manager / Acting Chief Executive

1. SUMMARY

1.1. The purpose of this report is to seek the recommendation of the Woodend-Sefton Community Board to proceed to detail design with the preferred option of upgrading the existing sumps to double back entry sumps as selected from attachment I.

1.2. There has only been one recorded property flooding in June 2019, which was during a 1 in 100 year event.

1.3. The design intent is to capture the surface water before it flows towards Norton Place. The stormwater network has been modelled (attachment IV) and shown for a 20% AEP event the flooding would be restricted to the roadway and would not be expected to affect private properties.

1.4. A letter was delivered to the locally effected residents (attachment II) proposing the new design. There have been no questions/ queries from the residents.

1.5. Upgrading the existing sumps and installing new sumps with back entry sumps along Hewitts Road at a cost of $165,000.00 will not increase the capacity of the current stormwater system, however it will reduce the risk of blockages.

1.6. A budget of $310,000.00 has been included in the draft 23/24 Annual Plan for the Norton Place stormwater upgrade.

1.7. The previous option to re-shape Hewitts Road would require 240m of kerb and channel will need to be replaced along with a complex tie-in detail at the intersection of Woodglen Drive and Hewitts Road

Attachments:

I. Norton Place concept design memo for client decision (TRIM No. 220927166032)
II. Letter to residents regarding stormwater upgrade - Feb 2023 (TRIM No. 230215019821)
III. Letter to residents regarding Norton Reserve following Street Meeting - Jan 2022 (TRIM No. 220201012537)
IV. Hewitts Road Stormwater Investigation (TRIM 140117004083)
V. 3 Norton Place Surface Water Flooding - Options Memo (TRIM 191202168675)

2. RECOMMENDATION

THAT the Woodend- Sefton Community Committee

(a) **Receives** Report No. 230224025812

(b) **Note** following the recommendation from the community board, staff will proceed to Utilities and Roading Committee for approval of the Upgrading existing sump option. Following the decision from the Utilities and Roading Committee, Council staff will complete design and proceed to construct.

AND

THAT the Utilities & Roading Committee:

(a) **Approves** the recommendation to proceed with design and construction of the upgrading existing sump option in 2023/24.

(b) **Notes** that there will still be an issue of lack of secondary flow path out of Norton Place for extreme events. However the 50 year level of service is maintained to prevent flooding of private property, by routine sump maintenance. It is likely Council will continue receiving complaints due to ponding in road reserve and the time it takes for the water to drain away.

(c) **Notes** that this is a reduced scope of work from the previously accepted design of overland flow path through Norton Reserve and Hewitts Road and has come about due to the practical challenges and constraints of the current localised topography and construction estimate for this upgrade being beyond the available budget.

(d) **Notes** that in events great than 1 in 100 years, overland flow path will continue to follow the natural low point towards the property.

(e) **Notes** that this option can be integrated into any future stormwater upgrades along Hewitts Road.

3. BACKGROUND

3.1. An investigation and options memo was completed in 2019 (attachment V) following the May/June 2019 storm event which flooded the Norton Place cul-de-sac and a property.

3.2. The memo also highlights during a 20% AEP event the flooding would be restricted to the roadway and would not be expected to affect private properties. The rainfall which occurred on 1 June 2019 was more severe than a 20% AEP event and resulted in overtopping into private property. The cause of the flooding during 2019 was due to a lack of secondary flow path.

3.3. Following the memo, it was decided to proceed with the basin design with an original budget of $305,000 for design, tendering and construction.

3.4. Following a street meeting held on the 19 January 2022 (attachment III), the basin design concept has a negative response from the local community. It was agreed to work through a new concept design and cost estimate to re-shape Hewitts Road adjacent to the reserve.

3.5. The intent of the re-shape Hewitts Road was to create a consistent fall from the Woodglen Drive intersection, so that overland flows will be conveyed down Hewitts Road towards Main North Road instead of toward Norton Place. This option had a cost estimate of $585,000.00.

4. ISSUES AND OPTIONS

4.1. Recommended option – Upgrading the existing sumps

The sump upgrade option consists of installing additional double sumps upstream of Hewitts Road and a new double sump at the low point in Norton Place. There will also be a non-return valve installed to prevent back flow from Hewitts Road to Norton Place. As seen in Figure 1.

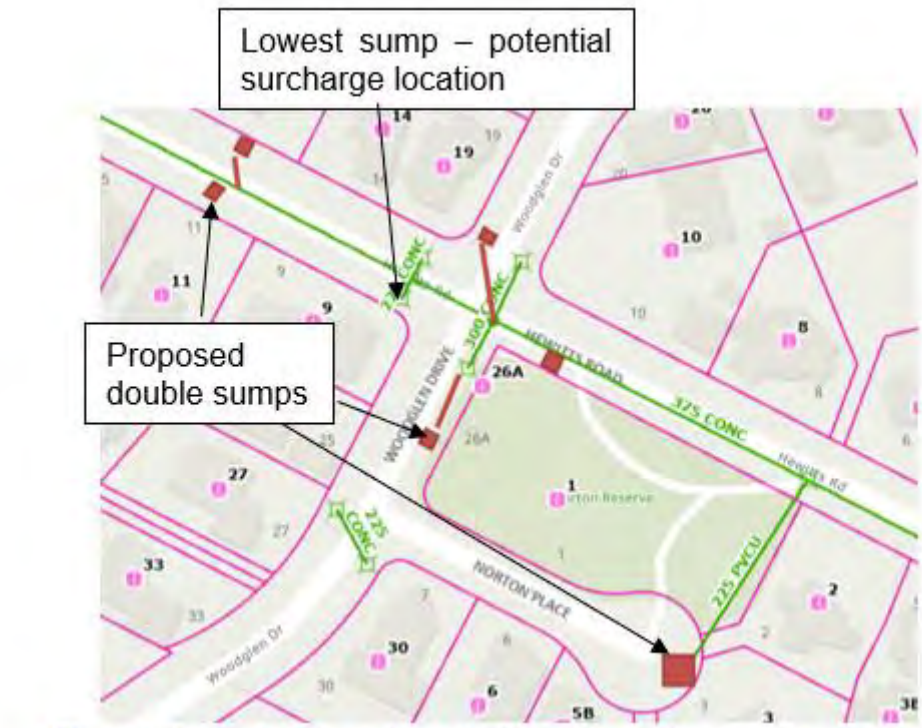

Figure 1 Approx. locations of new double sumps and non-return valve.

The design intent is to capture the flow before it reaches Woodglen Dr and then down to Norton Place. This option will meet Waimakariri District Council's Engineering Code of Practice section 5.6.5 of a 20% AEP level of services for primary reticulation system.

The advantages and disadvantages associated with this option are shown below in table 1.

Advantage	Disadvantage
Significantly lower cost than the overland flow path option	Potential for further flooding in events greater than 10% AEP.
Complies with Waimakariri District Council's Engineering Code of Practice section 5. 5	Stormwater network running at full capacity during 20% AEP.

Least disruptive to local residents during construction.	

Table 1 – Proposed Option Advantages and disadvantages

4.2. Stormwater basin option

The stormwater basin option consists of excavating the dome shaped reserve into a basin, approx. 2000m³ of earthworks and civil works required along Hewitt Road. As seen in figure 2 below.

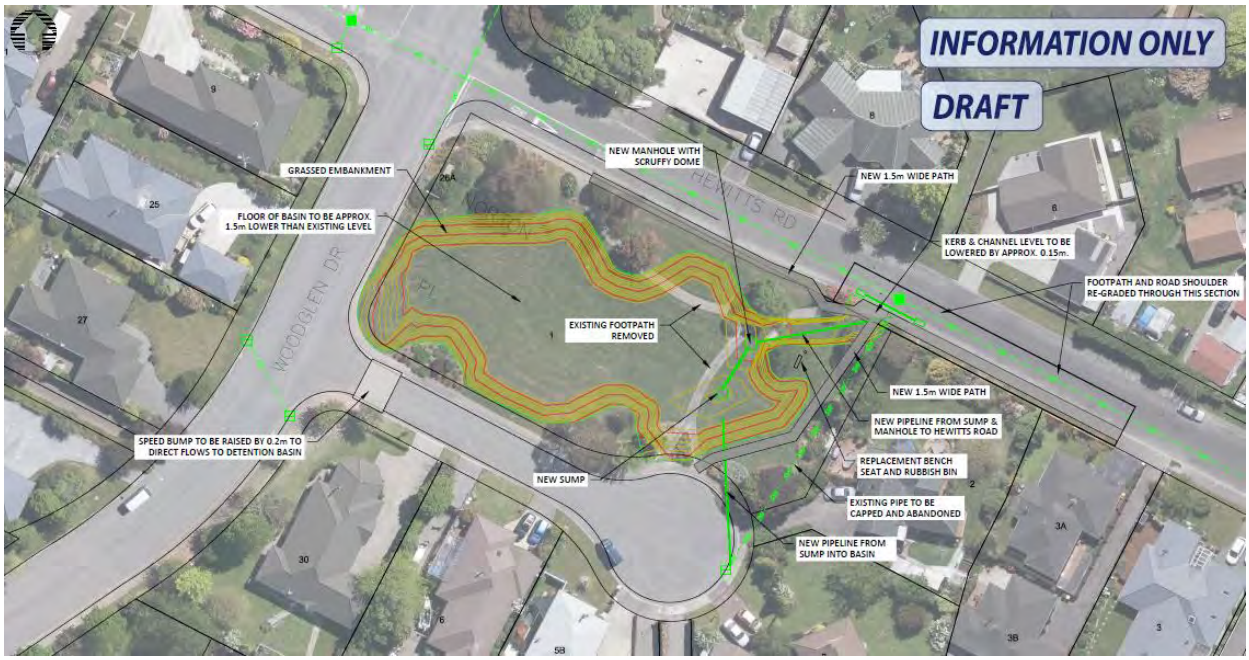

Figure 2 Option 2 scope of works

A ground investigation was carried out and completed by Aecom in October 2021, which identified the ground water was 1.9m below current ground level. The concept design is to excavate the basin up to 1.65m deep from the existing ground level with 1V:3H side slopes, which is approx. 300mm above the ground water level. As part of the investigation, Aecom have installed a piezometer for Council to carry on monitoring the ground water level. Follow up site inspection of the piezometer found the ground water to range from 1.7 to 1.9m below ground level.

This option was presented to the residents and then discussed during the street meeting on 19 January 2022 and was not well received due to a number of reasons. Some of the reasons were the current green space being a source of local pride for the residents, the effect on house prices and the main source of the problem wasn't being resolved.

The engineers cost estimate for the work is $450,000, including professional fees and contingency. This has been revised from the 2019 estimate based on recently tendered and more conservative rates.

The advantages and disadvantages associated with this option are shown below in table 2.

Advantage	Disadvantage

Create a basin with enough volume to receive and store all floodwaters from a 1% AEP event.	Very high risk of the basin becoming a wetland due to the high water table.
	Estimated total project spend is $145,000 over the current budget for 2022/23
	Least favourable with the residents

Table 2 Advantages and disadvantages for option 2

4.3. **Hewitts Road Re-shape option**

This option was reconsidered for concept design following the street meeting, which was held on the 19 January 2022.

This option consist of lowering 140m of Hewitts Road surface level up to depths of 420mm (potentially 620mm depending of the subgrade) to allow the overland surface water to flow straight across the intersection and towards Main North Road, refer to figure 4 below for new surface level. This option will also include installing a new speed ramp along the intersection with Woodglen Drive and Hewitts Road. To achieve the new design levels of Hewitts Road, 240m of kerb and channel will need to be replaced along with a complex tie-in detail at the intersection of Woodglen Drive and Hewitts Road.

An alternative variant to this option was to create a deep channel on the footpath to convey the surface flow from the speed ramp to the existing sump. However, this variant was rejected due to the size of the channel required (0.4m deep, 3m wide) and the constructability of the design.

Figure 3 – Option 3 Proposed extent of works

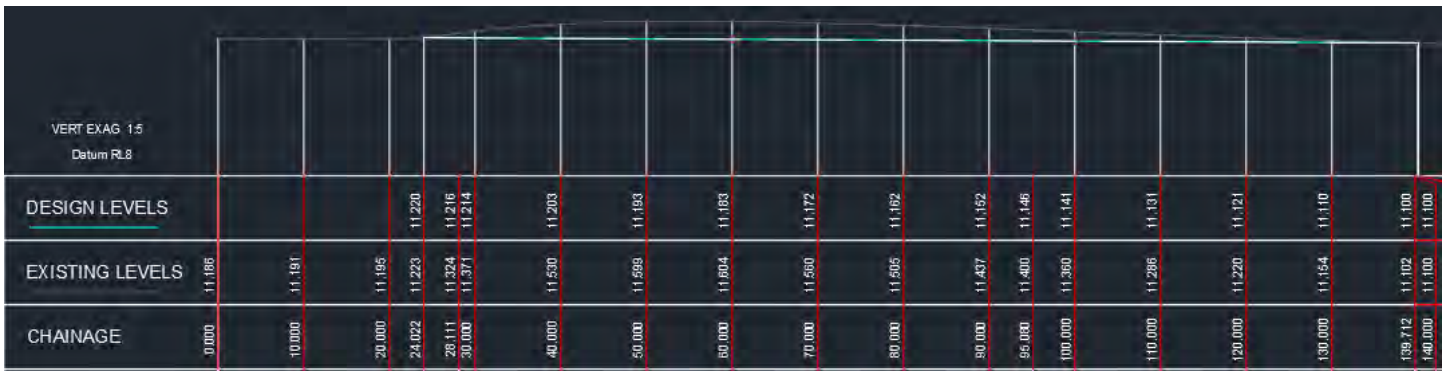

Figure 4 Proposed new surface level for Option 3

The engineers cost estimate for the work is $590,000

The advantages and disadvantages associated with this option are shown below in table 3.

Advantage	Disadvantage
Resolves the overland surface water flooding along Norton Place by removing the slope in Hewitts Road.	Complex roading design required in the tie-in between the junction of Woodglen Drive and Hewitts Road.
Most favourable with the residents.	Construction estimate is $285,000 over the initial budget.
	Cost vs reward – only one recorded property flooding. Where the rain event was a 1 in 100 year.
	Most disruptive to local residents during construction

Table 3 Advantages and disadvantages for Option 3

Implications for Community Wellbeing

Having a functioning stormwater system and reducing the risk of flooding is important to the community wellbeing of the local residents in this area..

4.4. The Management Team has reviewed this report and support the recommendations.

5. COMMUNITY VIEWS

5.1. Mana whenua

Te Ngāi Tūāhuriri hapū are not likely to be affected by or have an interest in the subject matter of this report. However, they do have an interest in the appropriate management and treatment of stormwater.

5.2. Groups and Organisations

There are not groups and organisations likely to be affected by, or to have an interest in the subject matter of this report.

5.3. **Wider Community**

The wider community is not likely to be affected by, or to have an interest in the subject matter of this report. However, the project can be integrated with any future stormwater upgrades within the wider community. The project will have immediate benefits in the local neighbourhood of the works.

6. OTHER IMPLICATIONS AND RISK MANAGEMENT

6.1. **Financial Implications**

This budget is included in the Annual Plan/Long Term Plan.

The new option has an estimated construction cost of $165,000.00. Currently the 23/24 budget has is $310,000.00. The project will be debt funded. The project can therefore be completed within budget.

6.2. **Sustainability and Climate Change Impacts**

The recommendations in this report do not have sustainability and/or climate change impacts. However, the catchment flow calculation are based on future rainfall predictions and the new sumps will accommodate increased rain fall volume from climate change.

6.3 **Risk Management**

There are risks arising from the adoption/implementation of the recommendations in this report. As the council may still receive complaints from the members of the public for standing water and the proposed option does not address the overland flood path issue.

This risk is mitigated by the ability for the current upgrade being compatible with any future improvements should they prove necessary.

6.3 **Health and Safety**

There are not health and safety risks arising from the adoption/implementation of the recommendations in this report. However, there will always be an element of risk in each adoption that council will mitigate as much as possible through safety in design work shops. The contract works will be managed under an approved site specific health and safety plan.

7. CONTEXT

7.1. **Consistency with Policy**

This matter is not a matter of significance in terms of the Council's Significance and Engagement Policy.

7.2. **Authorising Legislation**

The Local Government Act is relevant in this matter.

7.3. **Consistency with Community Outcomes**

The Council's community outcomes are relevant to the actions arising from recommendations in this report.

Core utility services are sustainable, low emissions, resilient, affordable; and provided in a timely manner

7.4. **Authorising Delegations**

The Community Board has delegation to make recommendations to the Utilities and Roading Committee.

Utilities & Roading community have the delegated authority to approve this recommendation.

WAIMAKARIRI DISTRICT COUNCIL

MEMO

FILE NO AND TRIM NO:	PD001721/ 220927166032
DATE:	17 October 2022
MEMO TO:	Kalley Simpson (WDC), 3 Waters Manager
FROM:	Teifion Matthews, Project Engineer
SUBJECT:	Norton Place Detailed Design Option

1. Purpose

The purpose of this memo is to seek guidance from the 3 Waters Manager on which option to proceed to detailed design.

2. Background

An investigation and option memo was completed in 2019 (TRIM 191202168675) following the May/June 2019 storm event which flooded the Norton Place cul-de-sac and a property. Following this memo, it was decided to proceed with the basin design with an original budget of $305,000 for design, tendering and construction.

Following a street meeting held on the 19 January 2022 (TRIM 220202013171), it was agreed to work through a new concept design and cost estimate to re-shape Hewitts Road adjacent to the reserve. The intent of the concept design was to create a consistent fall from the Woodglen Drive intersection, so that overland flows will be conveyed down Hewitts Road towards Main North Road instead of toward Norton Place.

3. Concept Options Considered

There are 3 concept design options currently being considered to carry through to detail design.

Option 1 – Sump upgrade

The 2019 option memo (TRIM 191202168675) refers to only one recorded property that was effect by flooding (DR1900314 & DR1900449) during the 1 in 100 year event. The memo also highlights during a 20% AEP event the flooding would be restricted to the roadway and would not be expected to affect private properties. The rainfall which occurred on 1 June 2019 was more severe than a 20% AEP event and resulted in overtopping into private property. The cause of the flooding during 2019 was due to a lack of secondary flow path.

The do minimum option consist of installing additional double sumps upstream of Hewitts Road and a new double sump at the low point in Norton Place. There will also be a non-return valve installed to prevent back flow from Hewitts Road to Norton Place. As seen in figure 1 below.

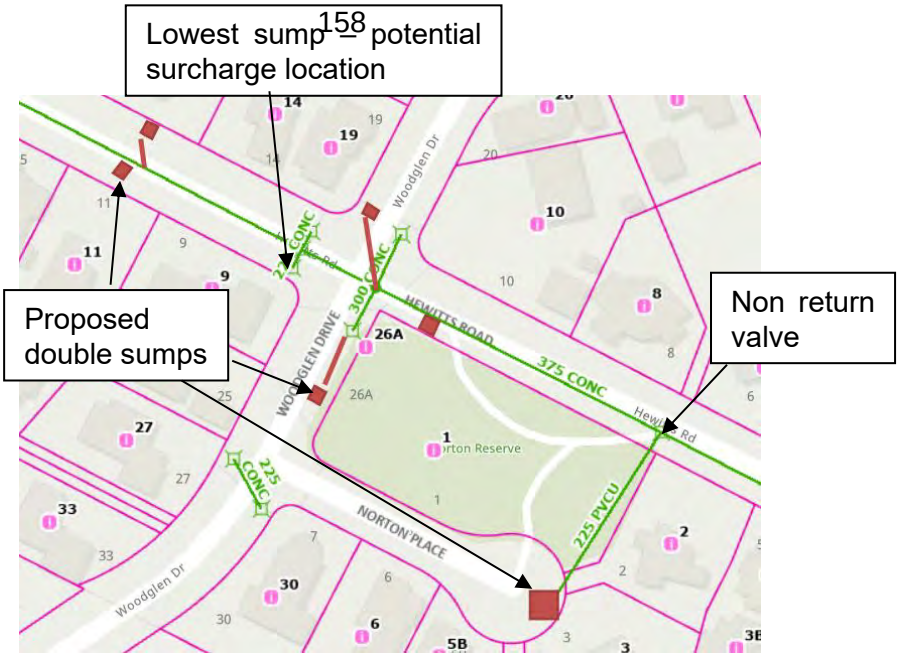

Figure 1 Approx. locations of new double sumps and non-return valve.

The design intent is to capture the flow before it reaches Woodglen Dr and then down to Norton Place. This option will still meet Waimakariri District Council's Engineering Code of Practice section 5.6.5 of a 20% AEP level of services for primary reticulation system.

The engineers cost estimate for the work is $165,000

The advantages and disadvantages associated with this option are shown below in table 1.

Advantage	Disadvantage
Significantly cheaper than option 2 and 3.	Potential back lash from residents & Woodend-Sefton Community Board as Council have advised that option 2 or 3 will proceed.
Complies with Waimakariri District Council's Engineering Code of Practice section 5.6.5	Potential for further flooding in events greater than 10% AEP.
Least disruptive to local residents during construction.	Stormwater network running at full capacity during 20% AEP.

Table 1 Advantages and disadvantages for option 1

Option 2 – Stormwater basin

The stormwater basin option consists of excavating the dome shaped reserve into a basin, approx. 2000m³ of earthworks and civil works required along Hewitt Road. As seen in figure 2 below.

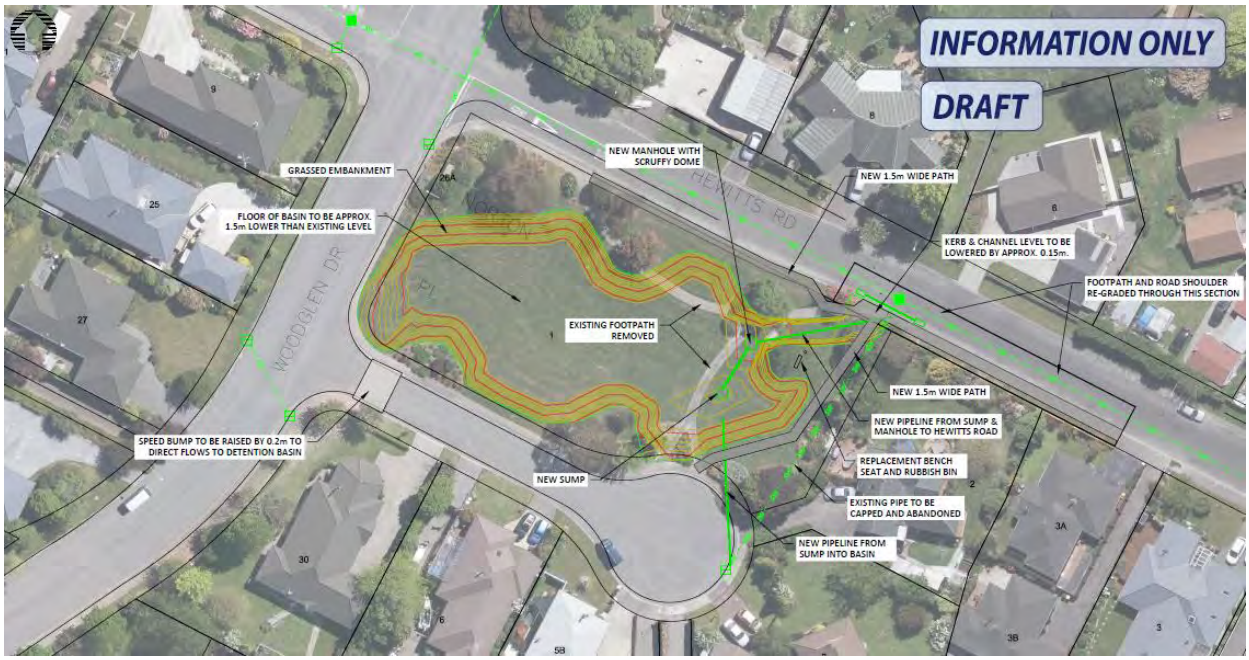

Figure 2 Option 2 scope of works

A ground investigation was carried out and completed by Aecom in October 2021 (TRIM 220106000618), which identified the ground water was 1.9m below current ground level. The concept design is to excavate the basin up to 1.65m deep from the existing ground level with 1V:3H side slopes, which is approx. 300mm above the ground water level. As part of the investigation, Aecom have installed a piezometer for Council to carry on monitoring the ground water level. Follow up site inspection of the piezometer found the ground water to range from 1.7 to 1.9m below ground level.

This option was presented to the residents and then discussed during the street meeting on 19 January 2022 and was not well received due to a number of reasons. Some of the reason were the current green space being a source of local pride for the residents, the effect on house prices and the main source of the problem wasn't being resolved.

The engineers cost estimate for the work is $450,000, including professional fees and contingency. This has been revised from the 2019 estimate based on recently tendered and more conservative rates.

The advantages and disadvantages associated with this option are shown below in table 2.

Advantage	Disadvantage
Create a basin with enough volume to receive and store all floodwaters from a 1% AEP event.	Very high risk of the basin becoming a wetland due to the high water table.

	Estimated total project spend is $145,000 over the current budget for 2022/23
	Least favourable with the residents

Table 2 Advantages and disadvantages for option 2

Option 3 – Hewitts Road Re-shape

This option was reconsidered for concept design following the street meeting, which was held on the 19 January 2022.

This option consist of lowering 140m of Hewitts Road surface level up to depths of 420mm (potentially 620mm depending of the subgrade) to allow the overland surface water to flow straight across the intersection and towards Main North Road, refer to figure 4 below for new surface level. This option will also include installing a new speed ramp along the intersection with Woodglen Drive and Hewitts Road. To achieve the new design levels of Hewitts Road, 240m of kerb and channel will need to be replaced along with a complex tie-in detail at the intersection of Woodglen Drive and Hewitts Road.

An alternative variant to this option was to create a deep channel on the footpath to convey the surface flow from the speed ramp to the existing sump. However, this variant was rejected due to the size of the channel required (0.4m deep, 3m wide) and the constructability of the design.

Figure 3 Proposed extent of works

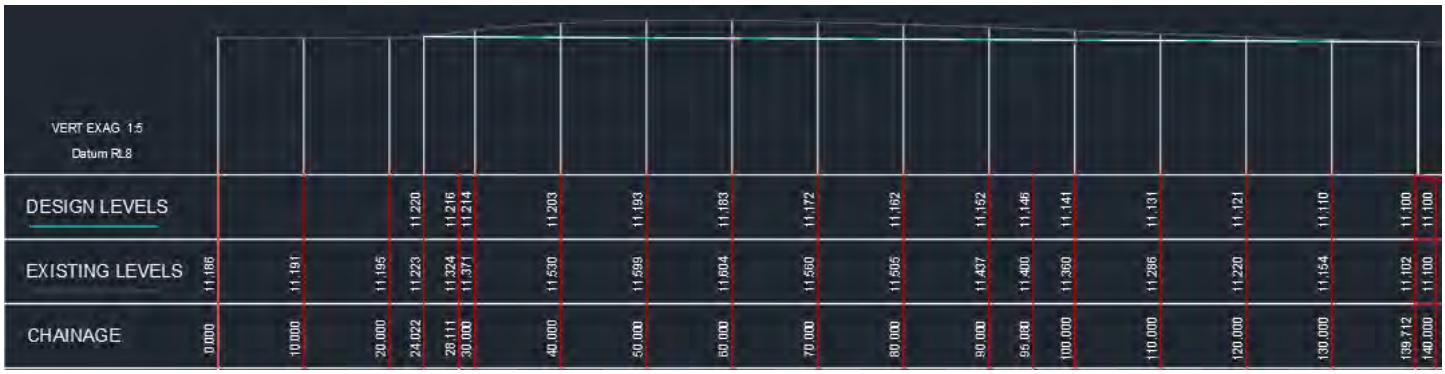

Figure 4 Proposed new surface level

The engineers cost estimate for the work is $590,000

The advantages and disadvantages associated with this option are shown below in table 3.

Advantage	Disadvantage
Resolves the overland surface water flooding along Norton Place by removing the slope in Hewitts Road.	Complex roading design required in the tie-in between the junction of Woodglen Drive and Hewitts Road.
Most favourable with the residents.	Construction estimate is $285,000 over the initial budget.
	Cost vs reward – only one recorded property flooding. Where the rain event was a 1 in 100 year.
	Most disruptive to local residents during construction

Table 3 Advantages and disadvantages for option 3

4. Conclusion

Due to only one recorded property flooding in June 2019, which was during a 1 in 100 year event. It is recommended to proceed with Option 1 to detail design.

The design intent of option 1 is to capture the surface water before it flows towards Norton Place. The stormwater network has been modelled (TRIM 140117004083) and shown for a 20% AEP event the flooding would be restricted to the roadway and would not be expected to affect private properties. The risk can be reduced further with a non-return valve installed in the manhole connecting Norton Place stormwater to Hewitts Road.

A strategic response/ communication plan will be required to inform the residents and community board of the change in Council response to the June 2019 flooding and ongoing road ponding during rain events greater than 20% AEP.

Waimakariri District Council
215 High Street
Private Bag 1005
Rangiora 7440, New Zealand
Phone 0800 965 468

Our Reference: 230215019821

1 March 2023

Dear Resident,

Proposed Stormwater Improvement Works around Norton Place – Update

In June of last year, we wrote to you outlining an alternate option to re-grade Hewitts Road and compare to the originally proposed Stormwater detention basin in Norton Reserve. I'm happy to provide another copy of this previous letter if you no longer have it.

In the space of this time Allie Mace-Cochrane has been assigned to another project and I (Teifion Matthews) have now picked up the project.

We have developed the re-grading of Hewitts Road option to a point, where we have carried out an assessment and determined this option would not be cost effective. The other option of the stormwater detention basin has been ruled out due to the high ground water table and resident's feedback.

The intent of the new concept design is to capture the flow of water before it reaches Woodglen Drive and then down to Norton Place. We would do this by installing new double sumps along Woodglen Drive & Hewitts Road.

This solution is an upgrade to the primary (piped) network that includes additional sumps and a non-return valve. This solution does not provide a secondary overland flow path during heavy storm events which was part of the original design intent but has proved very difficult to achieve without significant cost. Therefore, in large events it is expected that there will still be localised ponding within the Norton Place Road corridor. However, the proposed upgrades will help reduce the magnitude of this, and the risk of floodwater entering private property. We will continue to monitor the impact of large rain events in the area.

The construction timeframe for the new double sumps is late 2023.

Apologies for the delay with this,

Regards

Teifion Matthews | **Project Engineer**
Project Delivery Unit
Phone: 0800 965 468 (0800 WMK GOV)

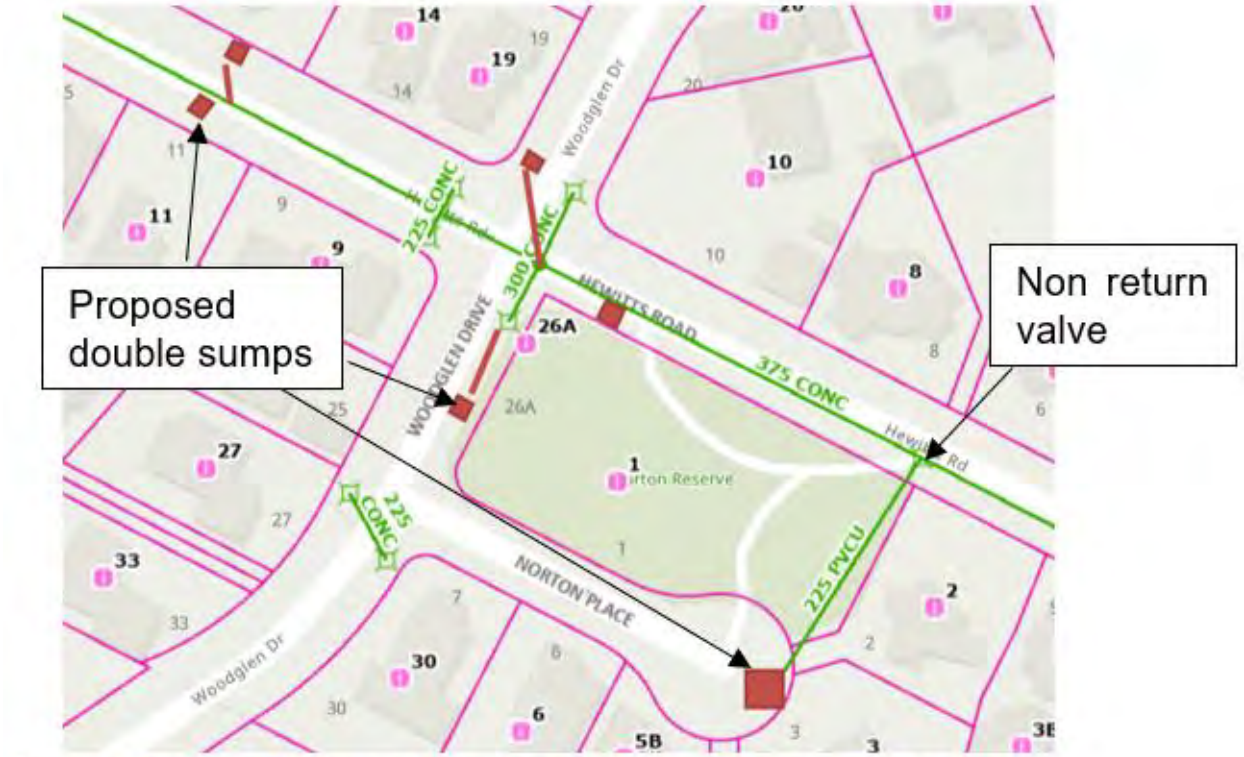

Figure 1 Approx. locations of new double sumps and non-return valve.

Waimakariri District Council
215 High Street
Private Bag 1005
Rangiora 7440, New Zealand
Phone 0800 965 468

Our Reference: 220201012537

1 February 2022

Dear

Proposed Works at Norton Reserve – Update Following Street Meeting

Thank you for your attendance at the Street Meeting held at Norton Reserve on January 19 2022. It was very heartening to see a large turnout of people who clearly have a strong connection with the reserve, as well as enjoyment and pride in their neighbourhood. If you did not attend the meeting, this letter should serve as a summary of what was discussed.

The intent of this letter is to summarise:

- The proposal to create a Stormwater basin within Norton Reserve
- The background work which got us to this point, and other options considered, which I did not cover this in detail at the meeting. On reflection, I should have begun the meeting by going through this background for you rather than jumping straight into discussing the proposed reserve modifications. Apologies for missing this.
- My understanding of the main points and concerns raised at the meeting
- Where to from here

The Proposal

I believe the letter previously sent prior to the meeting covered the basin proposal reasonably well, and this should be referred to. Perhaps what wasn't emphasised, was that the intent of the basin is only to manage those flows which occur in storm events which are beyond the capacity of the pipelines. The pipelines are designed to a level of service to convey moderate level flows. Severe storm events, such as the May/June 2019 storm event, exceed the capacity of the pipelines in and around Hewitts Road and Norton Place as they typically do throughout the majority of the stormwater network in the district. However in most other areas there are secondary flow paths to convey flows from larger scale events when the pipes are overwhelmed. There is currently no such secondary flow path out of Norton Place.

The lack of a secondary flow path is a legacy issue from when Hewitts Road, Norton Place and surrounding roads were developed, which I am not fully aware of the history of. My scope of work is only to identify and mitigate the current flooding issues.

The intent of the basin is for it to operate during storm events in which the pipe network is overwhelmed, to hold the excess water until flows subside. In the most extreme events, the basin is designed so that any overflow once the capacity is reached will outfall into Hewitts Road, where the height at the north east corner of the reserve will be lower than the height at the basin entry points off Norton Place.

During dry weather or light to moderate level rain/storm events the basin will not hold water. The intent of the basin concept is to maintain the amenity of the reserve by way of preserving the mature trees, reinstating the grassed surface, and replacing the existing paths with new paths on different alignments. The main difference under normal conditions is the shape of the reserve being bowl shaped rather than the current dome profile.

There is also a proposed upgrade to the pipework crossing the reserve, to provide a larger diameter pipe, and to prevent backflows from reaching the Norton Place sump.

The Background

An investigation and report was completed in 2020 following the May/June 2019 storm event which flooded the Norton Place cul-de-sac and several properties. This report was presented to the Three Waters Manager (Kalley Simpson). This report looked at options to improve the primary (piped) network capacity and to provide a secondary flow path away from Norton Place. The options for a secondary flow path were modelled by Council staff using our flood modelling software. The results of some of these model runs are shown in the maps on the pages attached. The maps are explained as follows:

1. This shows the flooding as modelled based on the rainfall data over May 31 – June 1 2019 collected at a rainfall gauge on nearby Chinnery's Road. This is a representation of what happened on that day, however it will not exactly reflect the water levels that actually were experienced, as these weren't measured by us. As can be seen, the model shows approximately 0.1 to 0.2m depth of water within the properties off the end of the Norton Place cul-de-sac. This model is considered to be a fairly close representation to the reality of what occurred. All further model runs were based on this same level of rainfall, with various additional theoretical measures in place.

2. This is a model run of the same event, with a non-return valve placed on the pipe running from Norton Place to Hewitts road. The intent of which is to prevent backflow from the Hewitts Road pipework surcharging out of the Norton Place sump. As can be seen, this would have little effect on flood levels in the cul-de-sac.

3. This model run has a theoretical wall of 2m height placed across the Norton Place entry, to show what would happen if flows were prevented from entering the street. This would prevent the private properties being flooded, but is obviously not a buildable option. Preventing the flows from entering Norton Place, while not providing an alternative flow path would push flow to the north along Woodglen Road, causing downstream issues to that network.

4. This model run has a 0.2m high speedbump across the Norton Place entry, which is a buildable option. This would not be sufficient to prevent flows from entering, as the top of the speed bump would still be lower than other surrounding points. It would not be feasible to build a hump any higher than this.

5. This model run has the basin as per the proposal you have been shown. This shows that waters will pool in the road reserve to the height of the footpath, and then top into the basin. The basin would then fill up and discharge into Hewitts Road at the north-east corner of the reserve. This option means that while the road reserve would still hold water, once it gets to a critical point it will overflow into the basin rather than into private properties off the end of the cul-de-sac. The flows which discharge from the

basin down Hewitts Road are not expected to lead to any further flooding issues downstream.

6. This model run shows a swale drain across the reserve. This shows that while such a swale would likely have some impact, it would not have sufficient gradient or capacity to prevent flooding of private properties in this event.

Various other scenarios were modelled, which did not have any impact on the Norton Place flooding.

The option to re-grade Hewitts Road was not modelled as this was discarded early in the process due to the minimal difference in elevation on each side of the existing rise as well as expected costs of re-grading the road being much higher than modifying the reserve (although this was not quantified). This option is discussed further in the “Where to from here” section of this letter.

After receiving this report, the Three Waters Manager presented a report to the Utilities and Roading Committee (which is a collection of elected members) who approved a budget of $305,000 for the project, to cover design, tendering and construction costs. The proposed basin solution was approved in principle as the preferred solution, subject to successful consultation with the Council Greenspace Team and endorsement by the Woodend-Sefton Community Board (WSCB). The WSCB is an elected group of community members who meet monthly and provide a voice for the Woodend-Sefton area on pertinent matters which impact on the community. The Greenspace Team are Council staff who manage the operation and maintenance of our park & reserves, and include Ed Sard, who was present at the street meeting.

The Greenspace Team was consulted by myself, by way of a briefing of the proposal and site visit to the reserve explaining the proposed work. They were in favour of the proposal. They also confirmed that it would not require a change to the parks status as a Recreation Reserve under the Local Government Act.

In order to obtain endorsement by the WSCB, the recent letter was sent and street meeting was conducted with the households surrounding the reserve, with the intent to take feedback received to the WSBC February meeting. My expectation was that there would not be as strong a representation or feeling as there turned out to be on the day. Therefore, following this meeting, I am delaying my submission to the WSCB to their March or April meeting, while I undertake some more work on the Hewitts Road option and go back to residents for your feedback.

Points and Concerns Raised at the Street Meeting

The below is my understanding of the main points and concerns raised at the Street Meeting, as well as in following correspondence, in relation to the proposal. Note, not all are covered. If you feel there is anything major I have missed, please let me know. I’ve provided some answers in italics:

- **How will this affect the amenity of the reserve, which is a source of pride for the local residents?** *We are endeavouring to preserve the character of the reserve as much as possible by maintaining or replacing trees, grass and pathways. There will of course be some changes, with the main one being the shape of the park. However the*

intent is to provide a solution to the flooding problem while still providing a quality recreation reserve in order to give a better outcome to the community.

- **Will this affect property values?** *While private property values and the property market are outside of our control, as described above we will be working to ensure the amenity of the reserve and surrounding roadways is not worsened.*

- **This will not fix the problem of the sumps and pipework not being able to convey high flows.** *This is a correct statement. The intent of the basin is to cater for those flows beyond the capacity of the pipework by,*
    - *Temporarily storing water until flows subside and it can drain away*
    - *In the event of continuous or severe rainfall, the basin will overflow to Hewitts Road.*

- **What construction impacts will there be? This is large scale work which will involve considerable noise, truck movements, dust, mud and impacts on traffic.** *This is correct that there will be an impact on you during the work. While we attempt to limit the impact of construction-related disruptions during works, there is of course still some un-avoidable effect. We are governed by District Plan requirements as well as a Land Use Resource Consent for this specific job, which have rules and limits around aspects such as dust generation, noise etc. As an example, dust will likely need to be suppressed using water sprayed over exposed soil surfaces or stockpiles. Noise will be measured periodically at the reserve boundary to ensure it is kept within District Plan limits. The contractor will be required to submit a Site Specific Safety Plan, an Erosion & Sediment Control Plan and a Traffic Management Plan, for Council approval prior to works commencing. These plans will also be monitored during the works to ensure they are being followed.*

- **How will the reserve be maintained once this is completed?** *There will be very little change to the current maintenance regime which the Greenspace contractor, Delta, currently undertakes in terms of mowing the grass, weed spraying, clearing debris etc. If there are any concerns you have about the current maintenance regime of the park or surrounding roads, this is a matter you may take up through visiting or contacting the Council Service desk or by using the "Snap, Send, Solve" phone app.*

- **The problem is that water bypasses Hewitts Road, due to a rise in the road alongside the reserve, and instead makes its way down Woodglen Road and into Norton Reserve. Why can't Hewitts Road be re-graded instead?** *This is indeed a significant factor in what happens during flood events. This option was looked at in brief detail during the earlier options assessment, but was discarded due to likely cost implications and difficulties in design. This is now being looked into in further detail in response to the concerns raised.*

I note there were some points raised around historical flood events and previous dealings with Council around the flooding issues in this area, as well as the maintenance of the sumps etc. I haven't addressed these in this letter as I am more focussed on my role and the way forward from here. If you wish to follow up any of these further please let me know.

<u>Where to From Here?</u>

We are now working through a concept design and cost estimate to re-grade Hewitts Road

adjacent to the reserve in order to create consistent fall from the Woodglen Drive intersection, so that overland flows will be conveyed down Hewitts Road instead of toward Norton Place as they do at present. This may also include placing a 0.2m high speed bump across the Norton Place entry, as well as other infrastructure upgrades/changes.
The results of this investigation will be presented to you in a future update and another street meeting may be held. I will confirm this nearer to the time. We will then endeavour to take a proposal to the Woodend-Sefton Community Board at either their March or April meeting for endorsement.
Whichever of the Basin or Hewitts Road concepts are ultimately confirmed will be subject to the Community Boards endorsement, which your feedback will help to inform. Construction of the chosen option is still planned for late 2022.

I will be in touch in due course with the next update.
Regards

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Hewitts Road Stormwater Investigation

Prepared by the Project Delivery Unit

January 2014

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1. SUMMARY

1.1. INTRODUCTION

The purpose of this investigation was to re-evaluate the proposed upgrades outlined in the 2001 Woodend Stormwater Management Plan (SMP) for the Woodend stormwater network, along Hewitts Road and Main North Road. These upgrades were recommended in the 2001 Woodend SMP and involved upsizing of pipes to pass peak flows during a 5 return period rain event.

This investigation involved:

- A site visit to confirm the location of sumps and manholes, and also confirm the pipe sizes within the Hewitts Road catchment.
- Updating the Mike Urban, 2013 Woodend–North Kaiapoi stormwater model with the findings from the site visit.
- Applying a 5 year level of service, critical rainfall event to the updated model and analysing the results.
- Determine upgrade solutions to meet the 5 year level of service.
- Recommending a way forward

It is noted that during the site visit there was water entering the stormwater network during dry weather conditions. This was traced upstream to two cracks in the walls of sumps 0108D00512 and 0108D00564.

1.2. BACKGROUND

Currently there is a 375mm diameter concrete pipe along Hewitts and Main North Road, which collects stormwater from the northern part of the study area. The southern branch of the network extends along Manahi Place and The Stables cul-de-sacs. Both of these sub-catchments contribute to a 675 mm diameter concrete pipe which conveys stormwater past the Littles Lane subdivision to Parsonage Road. The current network is presented in Figure 1 below.

Figure 1: Hewitts Road Network and Study area

Most of the network was constructed in 1994; the exception being the 675mm diameter section which runs along the boundary of the Methodist Church and Littles Lane subdivision, which was constructed in 2003.

1.3. CURRENT PREDICTED NETWORK ISSUES

The model predicted that the current network has significant flooding in Norton Place, where water levels are exceeding 0.3m. Norton Place is relatively low lying and any surcharging within the network will be more evident at this location. The flooding is largely the product of backflow from the downstream sections of pipework. This level of flooding does not meet the Council's desired level of service for a 5 year storm event.

By analysing the pipe long-sections there were notable areas of interest. There is significant headloss along all sections of pipe displayed in Figure 6, the sumps surcharge in many locations and there are backwater effects caused by the capacity of the downstream network.

Therefore it was decided to focus on the following problem areas:

- The 375mm diameter along Hewitts Road
- The 375mm diameter along Main North Road
- The 675 mm diameter pipe from Main North to Parsonage Road.

It was predicted that upgrading these sections of the network would relieve the majority of the flooding within the study area catchment as these are the sections with high levels of headloss indicating the pipes are undersized. These sections are also similar to the sections identified in the 2001 SMP as requiring upgrades. The southern upstream branch of the study area network (Manahi Place) does not have a notable capacity issue, and was also not identified as a problem in the 2001 SMP.

It is noted that the slope of the pipe across Main North Road is quite steep, approximately 1:83, which compounds the backwater effects upstream. Therefore a more consistent slope between A and C was modelled for the upgrade solutions.

1.4. UPGRADE SOLUTIONS

Sections of the network were upgraded in the model to find the full upgrade solution and the recommended upgrade solution. See Table 1 and Figure 2 for a summary of the upgrade solutions.

Table 1: Hewitts Road Upgrade Solution Summary

Solution	Upgrade Description	General Result Comment
Full Upgrade Solution	Combination upgrade, upgrade to a 525mm diameter pipe along parts of Hewitts Road and along Main North Road; and upgrade to a 900mm diameter pipe from Main North Road to Parsonage Road.	This solution has all pipes operating efficiently to convey the stormwater. This is the **full upgrade solution**, which resulted in the majority of the flooding being less than 0.1m. The Main North to Parsonage Road upgrade was outside the original scope of the project; however it significantly alleviates the backwater effects along Main North and Hewitts Road, and has therefore been included.

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Recommended Upgrade Solution	Combination upgrade, upgrade to a 525mm diameter pipe along parts of Hewitts Road and along Main North Road.	This is the **recommended upgrade solution**, which resulted in the same level and extent of flooding as the full upgrade solution; however due to downstream backwater effects the network is predicted to be operating at full capacity. It is recommended that this solution is constructed in stages, starting with the Main North Road section; where monitoring can be undertaken before upgrading Hewitts Road. This solution can be further developed in the future to the full upgrade solution by simply upgrading the pipe section between C and E (see Figure 2)

Note that additional simulations were completed in addition to these presented in Table 1. These upgrade solutions are similar to the upgrades presented in the 2001 SMP.

Figure 2 presents the staged approach to the full upgrade solution. The recommended upgrade solution is to only undertake stages 1 and 2.

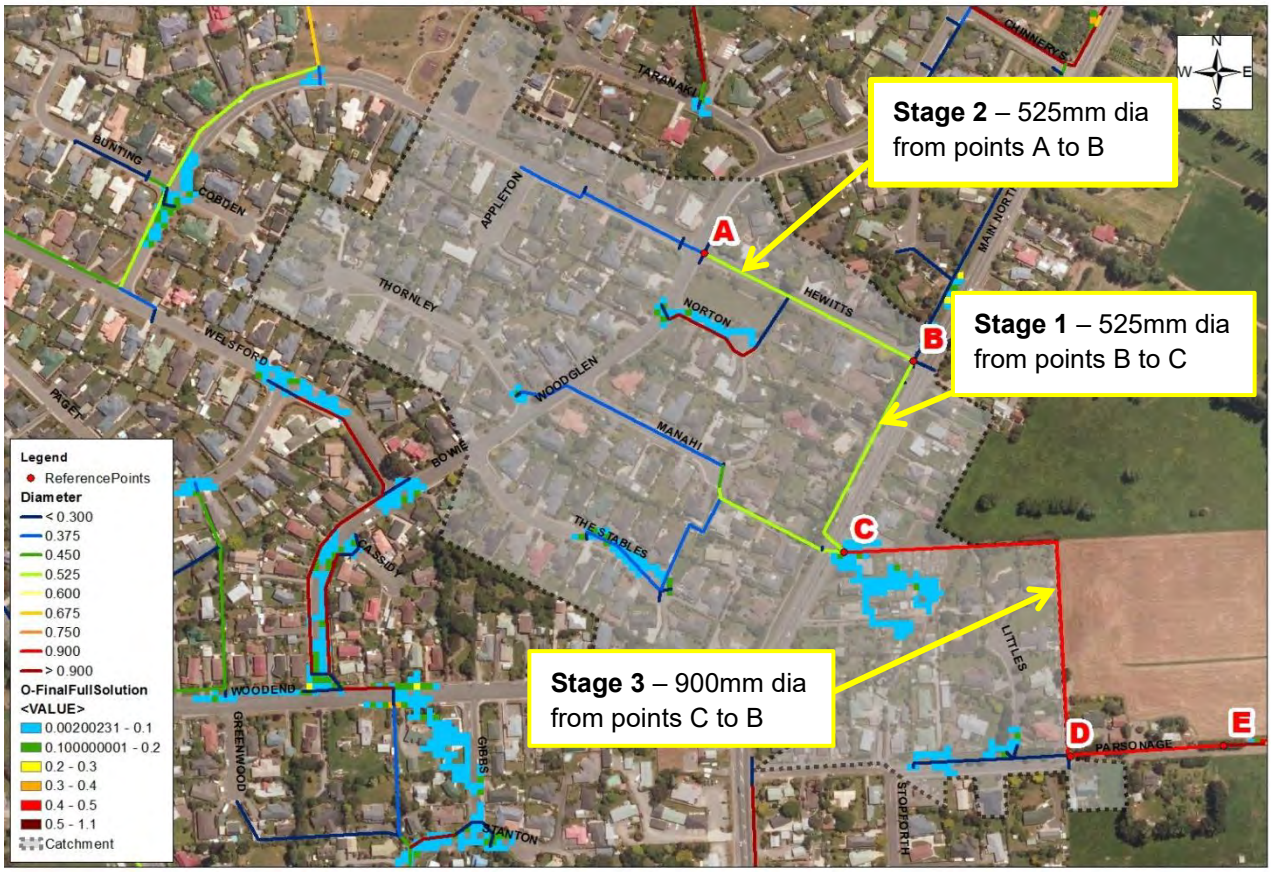

Figure 2: Full Upgrade Solution for the Hewitts Road Catchment, recommended Stages shown

A rough order budget estimate was undertaken for the full upgrade solution and the recommended upgrade solution. Table 2 presents a summary of the budget estimate to complete the upgrade solutions.

Table 2: Budget Estimate for the Hewitts Road Stormwater Upgrade

Full Upgrade Solution	**Total Upgrade**	**$**	**2,880,000.00**
Recommended Upgrade Solution	**Stage 1**	$	630,000.00
	Stage 2	$	340,000.00
	Total Upgrade	**$**	**970,000.00**

1.5. RECOMMENDED ACTION

It is not recommended that any work is undertaken in the short term and instead monitoring is undertaken on Norton Place, The Stables and at the Methodist Church on Main North Road prior to undertaking detailed design and construction. This is based on the following reasons:

1. There is no record of significant flooding in this area.

2. Flooding is mostly on the road; there predicted to be is no flooding risk to households in the 5 year return period rainfall event.

3. The main upgrade recommended is to the 375mm diameter pipe along a state highway, which is controlled by NZTA. This will complicate the construction and increase the cost to install the pipe.

4. The Woodend by-pass is forecast in the next 10 to 20 years by the NZTA. When this occurs, the crossing of Main North Road will be easier and be less costly, as thrusting may not be required.

If the flooding is to the same extent as predicted in the model, then it is recommended that a staged construction approach of the recommended upgrade solution is undertaken; otherwise it is recommended that the network remains as Status Quo.

1.6. CONCLUSION

In conclusion, the Woodend-Kaiapoi North Stormwater Model was updated after a site visit. The model was run using Mike Urban software to find the full upgrade solution and the recommended solution.

The recommended upgrade solution details an upgrade on a section of Hewitts and Main North Roads from a 375 mm diameter to a 525 mm diameter pipe. The full upgrade solution includes both the recommended upgrades plus a upgrade to the 675 mm diameter around Littles Lane subdivision; however this upgrade is outside of the scope of this project.

The full upgrade solution is estimated to cost $2,880,000 and the recommended upgrade solution is estimated to cost $970,000. Staging the upgrades beginning with the Main North Road section is recommended.

However due to the location and timing of this upgrade it is recommended that the project is delayed and monitoring is undertaken, before commencing any work.

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2. RECOMMENDATIONS

From the findings of this report, it is recommended:

1. That the 3 Waters Manager receives this report.
2. That no work is undertaken in the short term and instead that monitoring is undertaken on Norton Place, The Stables and at the Methodist Church on Main North Road, prior to undertaking the detailed design and construction.
3. That if significant flooding is present as predicted in the model, then a staged construction approach of the recommended upgrade solution is undertaken, which is predicted to cost approximately $ 970,000.00.
4. That cracks in manholes 0108D00512 and 0108D00564 should be patched, these cracks were noticed in dry weather conditions during the site visit. significant inflows were noticed within manholes.

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3. INTRODUCTION

The purpose of this investigation was to re-evaluate the proposed upgrades outlined in the 2001 Woodend Stormwater Management Plan (SMP) for the Woodend stormwater network, along Hewitts Road and Main North Road. These upgrades were recommended in the 2001 Woodend SMP and involved upsizing of pipes to pass peak flows during a 5 year return period rain event.

This report outlines the full upgrade solution, a recommended upgrade solution and the recommended action, to address the capacity issues in the Hewitts Road stormwater catchment.

This investigation involved:

- A site visit to confirm the location of sumps and manholes, and also confirm the pipe sizes within the Hewitts Road catchment.
- Updating the Mike Urban, 2013 Woodend–North Kaiapoi stormwater model with the findings from the site visit.
- Applying a 5 year level of service, critical rainfall event to the updated model and analysing the results.
- Determine upgrade solutions to meet the 5 year level of service.
- Recommending a way forward

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4. BACKGROUND

The Hewitts Road pipeline upgrade was recommended in the 2001 Woodend SMP (MC6), as a medium priority upgrade. The 2001 project description proposes that the following upgrades are to be undertaken, see Figure 3 below.

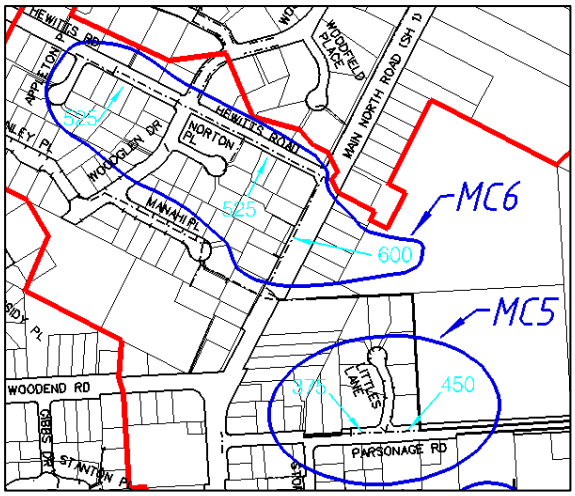

Figure 3: 2001 Woodend Stormwater Management plan, Hewitts Road

The scope of MC6 in Figure 3 is the same as the scope of this project, focusing on Hewitts and Main North Roads. The 2001 SMP project description recommends an upgrade to the pipes along Hewitts and Main North Roads, to a 525mm and 600mm diameter respectively.

In order to get a better understanding of the catchment, the area circled as MC5 in Figure 3 was also analysed as any capacity issues in the pipe around the Littles Lane subdivision may contribute to flooding in both MC5 and MC6.

This investigation therefore focused on the Hewitts Road wider catchment, upstream of Parsonage Road; this will be referred to as the study area throughout this report. See Figure 4 for the study area.

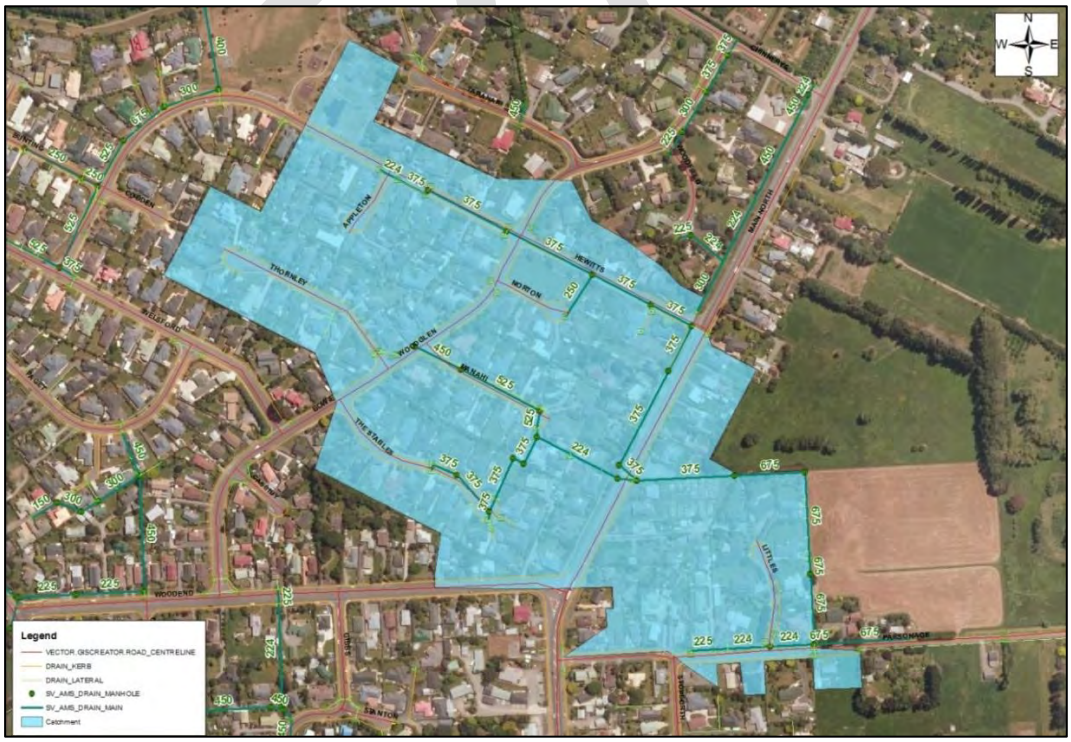

Figure 4: Study area (extended Hewitts Road stormwater catchment)

Currently there is a 375mm diameter concrete pipe along Hewitts and Main North Road, which collects stormwater from the northern part of the study area. The southern branch of the network extends along

Manahi Place and The Stables cul-de-sacs. Both of these sub-catchments contribute to a 675 mm diameter concrete pipe which conveys stormwater past the Littles Lane subdivision to Parsonage Road.

Most of the network was constructed in 1994; the exception being the 675mm diameter section which runs along the boundary of the Methodist Church and Littles Lane subdivision, which was constructed in 2003.

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5. METHODOLOGY

5.1. SITE VISIT

A site investigation was undertaken to confirm the location of sumps and manholes, also confirm the pipe sizes within the catchment. The model was updated with the observations from the site visit and as-built information where available.

It is noted that during the site visit there was water entering the stormwater network during dry weather conditions. This was traced upstream to two cracks in the walls of sumps 0108D00512 and 0108D00564. The owner from 21 Hewitts Road said that there was often a bad smell coming from these sumps. It is recommended that this is investigated further and the sumps repaired.

5.2. MODEL UPDATES

The Woodend-North Kaiapoi 2013 stormwater model was used to model peak flows from the Hewitts Road catchment. This model was updated after the site visit; the following updates were made to the model:

1. A single sump was placed on Main North Road, behind 9 Manahi Place, which contributes stormwater to manhole 0107D00019.
2. A single sump was placed on Main North Road, with a direct connection from the kerb and channel into the 375 mm pipe, near 1 Hewitts Road.
3. Two single sumps were placed on Main North Road, at the intersection of Hewitts and Main North Road, contributing stormwater to manhole 0108D00212.
4. Two single sumps and a manhole were placed on Hewitts Road, at the intersection of Woodglen Drive and Hewitts Road.
5. A single sump was placed at the end of The Stables cul-de-sac, contributing stormwater to manhole 0898D00098.

In addition there were some minor changes made to the stormwater catchments in the model; however the total catchment size contributing to the study area did not change significantly.

There are design drawings for sections of the Hewitts and Main North Road stormwater network. These were compared with the model data, and it was the model was accurate.

5.3. MODELLING PROCEDURE

The WDC uses a hydraulic model to determine areas of the network which are not meeting the service levels in the ECOP. The 2013 Woodend-North Kaiapoi model, with model updates, was run using Mike Urban 2012 software. The Woodend-North Kaiapoi stormwater model models piped network flows and secondary flow paths during a rainfall event.

To evaluate the performance of the Hewitts Road stormwater network and identify the critical storm duration, a range of 5 year annual recurrence interval (ARI) rainfall events were applied to the model, as this is the WDC level of service for the primary pipe network.

The rainfall hyetograph was obtained from NIWA records, using the High Intensity Rainfall Design System (HIRDS), version 3 software and with a 16% climate change factor. The model runoff simulation incorporates calibrated ground infiltration parameters and measured impervious values. The runoff method used is the kinematic wave equation within the Mike Urban modelling software, which incorporates infiltration losses using Horton's equation. There were no changes made to the runoff parameters or rainfall hyetograph from the Woodend-North Kaiapoi model.

Within the model, the stormwater network and secondary flow paths are connected at the sumps. The stormwater from the sub-catchments enter the network, if the network reaches capacity the stormwater

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overflows at the sumps and enters the secondary flow paths. This is modelled in a coupled Mike 21 2D simulation which predicts areas of flooding.

The network and secondary flow path results from the existing network were analysed and key upgrade areas were identified. Within the model, pipe capacities were increased iteratively and the results were analysed to determine the recommended upgrade solutions.

5.3.1. Notable Stormwater Model Limitations

The slope and flow paths for each sub-catchment were calculated using LiDAR data and ArcGIS software. These programmes interpolate and average values, which limits the degree of accuracy.

The 2D model simulation (secondary flow path simulation) has been run using a 5m grid. This is where the model averages the LiDAR elevations across a 5m by 5m area, and based on this assumption as stormwater surcharges from sumps it predicts the flooding extent, direction and depth.

The model's DEM (Digital Elevation Model) is based on 2005 LiDAR data. Changes to the ground elevation may have occurred since 2005 such as

- The 2010 Canterbury earthquakes may have altered the ground levels. Although it is also noted that the manhole lid levels were surveyed after the earthquakes and little change was evident in Woodend.
- Development since 2005 will have altered the ground levels in some areas although the Hewitts Road catchment has experienced very little development since this time.

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6. RESULTS ANALYSIS

The 5 year return period rainfall event which produced the peak network flows in the study area was the 5 year, 1 hour ARI rainfall event. This is the critical rainfall event used during this investigation.

6.1. EXISTING NETWORK ANALYSIS

The existing stormwater network capacity, within the study area was assessed using DHI Mike Urban software.

The following map (Figure 5) presents the existing pipe sizes within the study area catchment. In Figure 5, points A, B, C, D and E will be used as reference points throughout this report.

Figure 5: Hewitts Road catchment, current network and flooding during the critical 5 year return period event.

For the current network the model predicted that the peak flows during a 5 year, 1 hour ARI rainfall event ranged from 30 L/s upstream (upstream of point A) to 500 L/s downstream (point D).

It is noted that the section of pipe from points C to E is outside of the scope of this project, however the model predicted that this 675 mm diameter pipe is causing backwater effects along Hewitts and Main North Roads.

The model predicted there to be significant flooding in Norton Place, where water levels are exceeding 0.3m. Norton Place is relatively low lying and any surcharging within the network will be more evident at this location. The flooding is largely the product of backflow from the downstream sections of pipework. This level of flooding does not meet the Council's desired level of service for a 5 year storm event.

There is also lesser flooding predicted along The Stables, Hewitts Road, Main North Road and at the Methodist Church Cemetery, however most of this flooding is less than 0.2m and is considered minor in nature.

The long-section in Figure 6 is of the upstream end of Hewitts Road, along Main North Road, to Parsonage Road. This model long-section simulation period is half way through the hour simulation (32 minutes) and before flooding is predicted to occur. The simulation's Hydraulic Grade Line (HGL) is displayed in dark blue and the red dashed line is the maximum HGL.

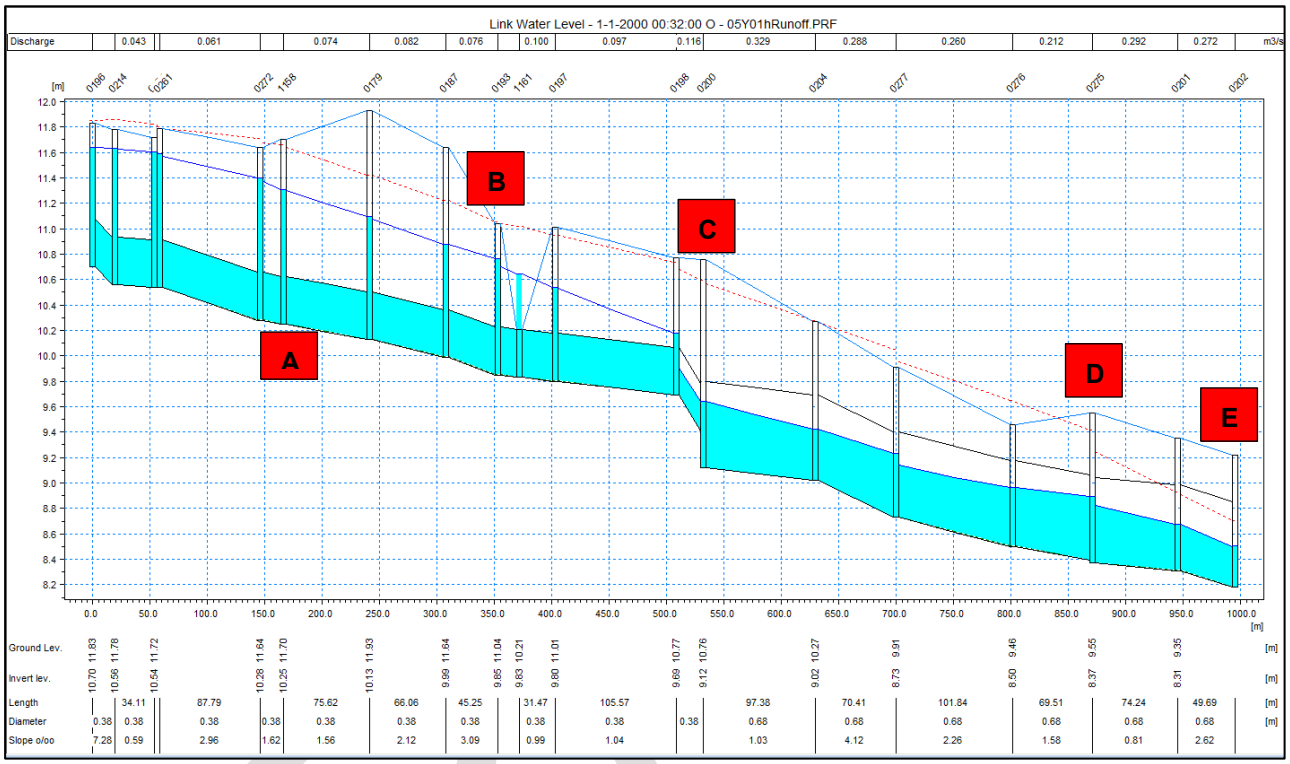

Figure 6: Long-section from upstream Hewitts Road, along Main North Road to Parsonage Road.

It is noted that as this simulation is a secondary flow path simulation, where when the water level reaches ground level the model predicts that the water will spread out across the ground, and producing flooding. The red dashed line shows the areas prone to flooding.

By analysing the flooding and headloss in the long-section there were notable areas of interest. There is significant headloss along all sections of pipe displayed in Figure 6, the sumps surcharge in many locations and there are backwater effects caused by the capacity of the downstream network.

Therefore it was decided to focus on the following areas of the network for upgrading opportunities:

- The 375mm diameter along Hewitts Road
- The 375mm diameter along Main North Road
- The 675 mm diameter pipe from Main North to Parsonage Road.

It was predicted that upgrading these sections of the network would relieve the majority of the flooding within the study area catchment as these are the sections with high levels of headloss indicating the pipes are undersized. These sections are also similar to the sections identified in the 2001 SMP as requiring upgrades. The southern upstream branch of the study area network (Manahi Place) does not have any notable capacity issues, and was also not identified as a problem in the 2001 SMP.

It is noted that the slope of the pipe across Main North Road is quite steep, approximately 1:83, which compounds the backwater effects upstream. Therefore a more consistent slope between A and C was modelled for the upgrade solutions.

The ECOP states that all new primary drainage systems are required to cope with a 5 year return period critical storm event. Therefore the network should not surcharge in the 5 year return period critical rainfall event. However in some cases the pipe may be correctly sized, but flooding is predicted due to backwater effects from the downstream network or due to the area being prone to flooding. Therefore if the HGL forms a similar slope to the pipe, this indicates that there is negligible headloss in this section of pipe, and the pipe size is considered acceptable.

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6.2. UPGRADE OPTION RESULTS

Sections of the network were iteratively upgraded to find the full upgrade solution. Based on this full upgrade solution a recommended upgrade solution was also identified along with the recommended actions.

The following model simulations were completed; refer to Figure 5 for reference points. See Appendix A for graphical simulation results.

Table 3: Model simulation completed as part of the Hewitts Road investigation

Simulation	Simulation Upgrade Description	General Result Comment
1	Status Quo	Significant flooding predicted and key upgrade areas were Hewitts, Main North and Parsonage Roads.
2	Upgrade the pipe between points D and E to a 900 mm diameter pipe.	This simulation was run to test if relieving the downstream network would elevate the flooding upstream in the study area; It did not relieve the flooding within the study area.
3	Upgrade the pipe between points B and C to a 525 mm diameter pipe.	Significant headloss was noted in this section of the network, however upgrading this section alone was not predicted to significantly elevate the predicted flooding in Norton Place.
4	Combination upgrade, upgrade between points B and C to a 525 mm diameter pipe and upgrade to a 900mm diameter pipe between points C and E.	This simulation was targeted at relieving the flooding in the all parts of the study are (e.g. The Stables and the Methodist Church Cemetery), however flooding was still predicted.
5	Combination upgrade, upgrade to a 525mm diameter pipe between points A and C.	This is the **recommended upgrade solution**; see section 6.4 for more details.
6	Combination upgrade, upgrade to a 525mm diameter pipe between points A and C and upgrade to a 900mm diameter pipe between points C and E.	This is the **full upgrade solution**; see section 6.3 for more details.

Note that additional simulations were completed in addition to these presented in Table 3. These additional simulations did not achieve the desired outcomes or the pipes were undersized, and were therefore left out of this report.

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6.3. FULL UPGRADE SOLUTION

In this full upgrade solution, the slope of the pipes from points A to C have been averaged to from a consistent slope and maximise the available head.

The full upgrade solution involves upsizing the following pipe sections:

- Upsize the Hewitts Road 375 mm diameter pipe, from Woodglen Road to Main North Road, to a 525 mm diameter pipe (points A to B).
- Upsize the Main North Road 525 mm diameter pipe to a 525 mm diameter pipe (points B to C).
- Upsize the 675 mm diameter pipe along Main North Road to the Parsonage Road open channel, to a 900 mm diameter pipe (points C to E).

Figure 7 presents the full upgrade solution for the Hewitts Road catchment; pipe sizes and model flooding results.

Figure 7: Full Upgrade Solution for the Hewitts Road Catchment with flooding predictions

The majority of the flooding is less than 0.1m in the full upgrade solution.

Figure 8 presents a long-section from Hewitts to Parsonage Road with predicted water levels. The red dotted line is the predicted maximum HGL.

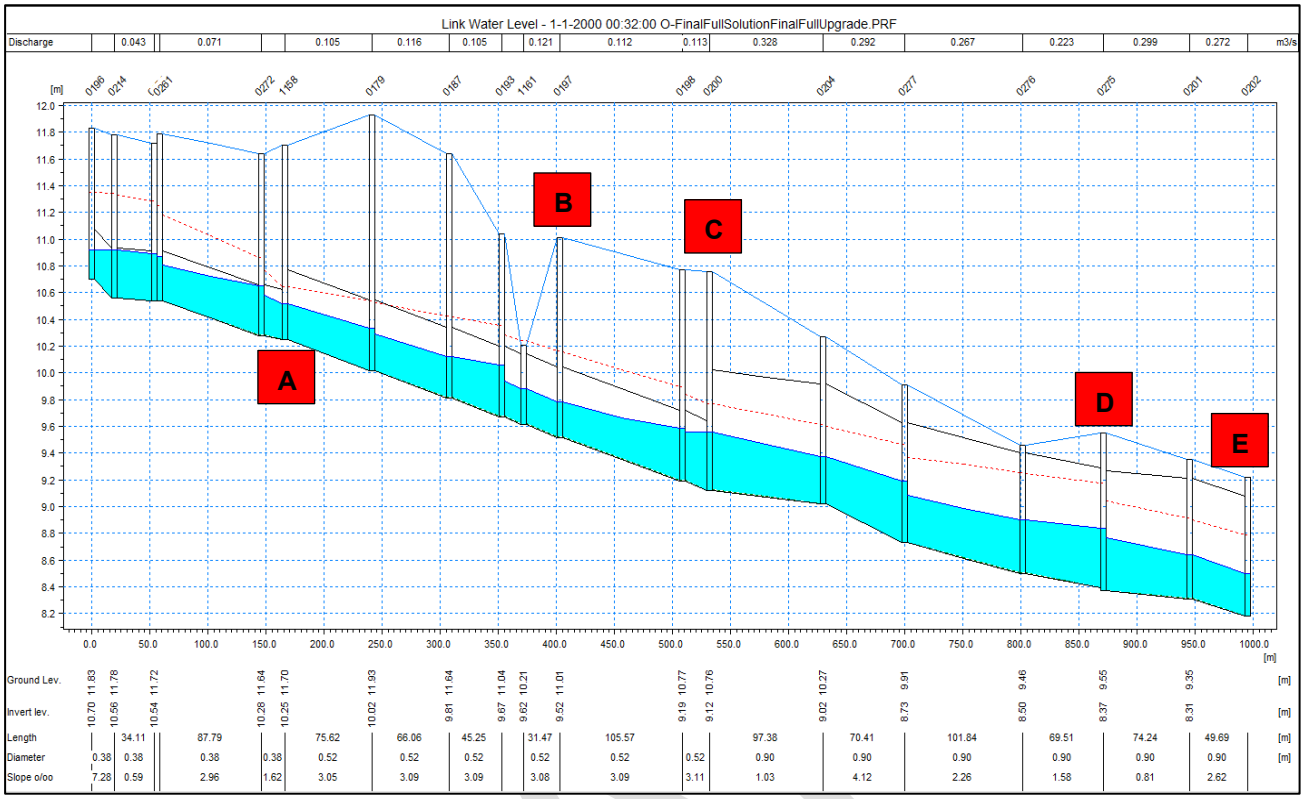

Figure 8: Full upgrade solution, long-section of the Hewitts Road Catchment

For the Hewitts to Parsonage Road long-section, the maximum HGL shows that all pipes are adequately sized for the 5 year level of service.

For the section from points C to D, the present 675mm diameter is undersized, causing backwater effects. A 750mm diameter pipe was modelled as an upgrade to this pipe but it was marginally undersized, so the next standard pipe size up was selected, which is a 900 mm diameter.

6.3.1. Full Upgrade Solution Discussion

Although the upgrade to the 675mm diameter pipe from Main North to Parsonage Road is outside of the scope of the initial Hewitts Road project (2001 SMP, MC6), upgrading this pipe alleviates some flooding on The Stables, Parsonage Road and Methodist Church Cemetery.

The ECOP states that all new primary drainage systems are required to achieve a 5 year level of service. Therefore the network should not surcharge in a 5 year return period critical rainfall event. The model predicted that low levels of flooding are still evident in parts of the catchment; however these ponding depths are considered minor. The majority of the flooding is less than 0.1m in the full upgrade solution. The flooding on Norton Place is considered to be shallow enough to be diverted by the kerb and channel. Although the pipes are appropriately sized, there is still some surcharging of the network in the full upgrade solution, indicating that this area of the network may be prone to low level flooding.

The HGL was analysed through stages of the simulation to find the appropriate upgrade pipe sizes. This predicted that there will be negligible headloss and there are no indicators of backwater effects from the downstream network.

6.4. RECCOMENDED UPGRADE SOLUTION

The recommended upgrade solution in this study is similar to the full upgrade solution in the 2001 Woodend SMP (MC6), in the sense that the upgrades were predicted to be required in similar location and a similar size.

Figure 9 presents the recommended solution for the Hewitts Road catchment, notably upgrading pipes along Hewitts and Main North Roads.

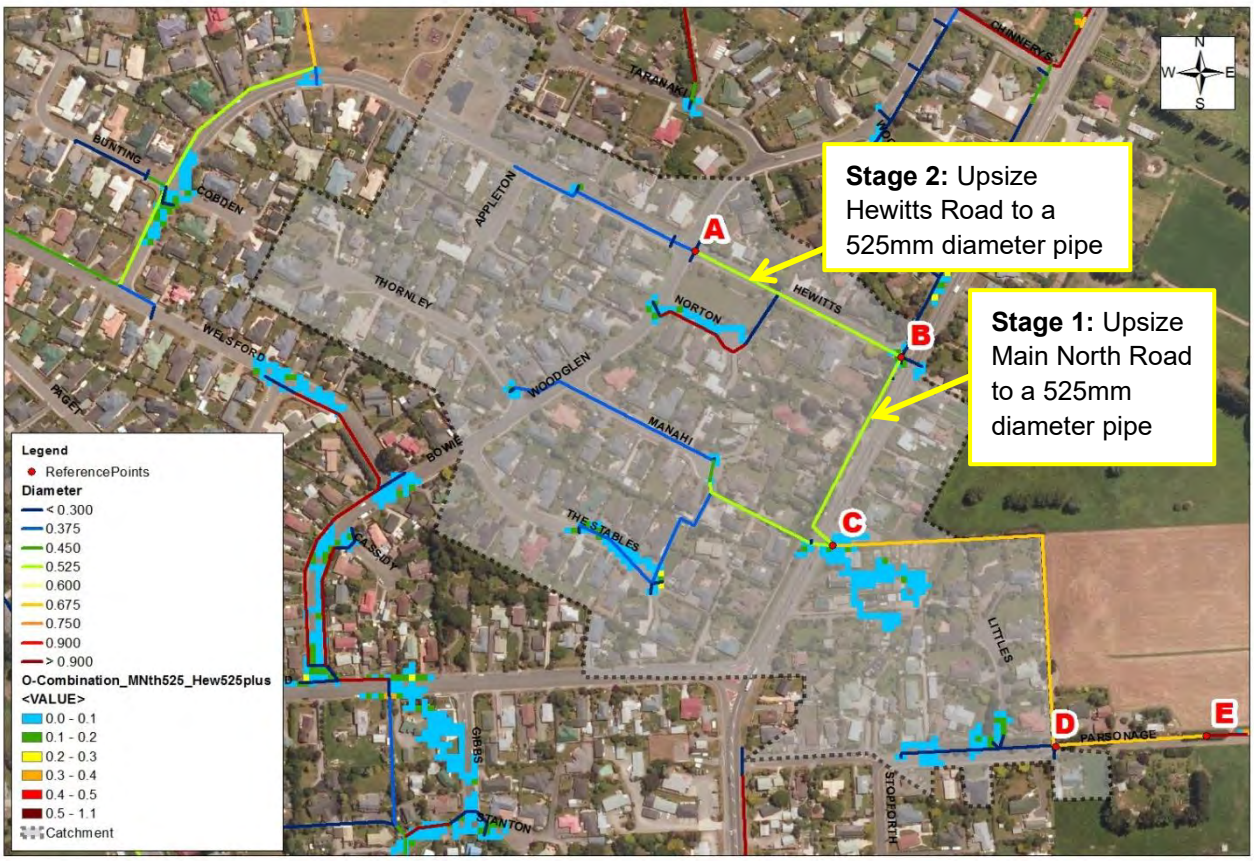

Figure 9: Recommended solution, for the Hewitts Road Catchment with flooding predictions.

It is noted that the level of flooding is very similar to the full upgrade solution, as the system has sufficient capacity for the 5 year return period rainfall event.

A 600mm diameter pipe was recommended along Main North Road in the 2001 Woodend SMP; however the 525mm diameter pipe modelled in this study has sufficient capacity.

It is recommended that the pipes are upgraded in stages, beginning with Main North Road, as this will alleviate the majority of the flooding. It is recommended that the network is monitored before Hewitts Road (stage 2) is constructed.

Figure 10 presents a long-section from Hewitts to Parsonage Road with predicted water levels. The red dotted line is the model predicted maximum HGL.

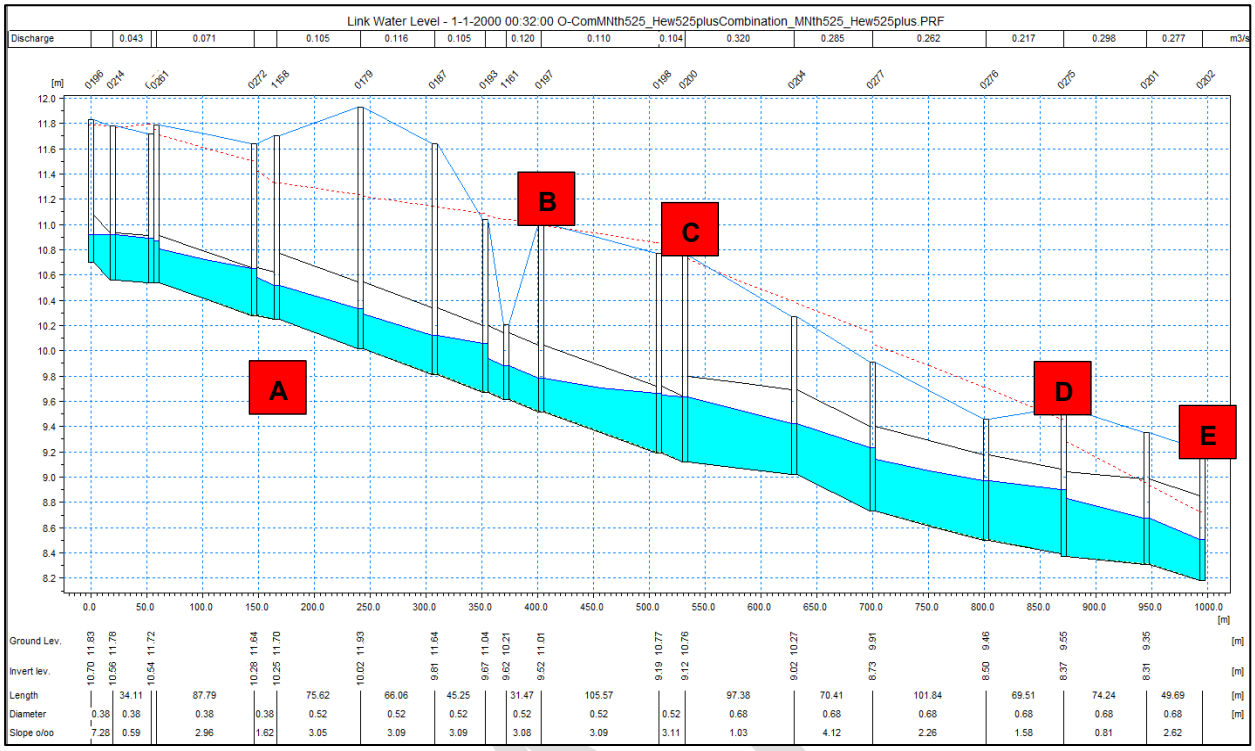

Figure 10: Recommended upgrade solution, long-section from Hewitts to Parsonage Road

For the Hewitts to Parsonage Road long-section, the maximum HGL predicts that the pipes upstream of point C are adequately sized. In many areas the network is at full capacity during this 5 year return period event.

However it is noted that the maximum HGL is much higher in the recommended solution relative to the full upgrade solution. This is the product of backwater effects, produced from the 675 mm diameter pipe from Main North to Parsonage Road.

6.4.1. Recommended Upgrade Solution Discussion

The model predicted that low levels of flooding are still evident in parts of the catchment; however these ponding depths are considered minor. The majority of the flooding is less than 0.1m in the recommended upgrade solution. The flooding on Norton Place is considered to be shallow enough to be diverted by the kerb and channel.

The recommended and full upgrade solutions have similar levels of flooding, however the predicted water level in this section of the network is greater in the recommended solution, due to downstream backwater effects.

This solution is a lower cost option compared to the full solution and it produces a similar 5 year level of service, fully utilising the available capacity of the network. This option was therefore recommended.

If the construction of the upgrade is undertaken in stages, Main North Road followed by Hewitts Road, this will allow flooding observations to be made during actual rain events, which could result in only upgrading Main North Road. See Appendix A for the model predictions where only Main North Road is upgraded.

It is also noted that solely upgrading the Hewitts Road section of the network is not predicted to alleviate the flooding in the area, as the downstream Main North Road pipes will still be undersized.

6.5. ADDITIONAL CONSIDERATIONS

There are several considerations to note about upgrading these sections of the network:

1. The section of pipe between C to E, around the back of the Littles Lane subdivision and through the Methodist Church Cemetery was upgrade in 2003 to a 675mm pipe and is under private property. Therefore any work to upgrade and replace this section of pipeline will be very costly and may be politically unpalatable.

2. Main North Road is a State Highway and therefore under the control of the New Zealand Transport Agency (NZTA). Any work on this road will require consultation with the NZTA. It is also likely that the NZTA may require the WDC to thrust the proposed 900mm pipe upgrade under the road. This will further complicate and add expense to this work.

Therefore these complications will need to be considered when undertaking this work.

6.6. RECOMMENDED ACTIONS

It is not recommended that any work is undertaken in the short term and instead monitoring is undertaken on Norton Place, The Stables and at the Methodist Church on Main North Road prior to undertaking detailed design and construction. This is based on the following reasons:

1. There is no record of significant flooding in this area.

2. Flooding is mostly on the road; there predicted to be is no flooding risk to households in the 5 year return period rainfall event.

3. The main upgrade recommended is to the 375 mm diameter pipe along a state highway, which is controlled by NZTA. This will complicate the construction and increase the cost to install the pipe.

4. The Woodend by-pass is forecast in the next 10 to 20 years by the NZTA. When this occurs, the crossing of Main North Road will be easier and be less costly, as thrusting may not be required.

If the flooding is to the same extent as predicted in the model, then it is recommended that a staged construction approach of the recommended upgrade solution is undertaken; otherwise it is recommended that the network remains as Status Quo.

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7. BUDGET ESTIMATE

A rough order costing has been undertaken for the Hewitts Road Stormwater Upgrade. The following assumptions were made to calculate this budget:

1. The pipes along Hewitts and Main North Road will be re-graded, and therefore all manholes and connections to sumps will need to be replaced.
2. Pipe alignment will remain the same, therefore excavation and cut to waste of existing infrastructure is required.
3. Inflation estimates based on older tender records were calculated, to find an annual 10% inflation in rates.
4. Dewatering is not included in this estimate as it is expected to be constructed in summer.
5. Easement costs were considered for upgrading the 675mm pipe from Main North to Parsonage Road, as well as Liaison with owner, difficulties accessing the property and general easement costs, although this is not the recommended option.
6. The 375mm diameter pipe under the State Highway is at a nominal pipe depth of 1.6m.
7. Preliminary and General has been assumed at 20% as there is expected to be high Temporary Traffic Management Costs along the State Highway.
8. 10% Construction Contingency, 10% Professional Fees and a 20% Funding Contingency.

Table 4 presents the estimated Budget required to undertake the Hewitts Road stormwater upgrade. It is noted that the costing are separated into three stages, a summary of the full upgrade solution (combination of stages 1 and 2) and recommended upgrade solution (combination of stages 1, 2 and 3) can be found in Table 5.

Table 4: Budget estimate for the Hewitts Road Stormwater upgrade solutions

				Stage 1 (Main North Road)		Stage 2 (Hewitts Road)		Stage 3 (Parsonage Road)	
		Revised Rate	Unit	Qty	Amount	Qty	Amount	Qty	Amount
1.0	**PRELIMINARY AND GENERAL**	20%	LS	1	$72,137	1	$38,917	1	$219,321
2.0	**STORMWATER RETICULATION**								
2.1	Supply and installation of DN 225 RRJ Class 4 Spun Reinforced Concrete pipe connecting sumps to new main	$440	m	3	$1,320				
2.2	Supply and installation of DN 300 RRJ Class 4 Spun Reinforced Concrete pipe connecting sumps to new main	$500	m	34	$17,000				
2.3	Supply and installation of DN 525 RRJ Class 4 Spun Reinforced Concrete pipe	$760	m	179	$136,040	187	$142,120		
2.4	Supply and installation of DN 900 RRJ Class 4 Spun Reinforced Concrete pipe	$1,060	m					460	$487,600
2.5	Supply and installation 1050 mm dia precast manhole with standard lid and benching. 0.6m to 1.9m depth.	$5,000	ea.	4	$20,000	2	$10,000		
2.6	Supply and installation 1500 mm dia precast manhole with standard lid and benching. 1.0m to 1.7m depth.	$9,500	ea.	1	$9,500			5	$47,500
3.0	**STRUCTURES**								
3.1	Break into existing manhole and make good per side.	$1,200	ea.	2	$2,400	2	$2,400	2	$2,400
3.3	Remove and dispose of existing pipes	$60	m	216	$12,960	187	$11,220	460	$27,600
3.4	Remove and dispose of existing manholes	$2,300	ea.	5	$11,500	2	$4,600	5	$11,500
4.0	**RESTORATION**								
	Surface reinstatement of trenches (includes mains and manholes)								

4.1	Grass Berm	$50	m	155	$7,750			460	$23,000
4.2	Road	$70	m	23	$1,610	187	$13,090		
4.3	Footpath	$330	m	50	$16,500				
4.4	Driveway	$170	m	16	$2,720			12	$2,040
4.5	Kerb and channel	$400	m	2	$800				
5.0	**THRUSTING**								
5.1	Extra over rate to Pipe Thrust 525mm dia Class Z Pipe under State Highway 1.6 m depth.	$4,400	m	23	$101,200				
6.0	**MISCELLANEOUS**								
6.1	Complete CCTV Inspection	$10	m	221	$2,210	189	$1,890	465	$4,650
6.2	Easement Costs - Liaison with owner, difficulties accessing the property and general easement costs	$1,000	m					460	$460,000
7.0	**EXISTING SERVICE CROSSING**								
7.1	Relocate services (power, water, sewer, telecom)	5%	LS	1	$17,176	1	$9,266	1	$30,315
8.0	**CONSTRUCTION CONTINGENCY**	10%	LS	1	**$43,282**	1	**$23,350**	1	**$131,593**
9.0	**CONSTRUCTION TOTAL**				**$476,105**		**$256,854**		**$1,447,518**
10.0	**PROFESSIONAL FEES**	10%	LS	1	**$47,610**	1	**$25,685**	1	**$144,752**
11.0	**FUNDING CONTINGENCY**	20%	LS	1	**$104,743**	1	**$56,508**	1	**$318,454**
12.0	**BUDGET REQUIRED**		LS	1	**$628,458**	1	**$339,047**	1	**$1,910,724**

See Appendix B for notes explaining tender records of which the item rates were sourced.

Table 5 is a summary of the total estimated costs for the Hewitts Road upgrades solutions.

Table 5: Summary of the estimated costs for the Hewitts Road Stormwater upgrade solutions

Full Upgrade Solution	**Total Upgrade**	**$**	**2,880,000.00**
Recommended Upgrade Solution	**Stage 1**	$	630,000.00
	Stage 2	$	340,000.00
	Total Upgrade	**$**	**970,000.00**

It is recommended that monitoring is undertaken prior to undertaking detailed design. If flooding is evident it is recommended that the Main North Road upgrade (stage 1) is undertaken first, with an estimated budget cost of $628,000; then further flood monitoring be undertaken before progressing to Hewitts Road (stage 2), $339,000.

8. CONCLUSION

In conclusion, the Woodend-Kaiapoi North Stormwater Model was updated after a site visit. The model was run using Mike Urban software to find the full upgrade solution and the recommended solution.

The recommended upgrade solution details an upgrade on a section of Hewitts and Main North Roads from a 375 mm diameter to a 525 mm diameter pipe. The full upgrade solution includes both the recommended upgrades plus a upgrade to the 675 mm diameter around Littles Lane subdivision; however this upgrade is outside of the scope of this project.

The full upgrade solution is estimated to cost $2,880,000 and the recommended upgrade solution is estimated to cost $970,000. Staging the upgrades beginning with the Main North Road section is recommended.

However due to the location and timing of this upgrade it is recommended that the project is delayed and monitoring is undertaken, before commencing any work.

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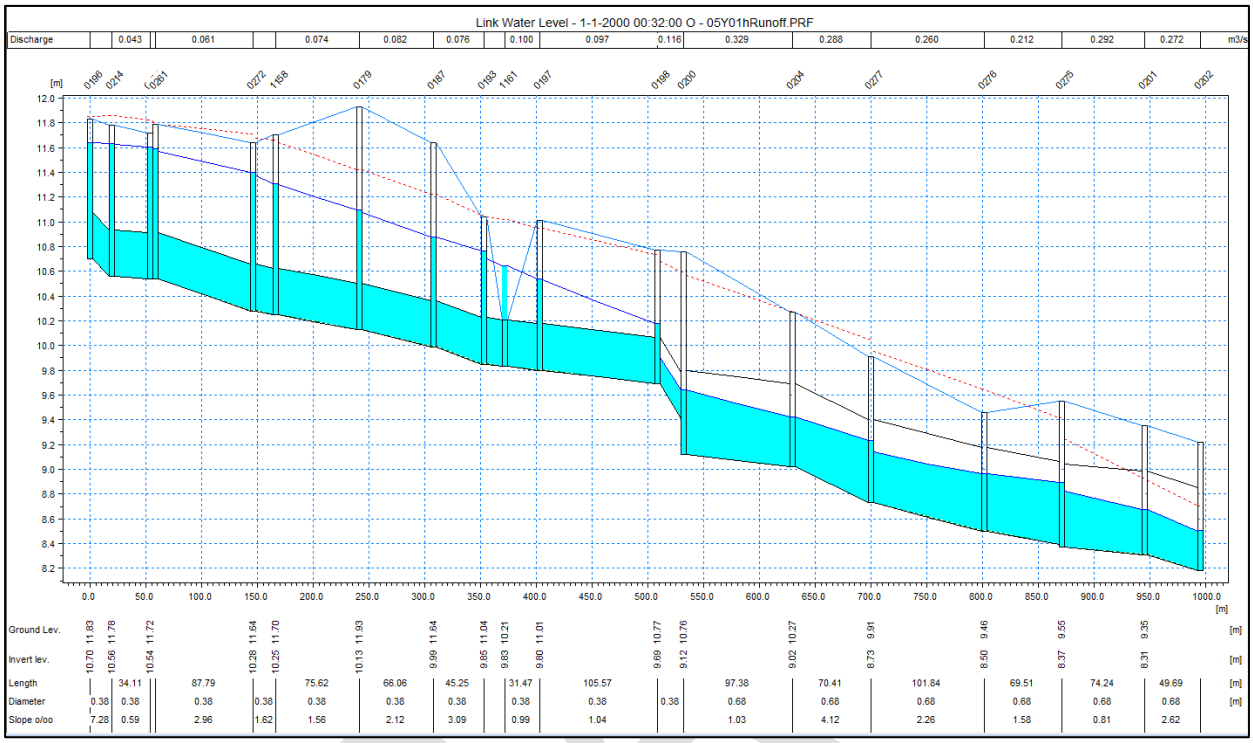
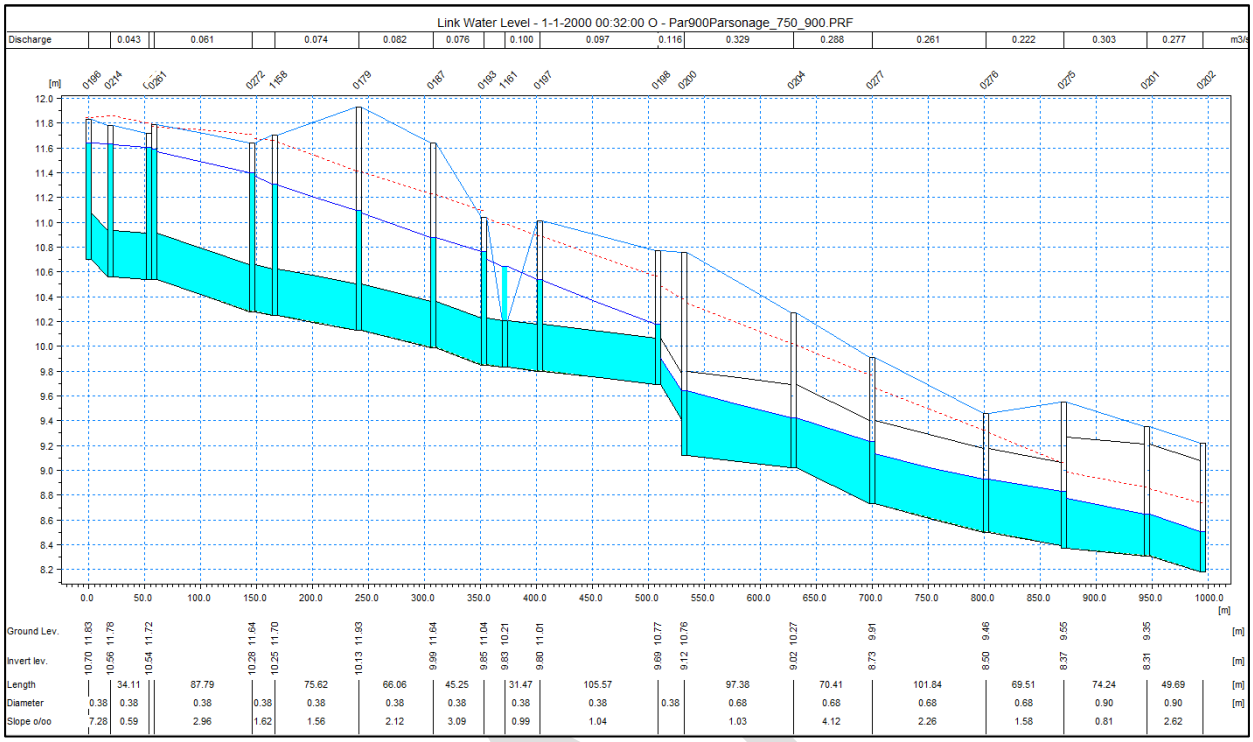
9. APPENDIX

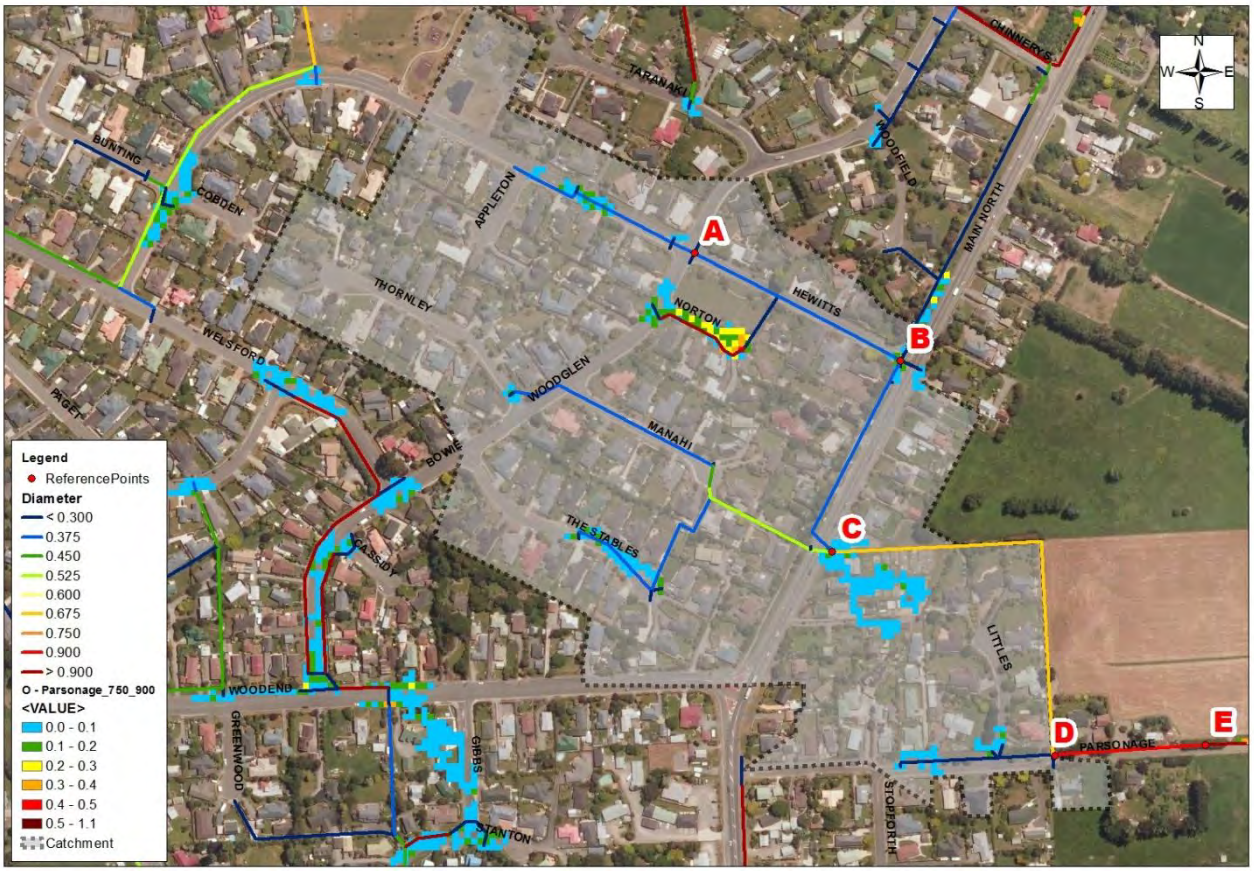
APPENDIX A: SIMULATION RESULTS

1. The current network

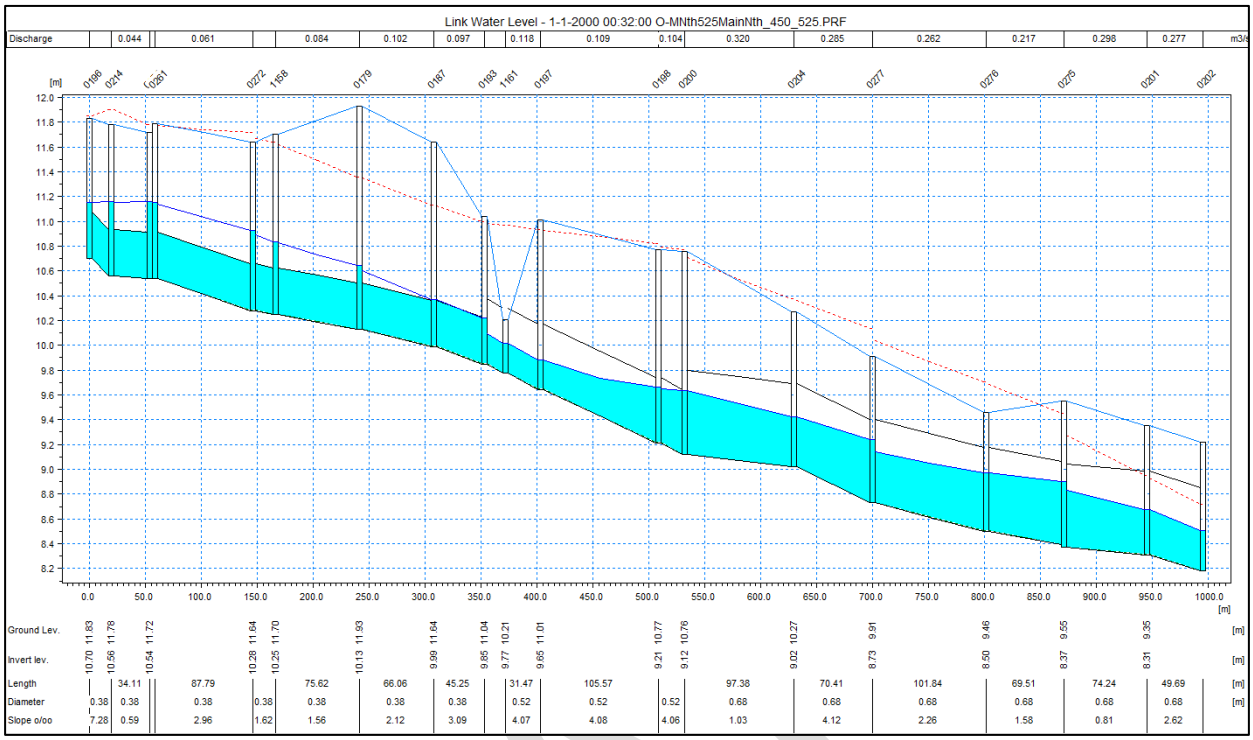


2. Upgrade the pipe on Parsonage Road 675 mm diameter pipe to a 900 mm diameter pipe from manhole 0002D09258 to the open channel

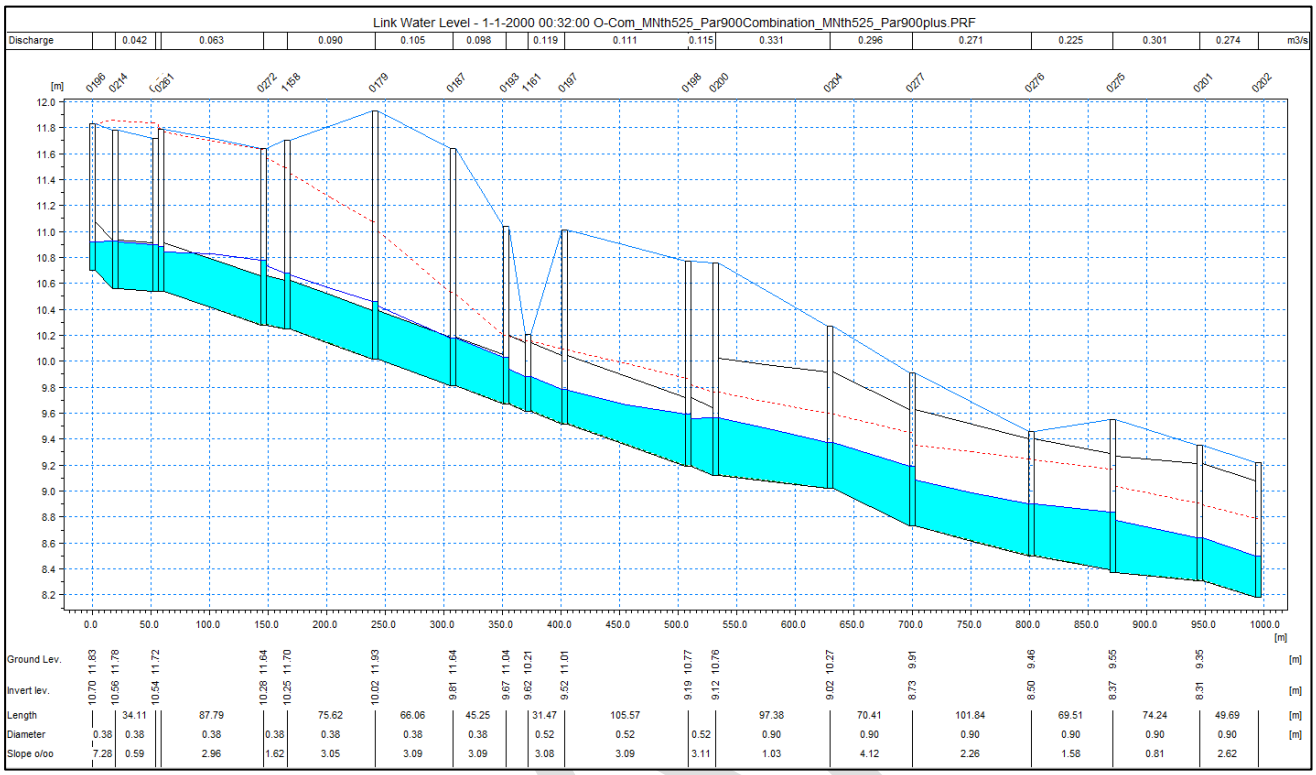




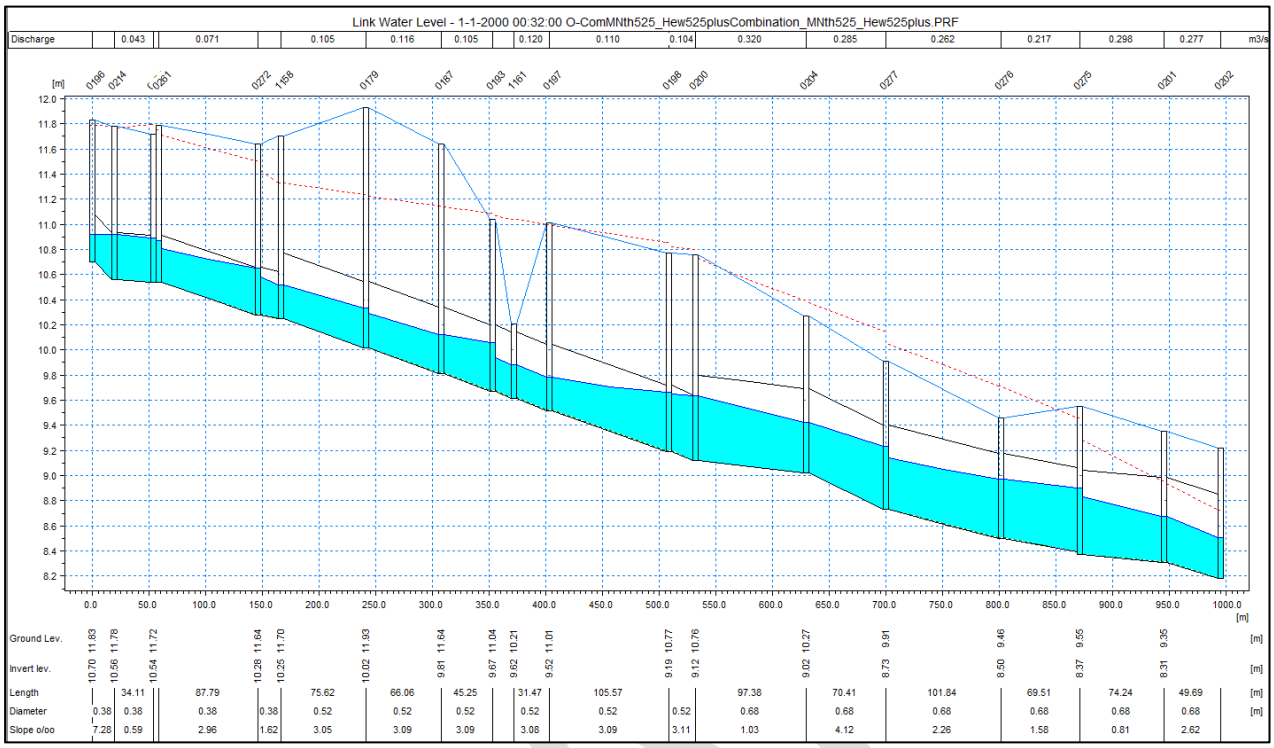
3. Upgrade the pipe along Main North Road from 375 mm diameter pipe to a 525 mm diameter pipe (points B to C).
   **Slope adjusted along Main North Road.*



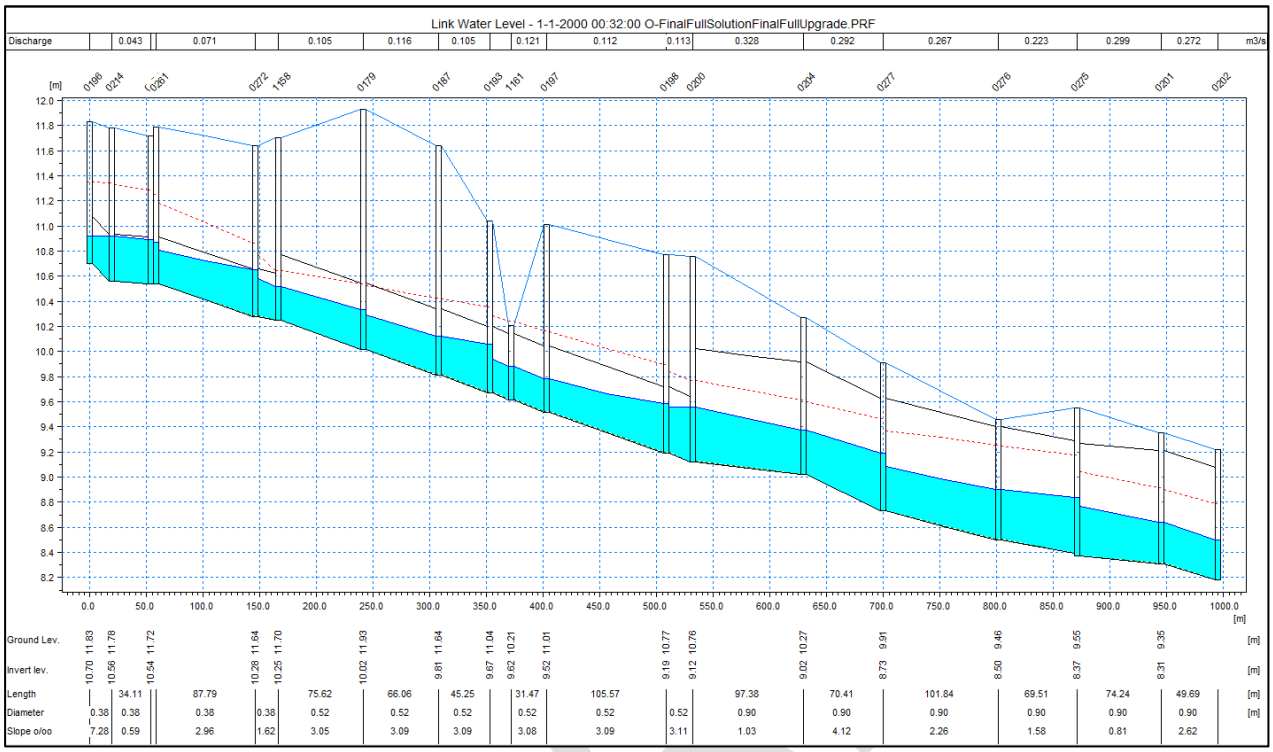
4. Combination upgrade, upgrade the pipe along Main North Road to a 525 mm diameter pipe (points B to C) and upgrade to a 900 mm diameter pipe from the Methodist Church to the open channel on Parsonage Road (points C to E).
   **Slope adjusted along Main North Road.*



5. **Recommended Solution**: Combination upgrade, upgrade to a 525 mm diameter pipe along Hewitts Road from Woodglen Road to Main North Road (point A to B) and upgrade to a 525 mm diameter pipe along Main North Road (point B to C).
   **Slope adjusted along Hewitts and Main North Road.*



6. **Full Upgrade Solution:** Combination upgrade, upgrade to a 525mm diameter pipe along Hewitts Road from Woodglen Road to Main North Road (point A to B), upgrade to a 525 mm diameter pipe along Main North Road (point B to C) and upgrade to a 900mm diameter pipe from Main North Road to the open channel on Parsonage Road (point C to E).
**Slope adjusted along Hewitts and Main North Road.*



APPENDIX B: ESTIMATED BUDGET

				Stage 1 (Main North)		Stage 2 (Hewitts)		Stage 3 (Parsonage)		Notes
		Revised Rate	Unit	Qty	Amount	Qty	Amount	Qty	Amount	
1.0	**PRELIMINARY AND GENERAL**	20%	LS	1	$72,137	1	$38,917	1	$219,321	20% to reflect high levels of Temporary Traffic Management
2.0	**STORMWATER RETICULATION**									
2.1	Supply and installation of DN 225 RRJ Class 4 Spun Reinforced Concrete pipe connecting sumps to new main	$440	m	3	$1,320					13-09 & 12-40D (small sections of pipe with connections to pipes and sumps)
2.2	Supply and installation of DN 300 RRJ Class 4 Spun Reinforced Concrete pipe connecting sumps to new main	$500	m	34	$17,000					12-59 & 12-37 (small sections of pipe with connections to pipes and sumps)
2.3	Supply and installation of DN 525 RRJ Class 4 Spun Reinforced Concrete pipe	$760	m	179	$136,040	187	$142,120			11-60 (17m) and 12-40 (138m), both $690
2.4	Supply and installation of DN 900 RRJ Class 4 Spun Reinforced Concrete pipe	$1,060	m					460	$487,600	10-11 (30m @ $925) & 10-19 (88m @ $749) & 09-26 (21m @ $980)
2.5	Supply and installation 1050 mm dia precast manhole with standard lid and benching. 0.6m to 1.9m depth.	$5,000	ea.	4	$20,000	2	$10,000			12-37
2.6	Supply and installation 1500 mm dia precast manhole with standard lid and benching. 1.0m to 1.7m depth.	$9,500	ea.	1	$9,500			5	$47,500	12-40 average of 1200mm and 1800mm, and adjusted by the price based on 1237 Contract
3.0	**STRUCTURES**									
3.1	Break into existing manhole and make good per side.	$1,200	ea.	2	$2,400	2	$2,400	2	$2,400	12-40 AS
3.3	Remove and dispose of existing pipes	$60	m	216	$12,960	187	$11,220	460	$27,600	12-45 W
3.4	Remove and dispose of existing manholes	$2,300	ea.	5	$11,500	2	$4,600	5	$11,500	12-40 AS
4.0	**RESTORATION**									
	Surface reinstatement of trenches (includes mains and manholes)									
4.1	Grass Berm	$50	m	155	$7,750			460	$23,000	Based on 12-40F difference between Berm and Road restoration cost of $20
4.2	Road	$70	m	23	$1,610	187	$13,090			12-40 (120m @ $65) & sewer 12-40E (171m @ $35)& sewer 12-40F (784m @ $57)
4.3	Footpath	$330	m	50	$16,500					12-40 (10m @ $ 251) & sewer 12-40F (21m @ $322)

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4.4	Driveway	$170	m	16	$2,720			12	$2,040	sewer 12-40E (9m @ $ 90) & sewer 12-40F (27m @ $275) --- 4 and 7 driveways
4.5	Kerb and channel	$400	m	2	$800					11-60
5.0	**THRUSTING**									
5.1	Extra over rate to Pipe Thrust 525mm dia Class Z Pipe under State Highway 1.6 m depth.	$4,400	m	23	$101,200					07-29 based on ratio of trusting to regular pipe installation (07-29 total cost $65,000), Engineering estimate of $100,000 total cost.
6.0	**MISCELLANEOUS**									
6.1	Complete CCTV Inspection	$10	m	221	$2,210	189	$1,890	465	$4,650	12-14
6.2	Easement Costs - Liaison with owner, difficulties accessing the property and general easement costs	$1,000	m					460	$460,000	Engineering Judgement (CB)
7.0	**EXISTING SERVICE CROSSING**									
7.1	Relocate services (power, water, sewer, telecom)	5%	LS	1	$17,176	1	$9,266	1	$30,315	Engineering Judgement based on 12-37, 5% of total costs
8.0	**CONSTRUCTION CONTINGENCY**	10%	LS	1	**$43,282**	1	**$23,350**	1	**$131,593**	
9.0	**CONSTRUCTION TOTAL**				**$476,105**		**$256,854**		**$1,447,518**	
10.0	**PROFESSIONAL FEES**	10%	LS	1	**$47,610**	1	**$25,685**	1	**$144,752**	
11.0	**FUNDING CONTINGENCY**	20%	LS	1	**$104,743**	1	**$56,508**	1	**$318,454**	Site visit = 20%
12.0	**BUDGET REQUIRED**		LS	1	**$628,458**	1	**$339,047**	1	**$1,910,724**	

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WAIMAKARIRI DISTRICT COUNCIL

MEMO

FILE:	DRA-16 / TRIM 191202168675
DATE:	2 December 20192 December 2019
MEMO TO:	Owen Davies, Drainage Asset Manager
FROM:	Shaun Fauth, Project Engineer (Reviewed MA 27/11/19)
SUBJECT:	3 Norton Place - Stormwater Flooding Options Memo

1. SUMMARY

The purpose of this memo is to determine the mechanism of flooding and summarise the design options considered to reduce the risk of surface water flooding at and around the property of 3 Norton Place, Woodend. The options consider improvements to the existing primary flow system and provision of a secondary overland flow path, which is not currently provided at Norton Place. Of the options considered, it is recommended that the most crucial improvement is to create a secondary flow path. Primary network upgrades would also offer reduced likelihood of stormwater flooding, however any such solution would incur significant cost due to works within the State Highway 1 Road corridor.

2. BACKGROUND

2.1. The property of 3 Norton Place experienced surface water flooding during a short duration, high intensity storm event on 1st June 2019. The stormwater run-off from the wider Hewitts Road catchment appears to have exceeded the primary network capacity (downstream pipework) resulting in overland flow in the vicinity of Norton Place. There is no secondary flow path provided on Norton Place within the road reserve or via council owned land and as such, the water eventually overtopped the driveway entry at 3 Norton Place and entered this house. It is estimated that flood levels reached a height of up to 11.8m Lyttelton Vertical Datum, within the area shown on Figure 1.

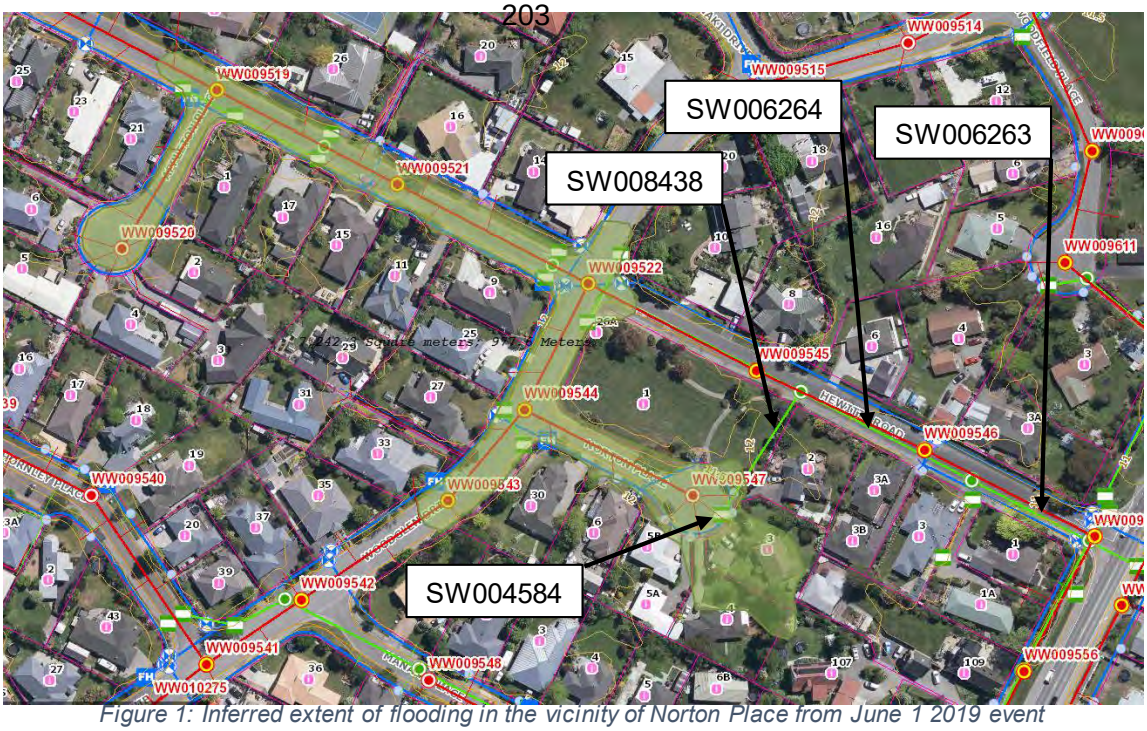

Figure 1: Inferred extent of flooding in the vicinity of Norton Place from June 1 2019 event

2.2. There are a number of factors that are considered to have potentially contributed to the flooding, comprising:

- Blockage of either of stormwater pipes SW006264 or SW006263 on Hewitts Road, leading to water backing up to the low point at sump SW004584 on Norton Place. This is considered unlikely, as CCTV footage from 21 August 2019 showed the pipework to be in reasonable condition and free of blockages.
- Insufficient capacity in the Hewitts Road primary network to convey the 20% AEP primary flow, leading to water backing up to the low point at sump SW004584 on Norton Place. This insufficient capacity was previously identified in a 2014 draft report by PDU "Hewitts Road Stormwater Investigation".
- Insufficient capacity of stormwater pipe SW008438, running from Norton Place to Hewitts Road, to convey the 20% AEP flow.
- No secondary overland flow path within the road reserve or within Council owned land available prior to spilling into private property.

2.3. A site walkover was undertaken on 15th August 2019 with Owen Davies, Drainage Asset Manager. During this visit, the owner of 3 Norton Place (Malcolm Sutton) gave the following information:

- Water levels reached up to the second course of bricks of the house cladding. Later GPS survey picked up this level as 11.83m Lyttelton Vertical Datum.
- The next door property, 4 Norton Place, also reportedly had water enter the house.
- Around the peak storm time (between midnight and 1am on the 1st of June) a very significant volume of water was seen gushing out of Sump SW004584, outside of the property. The significant flow of water gave the impression of being pumped up through the sump grate.
- The property has no reported history of stormwater reaching house floor level.

The property is contoured in such a way that there is a highpoint at the driveway, between the end of the cul-de-sac and the house. As such, once the pooled water reached the crest of the driveway it was able to over-top into the property. This crest height was found by GPS survey to be 11.72m Lyttelton Vertical Datum. The spill point of a secondary overland flow path would need to take into account this critical level.

There is a park reserve at 1 Norton Place (Norton Reserve) which could potentially be useful for conveyance of secondary overland flows, however it is elevated at a higher ground level than Norton Place and the properties at the end of the cul-de-sac, thus preventing Norton Place surface flows from reaching Hewitts Road in the current configuration.

2.4. Given the observations made, it is considered that the flows from the Norton Place road reserve area alone would not be enough to create this level of flooding. As such, the bulk of the water is likely to have come from the wider Hewitts Road catchment.

Desktop studies have identified that the stormwater pipe trending northeast to Hewitt Road consists of a 225mm PVC pipe acquired in 1994 (Note: this pipe is incorrectly identified as 250mm spun reinforced concrete in Waimap). This pipe has one contributing road sump directly outside of 3 Norton Place. The receiving manhole is located downstream, at Hewitts Road. However, this manhole has a higher lid level than the contributing sump

2.5. A CCTV survey of the stormwater pipes from Norton Place to Main North Road (SH1) was performed by Hydrotech on 21 August 2019. No obstructions or pipe damage was observed in this footage. This survey is discussed further in section 5.

2.6. Indicated in Figure 2 are SCADA records of cumulative rainfall in Woodend (Chinnerys Road) and Kaiapoi (Peraki Street) on 1st June 2019. This shows a very rapid increase in rainfall around midnight of 31st May in the time leading up to the event and a levelling-off afterwards. Note that the gauge at Chinnerys Road was damaged during the most intense storm period, the Woodend rainfall is thus an estimate only, based on the trend prior to this. This estimated rainfall data was verified by a model run to re-create the 1 June event (see Section 9) and resulted in a reasonably accurate reflection of the reported flooding that occurred. The extrapolated rainfall intensity in Woodend is equivalent to a short duration (approx. 20 minute) 500 year storm event.

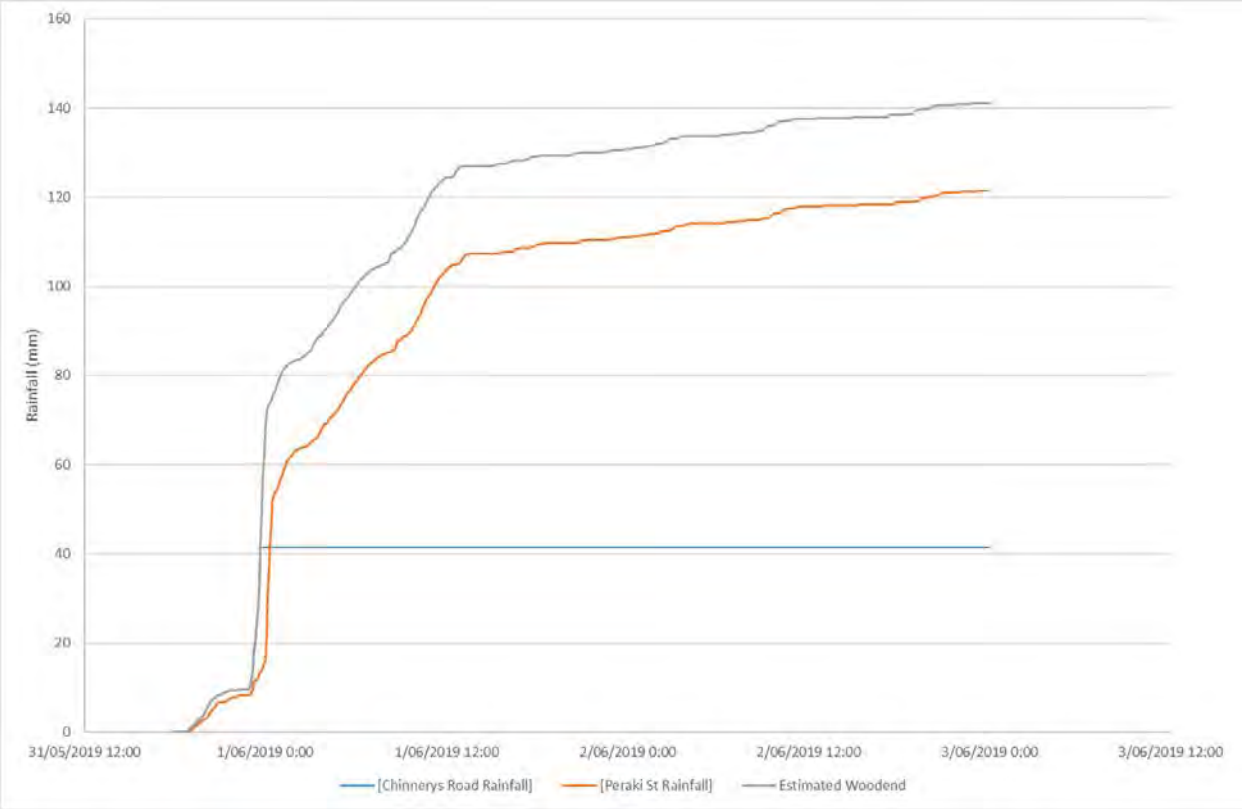

Figure 2: SCADA Cumulative Rainfall in Kaiapoi & Woodend 31 May to 3 June 2019

2.7. A high level topographical survey of the site was undertaken using the Trimble GPS system on 16 August 2019. Some select levels from those obtained are indicated in Table 1.

Feature	Level (m)
Flood tide mark against house at 3 Norton Place	11.830
Crest of driveway where overtopping is inferred to have occurred	11.718
Lid level of sump on Norton Place	11.192
Top of 225mm pipe at Norton Place sump	10.489
Edge of grass on Norton Reserve (south east corner)	11.678
Top of kerb on Hewitts Road at north east corner of Norton Reserve	11.700
Invert of channel on Hewitts Road at north east corner of Norton Reserve	11.500

Table 1: Select Site Survey Levels (note: these levels are of those features at or nearest to 3 Norton Place, unless stated otherwise; where multiple levels were obtained for the feature given, the level stated is that which presents the most conservative value for this exercise

3. UPSTREAM CATCHMENT AND FLOW ANALYSIS

3.1. The flooding experienced on Norton Place was similar to that modelled and described in the 2014 PDU report "Hewitts Road Stormwater Investigation" (TRIM 140117004083). This modelling predicted surcharging at Norton Place, with water levels exceeding 0.3m for a 5 year (20% AEP) event.

3.2. The primary flow path solution recommended in the abovementioned report was to upgrade the Hewitt Road pipe network as shown in Figure 3 to alleviate this problem.

Figure 3: Primary system upgrade options from 2014 "Hewitts Road Stormwater Investigation" report

3.3. The catchment area discharging to the manhole at the intersection of Hewitts Road and Main North road is estimated to comprise a 63.8Ha area as indicated in Figure 4. The peak surface water runoff of the catchment is calculated using the Rational Method as 421 l/s for 20% AEP, 815 l/s for 2% AEP and 954 l/s for 1% AEP. Further information on these calculations can be found in APPENDIX A.

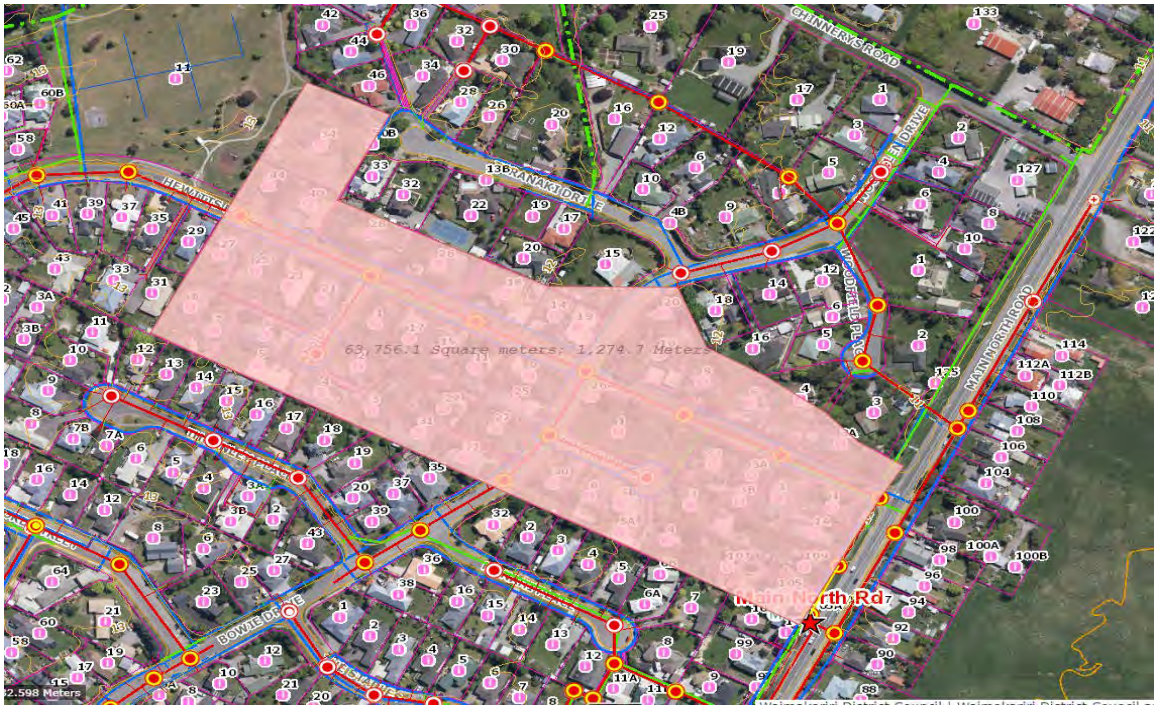

Figure 4: Approximate Hewitts Road stormwater catchment area

3.4. Review of level information and the modelling conducted for the 2014 report indicates that the existing 375mm concrete pipework along Hewitts Road does not have sufficient capacity to convey the peak flow associated with a short duration high intensity 20% AEP rainfall event. There is also no secondary overland flow path within the Norton Place road reserve available prior to spilling into private property.

3.5. The recommended primary upgrade option from the report was that Stage 1 and 2 (i.e. upgrade of part of Hewitts Road and Main North Road) be undertaken to increase flow capacity to above the 20% AEP level. However the report recommended that no work is undertaken in the short term and instead that monitoring of real flood events is undertaken prior to detailed design and construction.

4. 1 JUNE 2019 RAINFALL EVENT ANALYSIS

4.1. An initial desktop analysis of Kaiapoi rainfall data from the 1st June 2019 event was undertaken. This showed that at between approximately 11:50pm on 31 May and 12:30am on 1 June, the rainfall reached levels of near 1% AEP (100 year return period) 10 minute duration intensity. Peak 10 minute duration intensity reached 89.4mm/hr at midnight. This correlates to 899 l/s catchment flow. Note that as the rainfall data is from Kaiapoi, the actual Woodend rainfall is expected to vary from this as discussed elsewhere in this memo.

Time (rough 10min intervals)	Cummulative time of storm	rainfall in period (mm)	10min duration intensity (mm/hr)	Storm return period (years)	Inferred Catchment flow rate Q (m^3/s)
31/05/2019 23:09:12	0				
31/05/2019 23:20:16	11.1	2.6	14.1		
31/05/2019 23:29:51	20.7	0.2	1.3		
31/05/2019 23:40:43	31.5	1.8	9.9		
31/05/2019 23:49:43	40.5	0.6	4		
31/05/2019 23:57:53	48.7	4.2	30.9	5	0.311
1/06/2019 0:07:49	58.6	14.8	89.4	100	0.899
1/06/2019 0:17:48	68.6	13.8	82.9	50	0.834
1/06/2019 0:28:01	78.8	10.4	61.1	5	0.615
1/06/2019 0:38:59	89.8	3	16.4		
1/06/2019 0:48:46	99.6	1	6.1		
1/06/2019 0:58:13	109	1.4	8.9		
1/06/2019 1:08:00	118.8	1.6	9.8		
1/06/2019 1:19:18	130.1	1.6	8.5		
			Weighted average flow (m^3/s):		**0.680**

Table 2: Summary of rainfall data and inferred catchment flow during most intense storm period on 31/05/2019 & 01/06/2019

4.2. During this time an estimated 7,250m² area in the vicinity of Norton Place was inferred to be flooded to an average depth of 0.22m. This equates to around 1,600m³ of water. Assuming that the entire northern portion of the Hewitts Road catchment was over capacity and surcharging into the vicinity of Norton Place during this time, flow rates during the most intense portion of the storm (31/05/2019 23:49 to 01/06/2019 0:28) would have averaged around 0.68m³/s (see Table 2 above). This average flow would take around 40 minutes to fill the 1,600m³ flooded volume. This analysis correlates very well with the timing of the storm and the time that the owner of 3 Norton Place stated that water entry into the property occurred.

Inferred area flooded **(m^2)**	7,250
Average ground level **(m)**	11.50
Height of crest at 3 Norton Place **(m)**	11.72
Average flood depth **(m)**	0.22
Total volume of water **(m^3)**	1,600
Average Q **(m^3/s)**	0.68
Time taken to flood **(minutes)**	39

Table 3: Summary of flood analysis calculations for area in vicinity of 3 Norton Place during most intense storm period on 31/05/2019 & 01/06/2019

4.3. It was therefore inferred that the greater part of the flows from the northern portion of the Hewitts Road catchment were discharging into Norton Place and immediate vicinity during this time. Surcharges at the sump at Norton Place would have created a localised high head, resulting in overtopping into 3 Norton Place.

4.4. The outcome of this flood event correlates with the modelling work presented in the 2014 report (TRIM 140117004083). This report stated that the downstream Hewitts Road primary network was under capacity for a 20% AEP (5 year) event and that flooding of Norton Place would result. For a 20% AEP event the flooding would be restricted to the roadway and would not be expected to affect private properties. The rainfall which occurred on 1 June 2019 was more severe than a 20% AEP event and resulted in overtopping into private property.

4.5. The root cause of flooding into 3 Norton Place is deemed to be the lack of a secondary flow path.

5. CCTV INSPECTION

5.1. CCTV was conducted on 21 August 2019 on the following pipes:

- SW008438 - 225mm diameter pipe between Norton Place and Hewitts Road
- SW006263 and SW006264 – 375mm diameter pipes on Hewitts Road

Figure 5: Pipework surveyed by CCTV on 21 August 2019

5.2. No obstructions were found to be present within the surveyed pipes and the condition of the pipe work appeared reasonable, in line with their age.

5.3. The following noteworthy aspects were observed from the CCTV footage:

- The pipe between Norton Place and Hewitts Road is 225mm diameter PVC, not 250mm diameter spun reinforced concrete as shown in Waimap.
- There was a consistent flow of water within the Hewitts Road pipes - to a depth in the pipe of approximately 20 to 50mm. The CCTV was undertaken in dry weather, following three consecutive days with no rainfall.
- Staining observed in the 225mm PVC pipe between Norton Place and Hewitts Road suggests that it might have had sediment sitting in the bottom third of the pipe prior to the CCTV survey.

Given the smaller pipe size between Norton Place and Hewitts Road than that previously assumed, it would be beneficial to incorporate this information into the flood model. However this is expected to have minimal impact on the resultant flooding and the scope and recommendations of this report.

6. DESCRIPTION OF OPTIONS – PRIMARY FLOW PATH

The following options were considered for conveying the primary flow path to reduce the risk of flooding at 3 Norton Place:

1. Upgrade of existing stormwater pipe between Norton Place and Hewitts Road.
2. Upgrade part of Main North Road pipe to 525mm diameter (Stage 1 of 2014 report upgrade recommendation)
3. Combination upgrade part of Main North Road and Hewitts Road pipes to 525mm diameter (Stage 1 & 2 of 2014 report upgrade recommendation)

Upgrading the primary flow path in isolation will not reduce the risk of flooding during storm events exceeding the current level of service. Only provision of a secondary overland flow path will reduce the risk of flooding beyond the primary flow path level of service.

6.1. Option 1

It is not considered necessary to upgrade the size of the existing stormwater pipe between Norton Place and Hewitts Road, as conveyance of flows away from the Norton Place sub-catchment is not the issue. The small pipe size did result in surcharge under pressure coming up through the Norton Place sump on the 1 June event and by upgrading the pipe size this backflow pressure would be reduced. However it would allow a greater volume of water to backflow up the pipe, potentially exacerbating the issue.

6.2. Option 2

Upgrading part of the Main North Road pipe to 525mm diameter would potentially prevent flooding of Norton Place. This would however be dependent on the ability of the 375mm pipe on Hewitts Road to convey peak flows. It is anticipated that in a 20% AEP or greater event, the Hewitts Road pipe capacity would still be exceeded and surcharge into Norton Place would occur.

6.3. Option 3

Undergoing a combination upgrade of the Hewitt Road and Main North Road pipework (Stage 1 & 2 of 2014 report upgrade recommendation) would improve the capacity of the primary network to convey the 20% AEP flow as per the Councils level of service. The depth of flooding for a 20% AEP event on Norton Place is reduced from 0.3m (status quo) to 0.1m.

A budget estimate for this combination upgrade was completed in the 2014 report and totalled $970,000. It has been considered that costs may be higher than this estimate due to the period of time which has lapsed since this estimate was conducted and new circumstances. Therefore the estimate was reviewed.

Overall the 2014 estimate is considered appropriate, however minor adjustments to some of the rates used have been made based on tendered prices for recent projects. More notably, the project contingency has been increased from 20% to 30%. This is to reflect the more difficult conditions along Main North Road, with an extremely limited pipe corridor available following recent sewer and water main installations. If the existing stormwater pipe is not able to be removed and the new pipe laid in its place, then the alignment would need to be along the carriageway, potentially blocking a land of traffic.

The project estimate has increased by an overall amount of $111,000 to the expected costs for Stage 1 & 2, bringing the estimate to slightly under $1.1m. A project budget of $1.1M is therefore considered to be suitable for these primary flow path upgrade works.

Recommended Upgrade Solution 2019 Revised Estimate	Stage 1 (Main North Road)	$ 717,000
	Stage 2 (Hewitts Road)	$ 364,000
	Total Upgrade	**$ 1,081,000**

Table 4: Updated Cost estimate of recommended primary network upgrades from 2014 report

If this option is proceeded with, the 2014 report suggested conducting the work in stages, with the Main North Road upgrade completed first, followed by monitoring of actual flood

events on Norton Place to determine the effect of the upgrade. Should flooding of Norton place prove to be a continued issue, the second stage (Hewitt Road upgrade) would then be required.

Any residual flooding concerns for the wider Woodend network could be further mitigated by the full upgrade option of the 2014 report (Stage 3), which included upgrading the pipe from Main North road to Parsonage road to 900mm diameter. This is considered to be outside of the scope of this report.

6.4. No service locating work has been undertaken as part of this study. This would be recommended at detailed design stage if this option is proceeded with. It should be noted that this is a key component of the Stage 1 (Main North Road) portion of the works due to the intensive number of services present along this roadway.

7. DESCRIPTION OF OPTIONS – SECONDARY FLOW PATH

7.1. Five options were considered to provide secondary overland flow paths to divert secondary flow away from Norton Place and the surrounding area where it is currently able to pool. These options were as follows:

1. Re-contouring Norton Reserve (1 Norton Place) to create a swale drain from the Norton Place cul-de-sac, parallel with the eastern boundary, through to Hewitt Road.
2. Re-contouring Norton Reserve (1 Norton Place) to create a stormwater detention basin to store flood waters and provide a spillway into Hewitts Road.
3. Relevelling of the pavement & channel along Woodglen Drive from No.20 to No.14 Woodglen Drive to create a consistent downward slope to the north east and allow floodwaters to flow into Woodfield Place.
4. Running a swale or drainage channel through private property at 3 Norton Place and 109 Main North Road, to discharge to Main North Road.
5. Installing a stormwater pump chamber to pump surface flows from Norton Road across the reserve to Hewitts Road.

7.2. The surface water runoff of 954 l/s for a predicted 1% AEP was taken to be the minimum discharge rate required by a system designed to convey the secondary flow. However this would reduce if an upgraded primary flow path were provided as described in section 6 (Option 3).

7.3. Option 1

A swale drain across Norton Reserve may help to direct flows into Hewitts Road, however due to the very small difference in levels across the reserve, a suitable gradient, channel size and therefore flow rate would not be able to be achieved. It would be practically impossible to design a drain with sufficient capacity to convey flows from at or above 20% AEP rainfall. The only way to achieve this would be to lower the road level on Hewitts Road around the north east corner of the reserve and heading east toward Main North Road so as to generate sufficient elevation difference for the drain to achieve a suitable depth and gradient.

7.4. Option 2

By creating a stormwater detention basin within Norton Reserve this would provide an area for flood waters to overtop into rather than private property. It would be difficult to create a basin with enough volume to receive and store all floodwaters from a 1% AEP event, however enough storage should be able to be provided to attenuate flows during a 20% AEP event. A spillway can be created at the north east corner of the reserve to allow

overflows to discharge into Hewitts Road rather than private property during peak (i.e. 1% AEP) storms. The basin would be excavated to a base level of around 10.5m (ensuring minimum 0.5m height above groundwater), with a spillway at maximum 11.6m, or ideally 11.5m if existing levels at Hewitts Road allow.

A sump and new pipe will be provided at the base of the basin. As this sump will be at a lower level than the existing sump on Norton Place, the backflows from the Hewitts Road catchment will surcharge into the basin rather than Norton Place. It would be considered prudent to hydraulically separate the sump on Norton Place from the new sump, to ensure that there is no surcharge into Norton Place.

If the existing speed bump at the start of Norton Place is raised by 0.2m, this will divert flows from Norton place into the detention basin. In this way the risk of overland flow from catchment upstream of Norton Place can be reduced.

It is recommended to retain the 225mm pipe size as this will help to restrict the flow rate of backflows entering the basin, with a portion of the flow instead overflowing at other sumps upstream on Hewitts road. The basin will therefore allow for a longer attenuation time before overtopping.

The overflow spillway into Hewitts Road will need to be carefully designed as there is very little difference in elevation between the overtopping point at 3 Norton Place and the existing channel depth at the north east corner of Norton Reserve. Hydraulic design for this spillway / weir has not been conducted at this stage and would be more appropriate at detailed design following approval of this option. Should this option be pursued, it is recommended that an additional topographical survey be undertaken of the site to capture all the levels required to ensure the effective design of this solution. Also, the greenspaces team would need to be consulted as to the re-purposing of this reserve.

Approximate basin capacity **(m^3)**	1250.0
Base level **(m)**	10.5
Average existing ground level **(m)**	12.0
Average cut depth **(m)**	1.5
Approximate volume of earthworks required **(m^3)**	2000.0
Spillway level **(m)**	11.5

Table 5: Proposed basin key parameters

A concept drawing for this proposed detention basin is given in Appendix C, which gives more detail around the proposed option. **This is the recommended secondary flow path option.**

7.5. Option 3

It would potentially be possible to lower the level of the footpath along Woodglen Drive in order to direct these flows to the north toward Woodfield place. There is a drainage easement at the end of the Woodfield place leading to Main North Road. However it is not considered sensible to direct flows from the Hewitt Road catchment into another catchment which is already close to or at full capacity. This would create system complexities where modelling work would need to consider these flows to be active within different catchments dependent on the flow volumes. Additionally, there are existing capacity issues with the Woodfield place easement which would be exacerbated. It would therefore be more prudent to keep the Hewitt Road flows within the same catchment.

7.6. Option 4

A drainage channel through private property at 3 Norton Place and 109 Main North Road, discharging to Main North Road would be very achievable due to a favourable gradient

through these properties (approx. 1 in 170). However there would be a multitude of issues involved with securing easements and / or purchasing private land. Construction access would be difficult and there would likely be affects to permanent features (e.g. driveways, outbuildings) on the properties which the owners would require compensation for.

Figure 6: Secondary Flow Path Option 4

7.7. Option 5

Given the significant size of the flow required to be discharged, the construction of a pump was considered. However, it is not recommended on the basis of an alternative viable option being available and due to the significant cost and reliability concerns of such an option.

7.8. A desktop study of those services mapped within the footprint identified the following, the service maps of which can be viewed in APPENDIX D:

- Optical fibre duct;
- Wastewater laterals
- 150mm PVC sewer gravity main
- 50mm water supply
- Telecom cable
- 4 core 120 AL low voltage electrical cable.

Particular care should be taken during any work around the electrical cable due to the risk of electrocution. This risk is increased as the age of the cable may be the same as or older than the property of 3 Norton Place, which was built in the early 1990s. This implies that the cable may be particularly fragile and prone to damage if disturbed. Lowering of this cable and a number of other services may be required or other mitigation measures implemented in order to achieve the minimum cover requirements.

8. OPTION 2 ESTIMATE

8.1. Costs were estimated for option 2 only as this is considered the preferred secondary overland flow path option. The cost is summarised in Table 6, with a detailed breakdown provided in APPENDIX B. A 30% construction contingency has been applied due to design uncertainties, which won't be known until detailed design stage.

Description	Amount
Preliminary and General – 15% of physical works	$21,086
Installation of new 225mm PVC	$33,208
Excavation & Civil works at Norton Reserve	$107,365
Construction Contingency – 30%	$48,498
Physical Works Subtotal	**$210,157**
Professional Fees – 12%	$25,219
Project Contingency – 10%	$28,246
Project Total (rounded to nearest $5k)	**$265,000**

Table 6: Estimated Costs for Secondary Flow Path Option 2

9. MODELLING WORK

9.1. In order to test the assumptions of the options assessment for a secondary flow path, stormwater modelling work was undertaken by the network planning team using MIKE FLOOD software to first establish the correct rainfall intensity for Woodend to reflect the June 1 event, and then test a range of scenarios based on Secondary Flow Path Options 1 & 2 . Each scenario was tested in isolation in order to properly assess its affect.

9.2. The following sequence of model runs were undertaken (plans of surface flooding extents for each model run are shown in Appendix E):

1. The model was run based on the status quo stormwater system using the measured Kaiapoi (Peraki Street) Rainfall to try and re-create the event experienced on 1 June. The Kaiapoi Rainfall levels did not result in any surface flooding beyond minor pooling (0.2-0.4m depth) on the roadway at Norton Place.

2. An extrapolation of the Woodend (Chinnerys Road) rainfall data was made from the time the sensor dropped out in order to estimate the rainfall intensity through the peak storm time (refer Section 2.6 & Figure 2). The model was again run based on the status quo in order to re-create the event experienced on 1 June. This produced a result which closely reflected the evidence of the flooding extent which occurred, including over 0.6m depth of flooding in the cul-de-sac which was sufficient to overtop into Nos.3 & 4 Norton Place.

3. The model was run using the same rainfall data with a non-return valve placed in the pipeline running from Norton Place to Hewitts Road in order to prevent surcharge into the Norton Place sump. There was very little discernible change from model run 2, and flooding again occurred through Nos.3 & 4 Norton Place.

4. The model was run without the non-return valve but with a large artificial wall placed across the top end of Norton place to block surface flows entering from Woodglen Drive. Under this scenario up to 0.5m depth of flooding occurred on Norton Place which was less than the critical height to overtop into Nos.3 & 4 Norton Place. There were slightly higher flood levels upstream along Hewitts Road and Woodglen Drive as a result of this, but no resultant ingress into private properties.

5. A similar run to model run 4 was undertaken but with a 0.2m high speedbump across the entry to Norton Place in order to simulate a constructible solution. This was found to be inadequate to prevent surface flows from entering Norton Place and as such an almost identical result to model runs 2 & 3 occurred.

6. At this stage it was considered that surface flows from the western end of Hewitts Road may be contributing to the Norton Place flooding and as such the model was run with a 0.2m high speed bump placed at Hewitts Road adjacent to Grange View Park in an attempt to redirect flows. This made no discernible change to the result as per model runs 2, 3 & 5.

7. The model was run with a speedbump as per model run 6 as well as a swale drain across Grange View Park to the drain on the northern side of the park. This resulted in a slightly reduced extent of flooding through the Norton Place vicinity although overtopping into Nos.3 & 4 Norton place still occurred. The maximum depth of flooding within 3 Norton Place was approximately 0.16m compared to 0.24m for model runs 2, 3 & 5.

8. The model was run with a stormwater basin constructed in Norton Reserve as per the concept design (Appendix C). This resulted in maximum flooding depths of 0.5m in Norton Place which was less than the critical height to overtop into Nos.3 & 4 Norton Place. Flows instead were redirected via the basin into Hewitts Road. As a result, up to 0.2m depth of flooding occurred along the eastern portion of Hewitts Road between Norton Reserve and SH1, but no resultant ingress into private properties.

9. Lastly, the model was run with a swale across Norton Reserve. This had a similar outcome to model run 7, with a reduction in the extent of flooding but overtopping into Nos.3 & 4 Norton Place still occurring.

9.3. The results of model runs 3 and 4 showed that the flooding extent through Norton Place is primarily impacted by surface flows entering from Woodglen Drive rather than direct surcharging through the Norton Place sump. Unfortunately due to the ground levels of the surrounding roadways it is not possible to provide a constructible solution to redirect these flows away from Norton place (as shown in model run 5) without major changes to surrounding roadway profiles.

9.4. It was found that works upstream on Hewitts Road (model runs 6 & 7) did little to prevent flooding of the Norton Place properties.

9.5. In terms of possible works in Norton Reserve, the model shows that the recommended basin option (Secondary Flow Path Option 2) would work to prevent ingress into the Norton Place properties in an event similar to June 1, while a swale drain would have insufficient capacity and gradient to convey sufficient flow volume across the park.

10. CONCLUSION

10.1. In terms of options for improving the primary flow, a combination upgrade of part of Main North Road and Hewitts Road pipes to 525mm diameter (Stage 1 & 2 of 2014 report upgrade recommendation) would improve the primary network capacity to service the 20% AEP (5 year) event. It would be sensible to conduct this in stages, with the Main North Road upgrade completed first, followed by monitoring of actual flood events on Norton Place to determine the effect of the upgrade. Should flooding of Norton Place prove to be a continued issue, the second stage (Hewitt Road upgrade) would then be required. This option however would require a total project budget of around $1.1M.

10.2. In terms of options for providing a secondary flow path, the recommended option is to excavate a stormwater detention basin within Norton Reserve (1 Norton Place) as per Option 2 of Section 7. The impact of this option would be three-fold as it would create a basin for floodwaters to enter instead of private property, allow for attenuation of 20% AEP stormwater flows during which time the downstream pipework is over capacity, and provide a secondary flow path for overflows to discharge onto Hewitt Road during peak rainfall events (i.e. 1% AEP). It is recommended that an additional topographical survey be undertaken of the site to capture all the levels required to ensure the effective detailed design of this as a solution.

10.3. It is important to note that the recommended option provides greater protection than the Council adopted 50 year (2% AEP) level of service. In a longer duration 500 year event this basin solution may not provide sufficient protection from flooding, however this has not been confirmed by modelling. It is important to note that the modelling and basin design reflects a short duration high intensity event as experienced on 1 June 2019.

10.4. Given the intensity of the 1 June storm, it is considered that the primary network upgrades may not sufficiently reduce the risk of property flooding during such an event. Provision of the recommended detention basin as discussed above would reduce the risk of future flooding of the affected properties in a similar event (i.e. 500 year short duration or 100 year long duration) at a significantly lower cost than the primary network upgrade option.

10.5. Primary network upgrades would be more appropriate to conduct once a motorway bypass or similar is provided by NZTA for Woodend and Main North Road is downgraded from a Level 1 road.

10.6. The recommended secondary flow path options are estimated to cost in the order of $265,000 (exc GST).

10.7. The Council Greenspaces team would need to be consulted as to the re-purposing of Norton Reserve.

Inferred area flooded **(m²)**	7242.00
Average ground level **(m)**	11.50
Height of crest at 3 Norton Place **(m)**	11.72
Average flood depth **(m)**	0.22
Total volume of water **(m³)**	1593.24
Average Q **(m³/s)**	0.68
Time taken to flood **(minutes)**	39.02

KAIAPOI (PERAKI STREET) RAINFALL DATA

Time (rough 10min intervals)	Cummulative time of storm (min)	rainfall in period (mm)	10min duration intensity (mm/hr)	Storm return period (years)	Catchment flow rate Q (m³/s)	Time of this intensity (min)	Portion of total time	Weighted portion of average flow
31/05/2019 23:09:12	0							
31/05/2019 23:20:16	11.1	2.6	14.1					
31/05/2019 23:29:51	20.7	0.2	1.3					
31/05/2019 23:40:43	31.5	1.8	9.9					
31/05/2019 23:49:43	40.5	0.6	4					
31/05/2019 23:57:53	48.7	4.2	30.9	5	0.311	8.2	0.214	0.067
1/06/2019 0:07:49	58.6	14.8	89.4	100	0.899	9.9	0.258	0.232
1/06/2019 0:17:48	68.6	13.8	82.9	50	0.834	10	0.261	0.218
1/06/2019 0:28:01	78.8	10.4	61.1	5	0.615	10.2	0.266	0.164
1/06/2019 0:38:59	89.8	3	16.4					
1/06/2019 0:48:46	99.6	1	6.1					
1/06/2019 0:58:13	109	1.4	8.9					
1/06/2019 1:08:00	118.8	1.6	9.8					
1/06/2019 1:19:18	130.1	1.6	8.5					
			Weighted average flow (m³/s):		**0.680**			

Time	31/05/2019 23:57		1/06/2019 0:07		1/06/2019 0:17		1/06/2019 0:28	
	Greenspace	Hardstanding	Greenspace	Hardstanding	Greenspace	Hardstanding	Greenspace	Hardstanding
0-5% slope runoff coefficient, C	0.25	0.8	0.25	0.8	0.25	0.8	0.25	0.8
Rainfall Intensity, I (mm/hr)	30.9		89.4		82.9		61.1	
I (m/s)	8.58333E-06		2.48333E-05		2.30278E-05		1.69722E-05	
A (m2)	26892	36864	26892	36864	26892	36864	26892	36864
Subcatchment Q (m3/s)	0.058	0.253	0.167	0.732	0.155	0.679	0.114	0.501
Q (m3/s)	0.311		0.899		0.834		0.615	

1	**PRELIMINARY & GENERAL**					
1.1	Site Establishment & Setting Out					
1.2	Pre-commencement Deliverables					
1.3	Traffic Management					
1.4	As Built Information					
1.5	Location & Protection of Existing Services, including Pot-holing					
1.6	Health and Safety Provision					
	SUB TOTAL				**$ 21,086.00**	15% of physical works

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2	**SUPPLY & INSTALL NEW 225mm PVC ACROSS NORTON RESERVE**					
2.1	Supply, and install DN225 SN 16 PVC pipe in ground including connections to new and existing manholes.	56	m	$ 350.00	$ 19,600.00	Used rates from 16/19 & 18/53 as guide
2.2	Install new 450mm sump at 1 Norton Place	100%	LS	$ 2,500.00	$ 2,500.00	18/53 eng estimate
2.3	Install new DN1050 precast manhole with scruffy dome at 1 Norton Place	100%	LS	$ 6,760.00	$ 6,760.00	16/66 average rate
2.4	Surface restoration of trenches in footpaths	12	m	$ 95.00	$ 1,140.00	16/66 average rate
2.5	Surface restoration of trenches in grass	44	m	$ 50.00	$ 2,200.00	16/66 average rate
2.6	CCTV inspection of new stormwater mains	56	m	$ 18.00	$ 1,008.00	16/66 average rate
	SUB TOTAL				**$ 33,208.00**	
3	**EXCAVATION & CIVIL WORKS AT NORTON RESERVE (assumes 2000m³)**					
3.1	Excavator Hire	80	hours	$ 150.00	$ 12,000.00	
3.2	Truck Hire	80	hours	$ 110.00	$ 8,800.00	
3.3	Construct new footpath	110	m²	$ 141.00	$ 15,510.00	16/66 average rate was $141/m² 18/53 average rate was $68/m²
3.4	Topsoiling, grassing and tree planting	1465	m²	$ 32.00	$ 46,880.00	16/66 average rate was $66/m² (only 6m² total) 18/67 average tender $212/m³ - averaged to 0.15m depth = $32/m² 17/21 average tender for placing topsoil and reinstating grass = $16/m²
3.5	Labour	160	hours	$ 60.00	$ 9,600.00	Assumes 2 x skilled labourers for 10 days
3.6	Relocate park bench	100%	LS	$ 1,000.00	$ 1,000.00	
3.7	Raise speed bump on Norton Place by 0.2m	100%	LS	$ 2,500.00	$ 2,500.00	
3.8	New kerb and channel at north east corner of Norton Reserve	100%	LS	$ 1,625.00	$ 1,625.00	16/66 average rate
3.9	supply and install 2 x sumps and 10m long DN225 SN 16 PVC at Hewitts Road	100%	LS	$ 9,450.00	$ 9,450.00	used rates from items 2.1, 2.2 & 2.4
	SUB TOTAL				**$ 107,365.00**	
	Construction contingency 30%				$ 48,498.00	
	TOTAL				**$ 210,157.00**	
	Professional fees 12%				$ 25,219.00	
	Project contingency 10%				$ 28,246.00	
	PROJECT COST				**$ 263,622.00**	

PLANTED 1:2 CUT BATTER
(WHERE SHOWN BY GREY HATCHING)

TOP OF BATTER

TOE OF BATTER
APPROX. **10.7m**

PROPOSED SUMP
10.5m

PROPOSED DOUBLE SUMP EACH SIDE OF
DRIVEWAY ENTRY, WITH 225mm PVC BETWEEN
FOR PRIMARY FLOWS TO BYPASS SPILLWAY

PROPOSED 225mm PVC
FROM NEW MANHOLE TO
EXISTING MANHOLE AT
HEWITTS ROAD

WIDE DRIVEWAY ENTRY TO BE CREATED TO
LOWER LEVEL OF FOOTPATH / SPILLWAY
TO BELOW **11.50m**

LEVEL OF EXISTING
CHANNEL APPROX. **11.50m**
AT THIS POINT

PROPOSED SPILLWAY INTO DETENTION BASIN
11.55m

SPEED BUMP TO BE RAISED BY 0.2m TO
DIRECT FLOWS TO DETENTION BASIN

EXISTING FOOTPATH REPLACED / NEW FOOTPATH
INSTALLED TO SUIT CHANGED GROUND ELEVATION
(WHERE SHOWN BY GREEN HATCHING)

EXISTING 225mm
DIAMETER PIPE TO
BE REPLACED

PROPOSED NEW MANHOLE
WITH SCRUFFY DOME
DOME LEVEL APPROX. **11.0m**
PIPE INVERT APPROX. **10.0m**

PROPOSED SPILLWAY INTO DETENTION BASIN
11.55m

225mm PVC TO BE REALIGNED TO
CONVEY SUMP FLOWS INTO BASIN

EXISTING SUMP ON NORTON PLACE
(POINT OF SURCHARGE ON 1 JUNE 2019)
11.19m

POINT OF FLOOD OVERTOPPING INTO
3 NORTON PLACE ON 1 JUNE 2019
11.72m

SCALE 1:500

REV	REVISION DETAILS	DRN	CHK	APP	DATE
A	---	---	---	---	--/--/2019

SURVEYED	SF	16/08/2019	PROJECT No	PD001606
DRAWN	SF	30/08/2019	CON No	N/A
DRAWING CHKD	MA	10/09/2019	SCALE (A3)	1:500
DESIGNED	SF	28/08/2019		
DESIGNED CHKD	MA	10/09/2019	DATE ISSUED	--/--/2019
APPROVED	---	--/--/2019		

WAIMAKARIRI DISTRICT COUNCIL

PROJECT
3 NORTON PLACE
SURFACE WATER FLOODING

SHEET TITLE
CONCEPT DESIGN FOR
STORMWATER DETENTION BASIN
WITHIN NORTON RESERVE

FOR INFORMATION
NOT FOR CONSTRUCTION

DRAWING	REVISION
4045	
SHEET 1	-

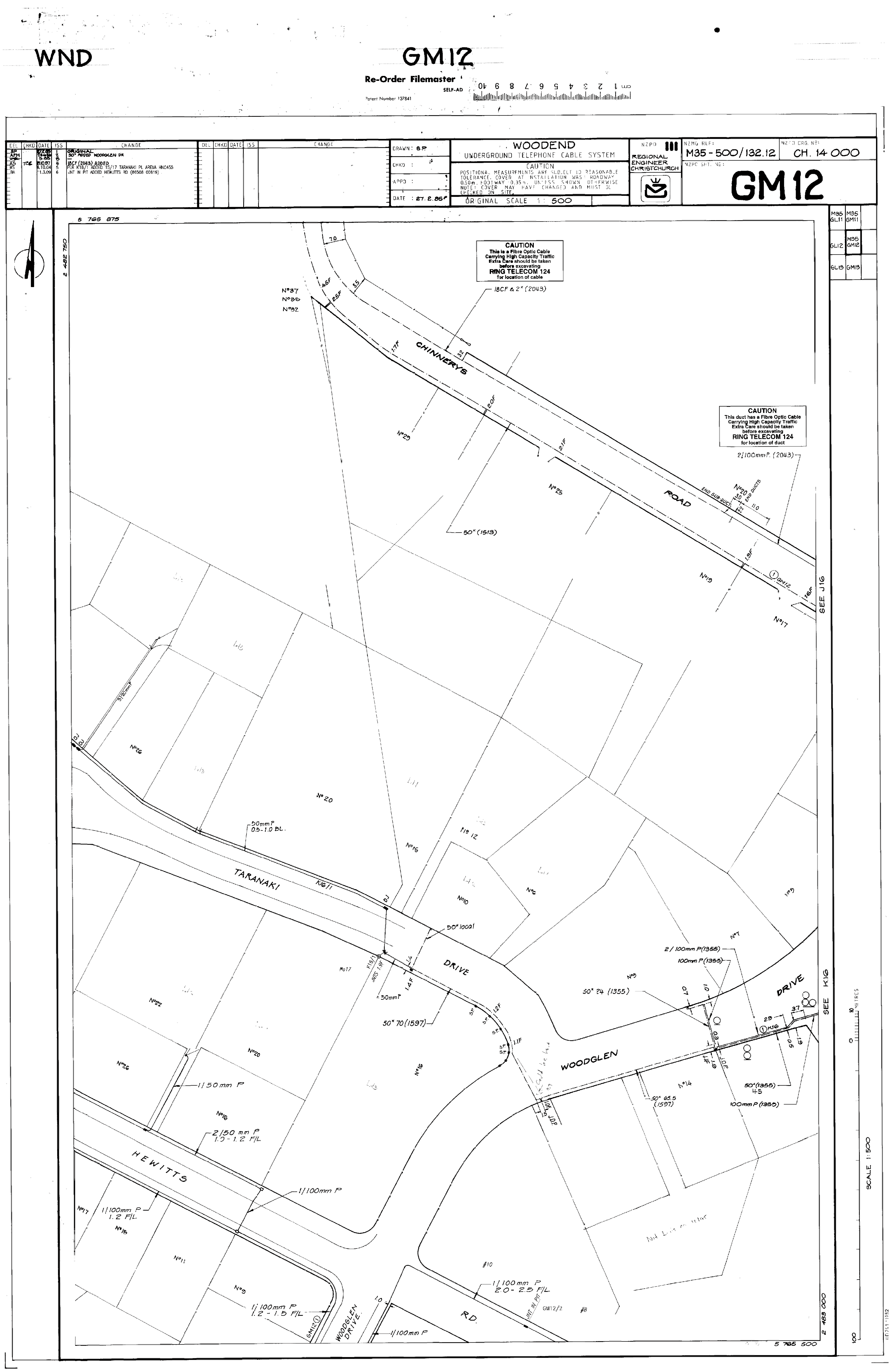
PLOT DATE: 11/09/2019 FILE: S:\PDU\PDU JOBS\PD001600-1699\PD001606 3 NORTON PLACE SURFACE WATER FLOODING\7 - DRAWINGS\3 NORTON PLACE.DWG

CHORUS

WARNING: Buried services are widespread and it should be assumed that they are present until it is proven otherwise.
Cables should be expected to be found at ANY depth. In most instances Chorus plans do NOT show house service feeds on private property.
Refer to cover letter provided with your request for additional information - use all plans provided in conjunction with each other
You are responsible for interpreting the information provided and should refer to Worksafe.govt.nz for the 'Guide for safety with underground services'
For assistance contact Chorus Network Protection on 0800 822 003 or if you suspect damage has occurred contact 0800 463 896 opt 2

N

Plan Name	GM12
Plan ID	269612
Version	GC
Current at	29/08/2019


WND
GM12
Re-Order Filemaster
WOODEND
UNDERGROUND TELEPHONE CABLE SYSTEM
CAUTION
POSITIONAL MEASUREMENTS ARE SUBJECT TO REASONABLE TOLERANCE. COVER AT INSTALLATION WAS: ROADWAY 0.50m. FOOTWAY 0.35m. UNLESS SHOWN OTHERWISE NOTE: COVER MAY HAVE CHANGED AND MUST BE CHECKED ON SITE.
ORIGINAL SCALE 1 : 500
DRAWN: S.P.
CHKD :
APPD :
DATE : 27.2.85
NZPO
REGIONAL ENGINEER CHRISTCHURCH
NZMG REF: M35 - 500/132.12
NZPO DRG. No: CH. 14 000
NZPO SHT. No:
GM12
SP 27.2.85 1 ORIGINAL
APM 2 50* ADDED WOODGLEN DR
3
AS TCE 8.10.97 4 18CF (2043) ADDED
WS 6.10.04 5 PLR K16/1 ADDED 15/17 TARANAKI PL AREVA HNC455
BA 1.3.09 6 JNT IN PIT ADDED HEWITTS RD (86508 00819)
M35 GL11
M35 GM11
GL12
M35 GM12
GL13
GM13
5 765 875
2 482 750
CAUTION
This is a Fibre Optic Cable Carrying High Capacity Traffic Extra Care should be taken before excavating
RING TELECOM 124
for location of cable
18CF & 2* (2043)
CAUTION
This duct has a Fibre Optic Cable Carrying High Capacity Traffic Extra Care should be taken before excavating
RING TELECOM 124
for location of duct
2/100mmP. (2043)
CHINNERYS
ROAD
TARANAKI
DRIVE
WOODGLEN
DRIVE
HEWITTS
RD.
WOODGLEN DRIVE.
SEE J16
SEE K16
No37
No35
No32
No29
No25
No20
No19
No17
No26
No20
No16
No12
No10
No6
No5
No7
No3
No17
No22
No26
No20
No16
No16
No14
No17
No15
No11
No9
#10
#8
50* (1513)
50* local
50mmP 0.5-1.0 BL.
K16/1
DJ
JNTS 1.9F
50mmP
50* 70 (1597)
50* 24 (1355)
2/100mm P(1355)
100mm P(1355)
50*(1355) 45
100mm P (1355)
50* 65.5 (1597)
1/50mm P
2/50 mm P 1.0 - 1.2 F/L
1/100mm P
1/100mm P 1.2 F/L
1/100mm P 1.2 - 1.5 F/L
1/100mm P
1/100mm P 2.0 - 2.5 F/L
JNT IN PIT
GM12/2
GM12 (1)
(1) GM12
(1) K16
END SUB-DUCT
END DUCTS
J.D.P.
Not built on later
3/20mmP
5 765 500
2 483 000
SCALE 1:500
METRES

CHORUS

WARNING: Buried services are widespread and it should be assumed that they are present until it is proven otherwise.
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N

Plan Name	GM13
Plan ID	269613
Version	GE
Current at	29/08/2019

WND

M35 - GM13

Re-Order Filemaster "D"
Sellotape 1230 Double Side Tissue
SELF-ADHESIVE PLAN HANGER
Patent Number 137841

CH 14

1 2 JAN 1999

A.P.M.		WOODEND	REGIONAL ENGINEER CHRISTCHURCH
			M35-500/132.13
			CH 14000
11.6.96		SCALE 1:500	A1

GM 13

11.6.96	1	ORIGINAL
04.07.97	2	100* (1639) ADDED
11.8.97	3	WOODGLEN AVE
11.8.97	4	MANAHI PLC ADDED
17.10.97	5	18CF & DUCTS (2043) ADDED
11.2.97	6	
4.1.99	7	DP ADDED NORTH RD
14.2.00	8	FAIO 8.17% 40% DRAIN AROUND DUCT WITH FIBRE
24.6.00	9	PLR ADDED DATAFIX 4725
29.6.00	10	THE STABLES ADDED
01.3.04	11	UNITS IN 300x ADDED GOODER HZ/654
1.3.05	12	TP67/653 ADDED HEWLITTS RD (88508 00819)
8.09.06	13	ADDED CUT-IN PLR [LI/20] MANAHI PLACE HD(88508 00887)

5 765 500

2 483 000

5 765 125

GL 12 | GM 12 | K16
GL 13 | GM 13 | GN13
GM 4 | GN 13

GM12 ①
1/100mm P 1.0 F/L
RESERVE
DRIVE
HEWITTS
TP67/653
LOCAL
15x/P
1/100mm P 20-25 F/L
ROAD
50mm P
1/100mm P 1.5 F/L
WOODGLEN
NORTON
PLC
2/50mmP
100mmP
GL13 ②
GM13 ②
1/100mm P 1.0 F/L
1/100mm P 1.0 F/L
2/50mmP
50mmP
50mmP
50mmP
50mmP
MANAHI
PLACE
50mmP
3/20mmP
50mmP
TL21/653
THE
TL17/212
TL21/655
TL21/654
STABLES
50*P
TL21/667
TL21/666
CAUTION
This is a Fibre Optic Cable carrying High Capacity Traffic
Extra care should be taken and a TELECOM N.Z. LTD OVERSEER ADVISED before excavating
3/100mm P (1325)
CAUTION
This duct has a Fibre Optic Cable Carrying High Capacity Traffic
Extra Care should be taken before excavating
RING TELECOM 124 for location of duct
JNT 3.0 F LT7/20
300x RPR 2.5
300x JNT 5.0
NORTH ROAD
MAIN ROAD
Church
300* 24.7 (326)
300* 16.7 (326)
300* 111.3 (326)
50* 136.3 (1325)
300*(1177)
400* (2041)
300* (1177)
50*
300* 7.9 (326)
300* 31.4 (326)
300* 66.8 (326) Copper Wire in Trench
2/100mm P (1639)
DETAIL Not to Scale
DETAIL Not to Scale
15* 44.5 (1325) in 25mm P
300* 141.0 (1160)
100* 109.8 (1639)
300* 108.4 (1160)
2/100mm P (2043)
Pipes end under Kerb
25* (1160)
DETAIL Scale 1:200
300* 170.4 (1173)
25* (1173)
OBSOLETE CABLE IN VICINITY NOT SHOWN
OBSOLETE CABLE IN VICINITY NOT SHOWN
WOODEND ROAD
50* 530.4 (339) 1.4-1.6 BL Unless Otherwise Shown
2/100mm P with 2/25* 427.7, 30* 606.6 inside 1.1-1.4 BL (1597)
50* 149.8 (1597) 1.1-1.4 BL
50* 141.7 (1597) 1.1-1.4 BL
2/100mm P (1160)
300* 66.8 (326) Copper Wire in Trench
2/100mm P (1639)
50* 5.8 (1258)
GM13 ① 18CF 4 200*

enable
Fibre Broadband

30/08/2019

ENABLE NEWORKS FIBRE OPTIC DUCT AND CABLE AS BUILT PLAN: Service Plan ID - 7385818

IMPORTANT: Whilst all due care has been taken the indicated offsets are nominal only. Contractors must use traditional service location methods prior to digging. Enable Networks shall not be liable for any damage arising out of the use of these plans (through inaccuracy or other means)
If in doubt - please ask! Enable contact 0800 4 FIBRE (0800 434 273).
Please note that stand-overs and service identification/location services attract fees.

0 0.0050.01 0.02 km

N

1:625

Duct
Drop Duct
Cabinet
Pedestal
Proactive Duct
Offsets
Chamber

IMPORTANT:
MPNZ DOES NOT GUARANTEE THE ACCURACY OF ITS RECORDS NOR DOES IT GUARANTEE THE ACCURACY OF ITS ELECTRONIC LOCATION. CABLES/INFRASTRUCTURE MAY BE PRESENT IN THE VICINITY OF THE WORKS WHICH ARE UNMARKED ON PLANS OR HAVE NOT BEEN ELECTRONICALLY LOCATED.

N
W
E
S

4 core 185 AL LV & 1ph-6 NS SL
4 core 120 AL LV & 1ph-6 NS SL
4 core 120 AL LV
4 core 185 AL LV & 1ph-6 NS SL 1-100 spare
4 core 185 AL LV 1ph-6 NS SL & 1-100 Spare
4 core 185 AL LV & 1ph-6 NS SL
4 core 120 AL LV & 1ph-6 NS SL
4 core 120 AL LV (in seperate trench to 11kV & SL)
3 core 95 AL 11kV 1ph-6 NS SL
3 core 95 AL 11kV & 1ph-6 NS SL
1ph 35 CU NS 1-100 future 1
1ph 35
joint in SL cable
16.8m BØ Joint
2-100
3-100
4-100
1100
11kV
LV
NORTON PLACE
DRIVE
16
9
8
25
26 A
27
33
30
32
7
6
1
2
3
5 B
5 A

IMPORTANT:
THE CUSTOMER SHOULD TAKE NOTE THAT WORKS IN THE VICINITY OF CABLES AND OTHER POWER INFRASTRUCTURE IS EXTREMELY HAZARDOUS AND SHOULD ONLY BE CARRIED OUT BY COMPETENT PERSONS. THE CUSTOMER SHOULD HAVE PROCEDURES IN PLACE THAT MITIGATE THE RISK OF CONTACT WITH LIVE CONDUCTORS. IF IN ANY DOUBT, CONTACT THE MPNZ CONTROL CENTRE: 03 311 8312

DRAWN	SXN	30/8/19

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ALL RIGHTS RESERVED
UNAUTHORISED USE PROHIBITED

mainpower

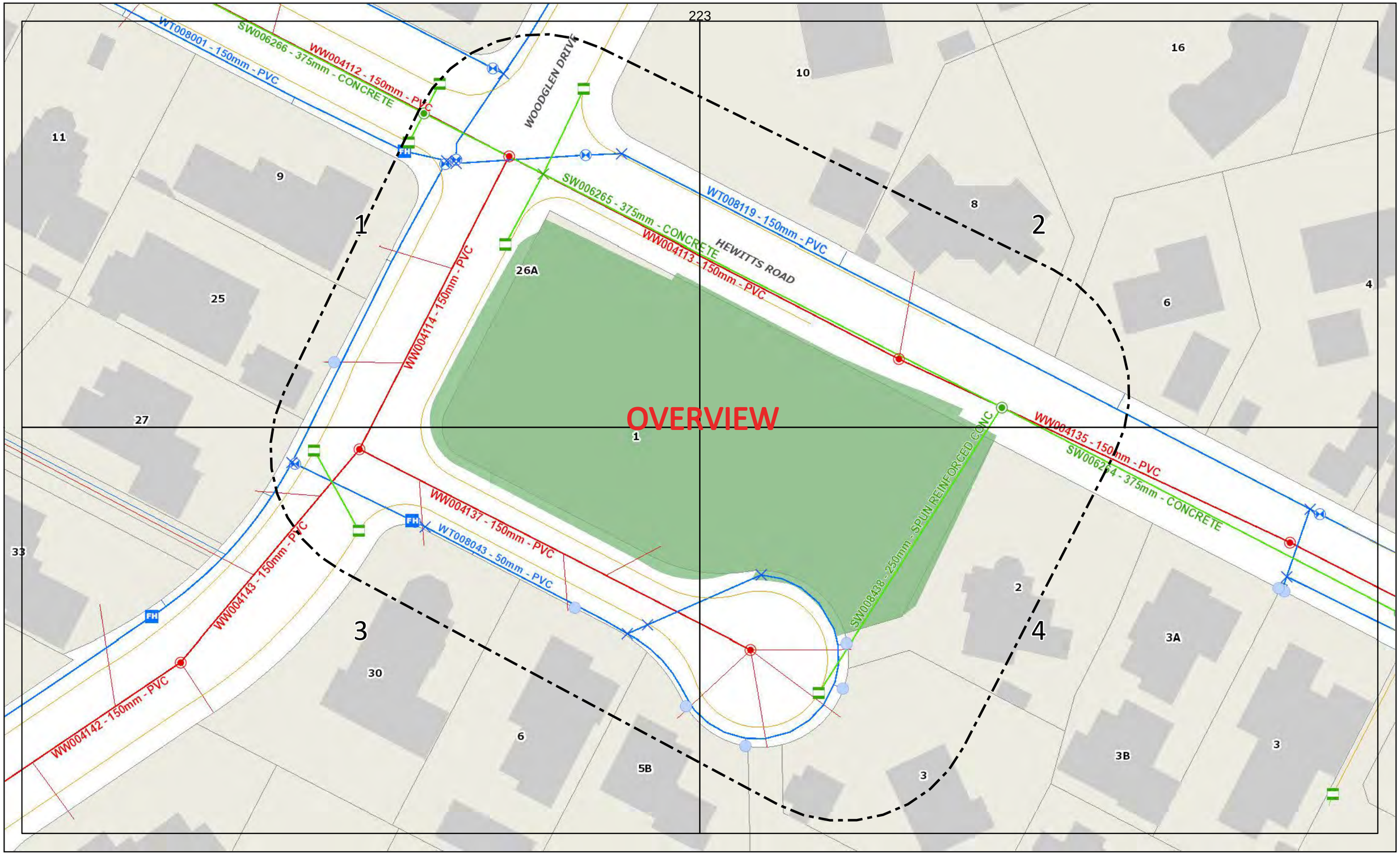
MAINPOWER NZ LTD

UNDERGROUND ASSETS
AS-BUILT PLANS

DATE CREATED	STATUS
30/8/19	AS BUILT

MAIN CATEGORY
UG RECORDS - WOODEND

SIZE	SCALE	SHEET	REV
A3	1:500	1 OF 1	-



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WAIMAKARIRI DISTRICT COUNCIL

DISCLAIMER: While reasonable measures have been taken to ensure the accuracy of the information contained in this plan response, neither the Waimakariri District Council or PelicanCorp shall have any liability whatsoever in relation to any loss, damage, cost or expense arising from the use of this plan response or the information contained in it or the completeness or accuracy of such information. Use of such information is subject to and constitutes acceptance of these terms.

SN: **7385815**
JN: **1480764**
Date: **29/08/2019**

224

WT008001 - 150mm - PVC
SW006266 - 375mm - CONCRETE
WW004112 - 150mm - PVC
HEWITTS ROAD
WT061876 - 150mm - PVC
WT008002 - 150mm - PVC
WT008119 - 150mm - PVC
SW006265 - 375mm - CONCRETE
WW004113 - 150mm - PVC
WW004114 - 150mm - PVC
WOODGLEN DRIVE
WT008205 - 100mm - PVC
FH
11
9
25
27
26A

Tile No: 1

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0 2 4 6 8 10 20 30 40 50 60 Metres

WAIMAKARIRI DISTRICT COUNCIL

For Legend details please refer to the attached document:

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Scale (A3): 1:250
SN: **7385815**
JN: **1480764**
Date: **29/08/2019**

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0 2 4 6 8 10 20 30 40 50 60 Metres

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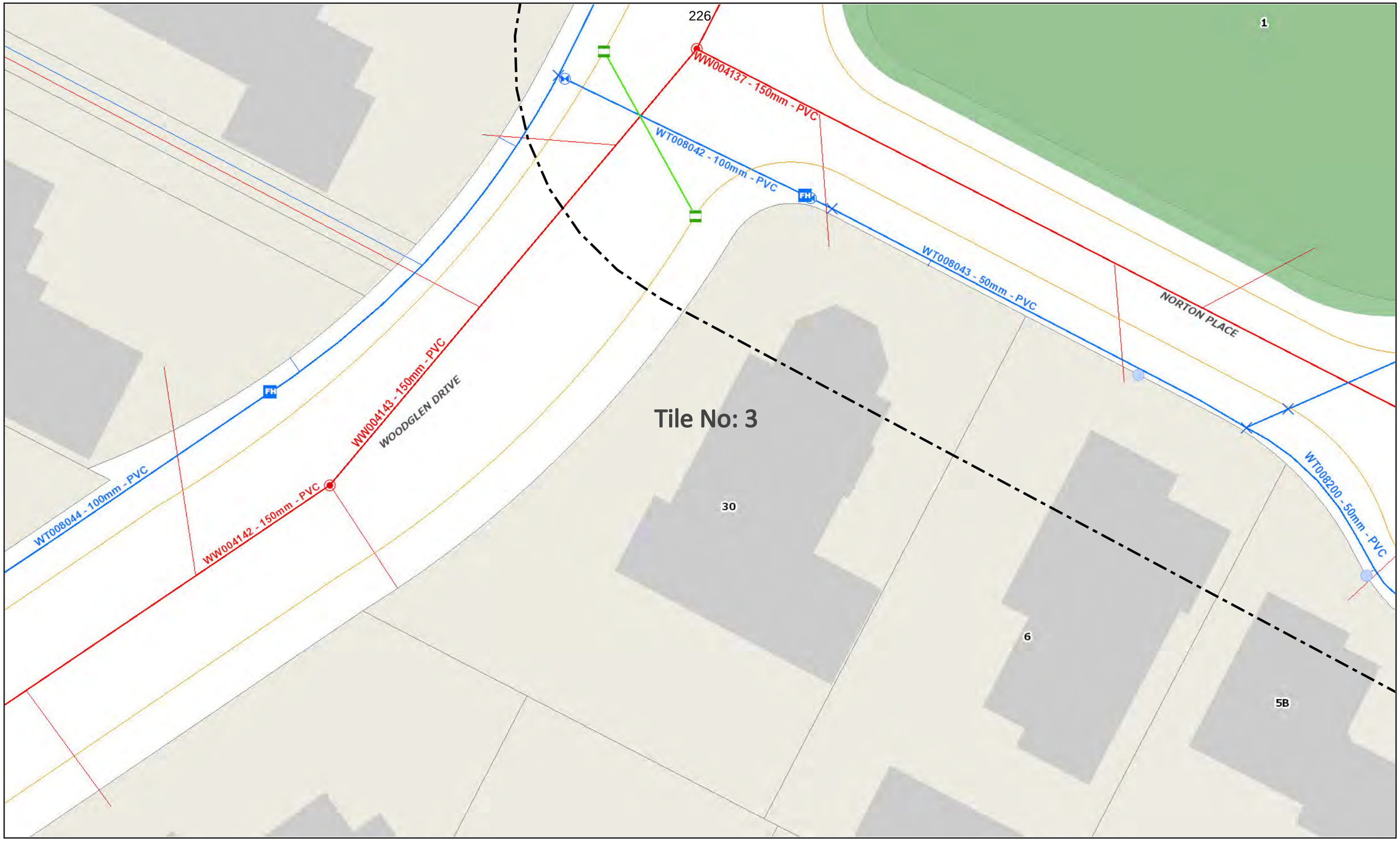
Scale (A3): 1:250
SN: **7385815**
JN: **1480764**
Date: **29/08/2019**



beforeUdig.co.nz

0 2 4 6 8 10 20 30 40 50 60 Metres

WAIMAKARIRI DISTRICT COUNCIL

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Scale (A3): 1:250
SN: **7385815**
JN: **1480764**
Date: **29/08/2019**

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0 2 4 6 8 10 20 30 40 50 60 Metres

WAIMAKARIRI DISTRICT COUNCIL

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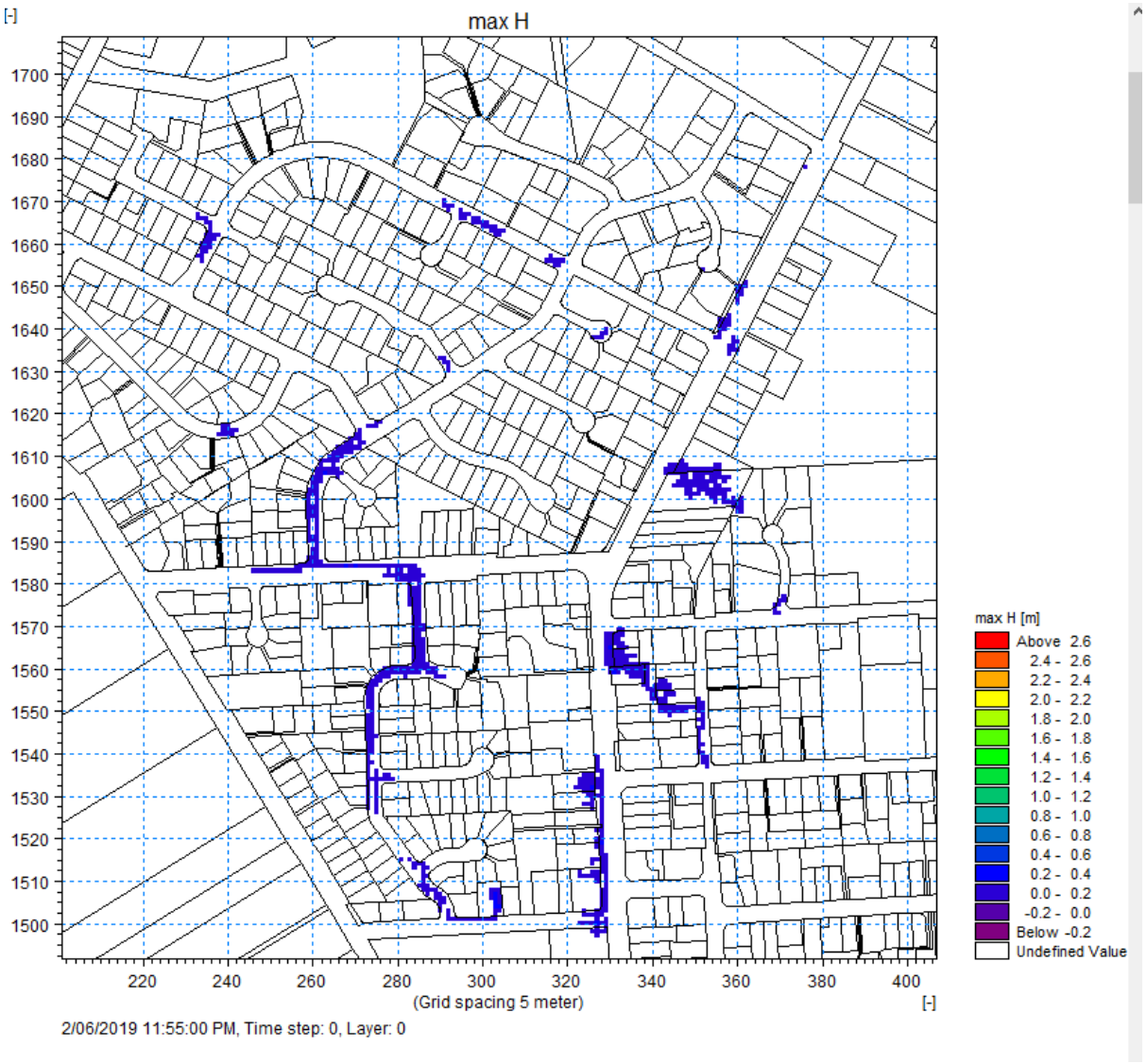
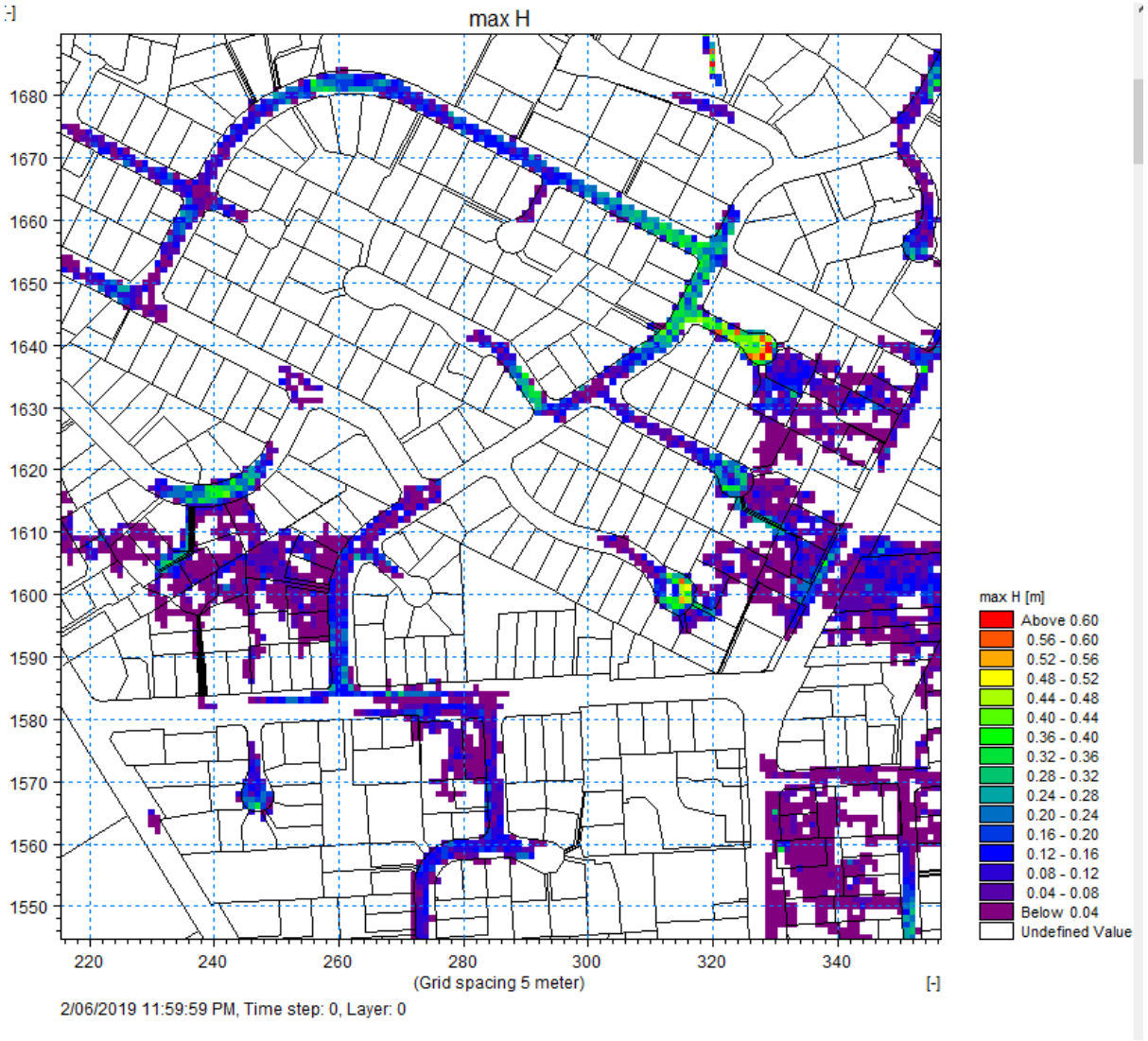
Scale (A3): 1:250
SN: **7385815**
JN: **1480764**
Date: **29/08/2019**

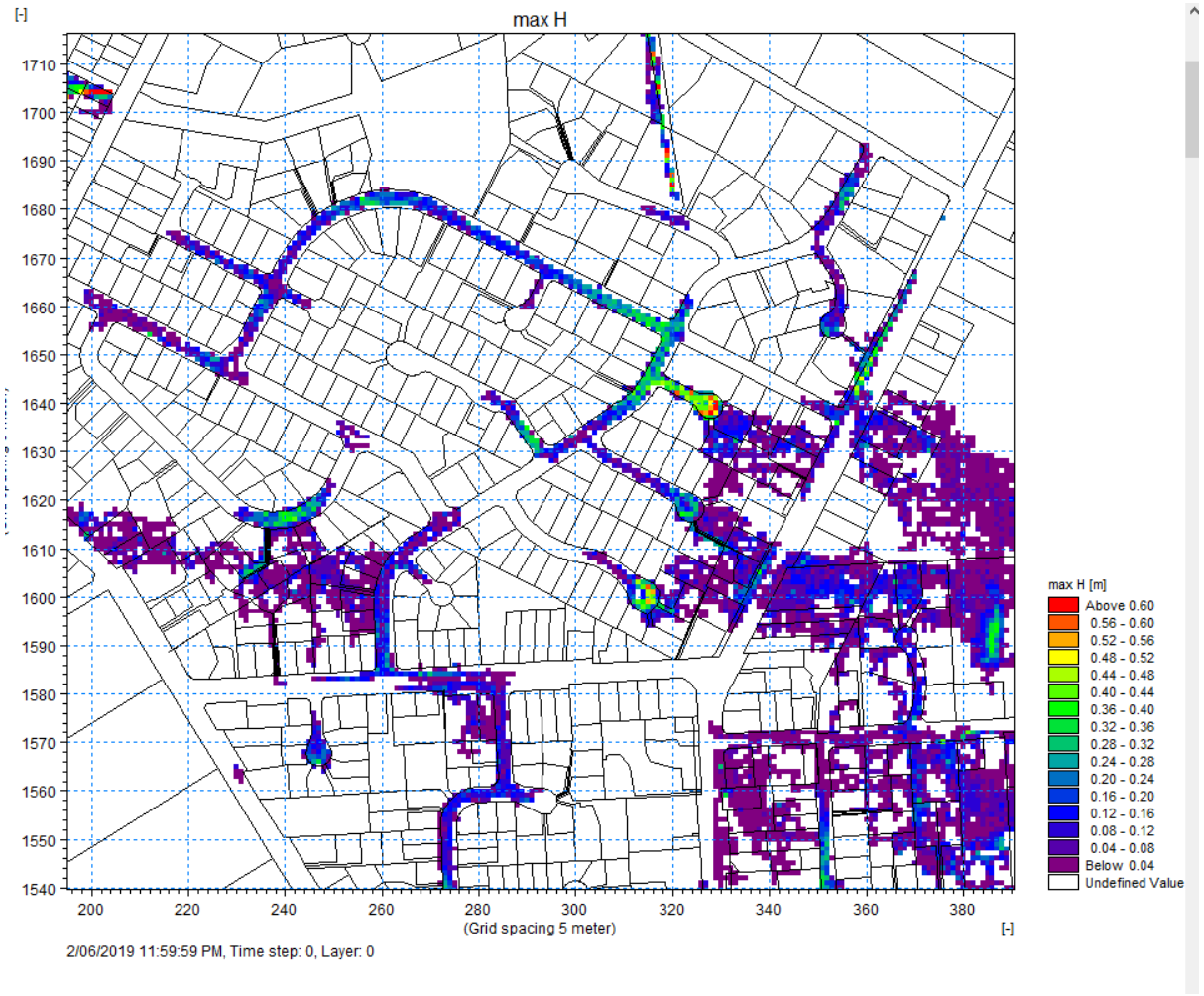
1. Kaiapoi Rainfall



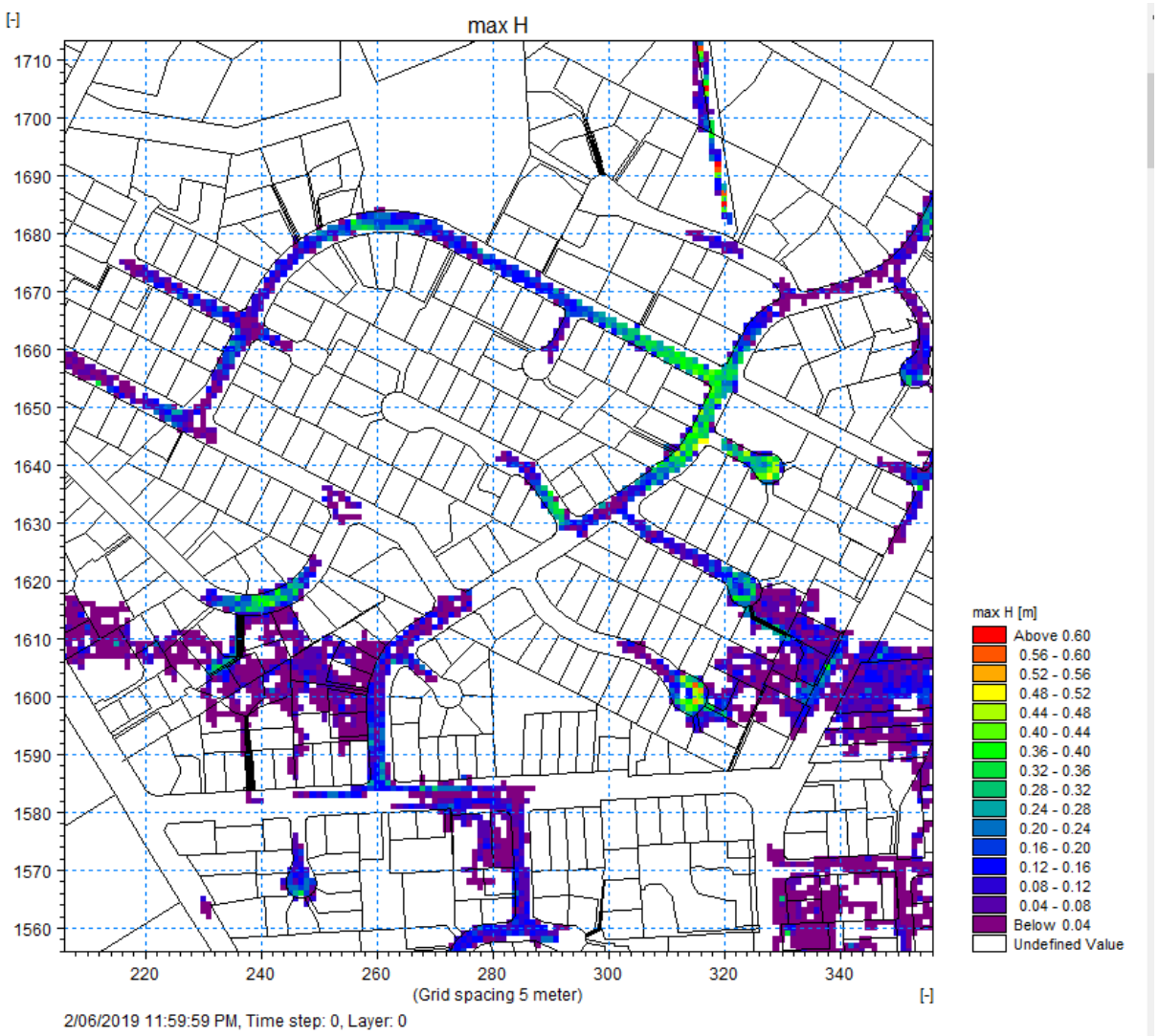
2. Woodend Rainfall



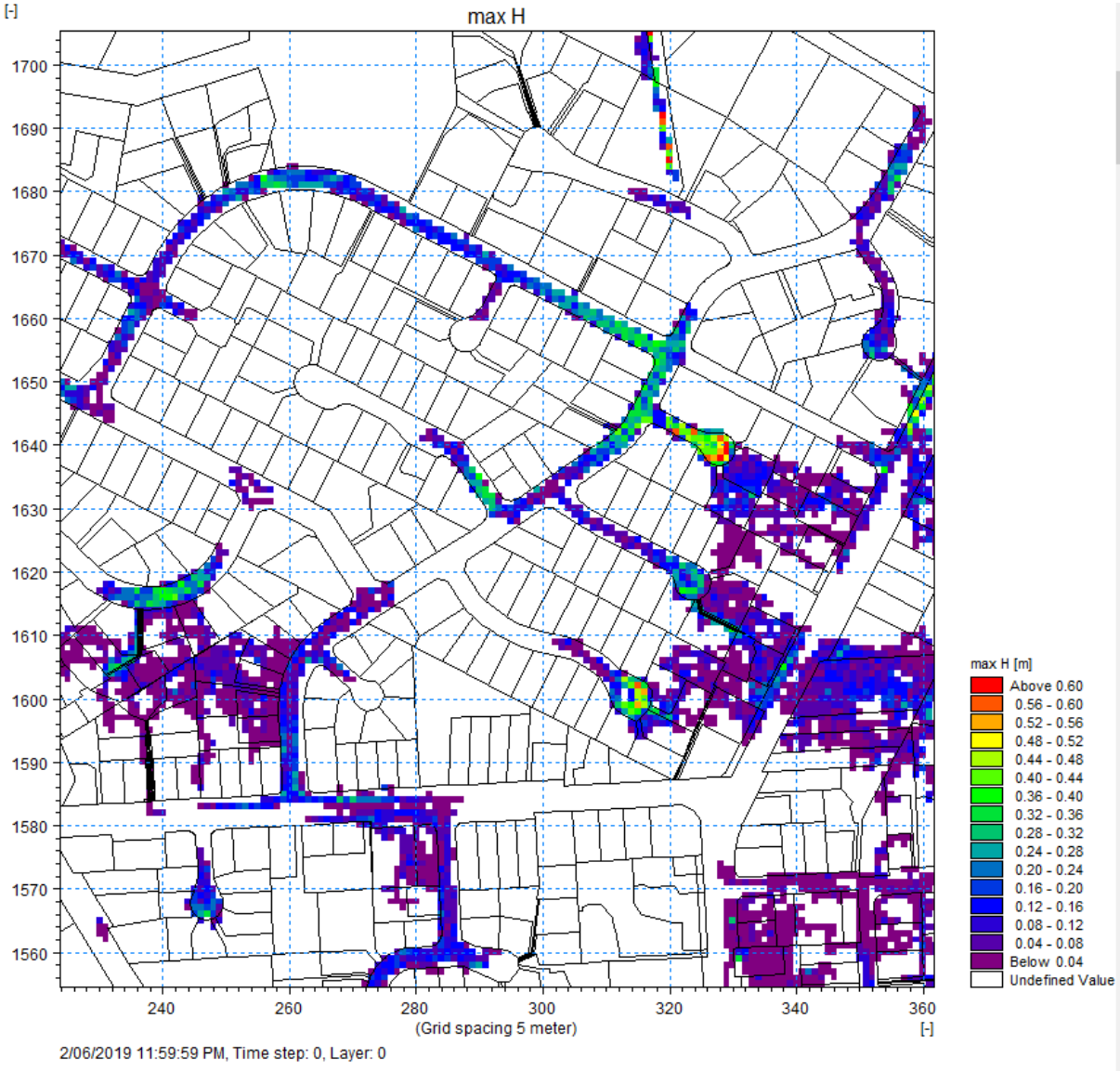
3. Woodend rainfall – non return valve



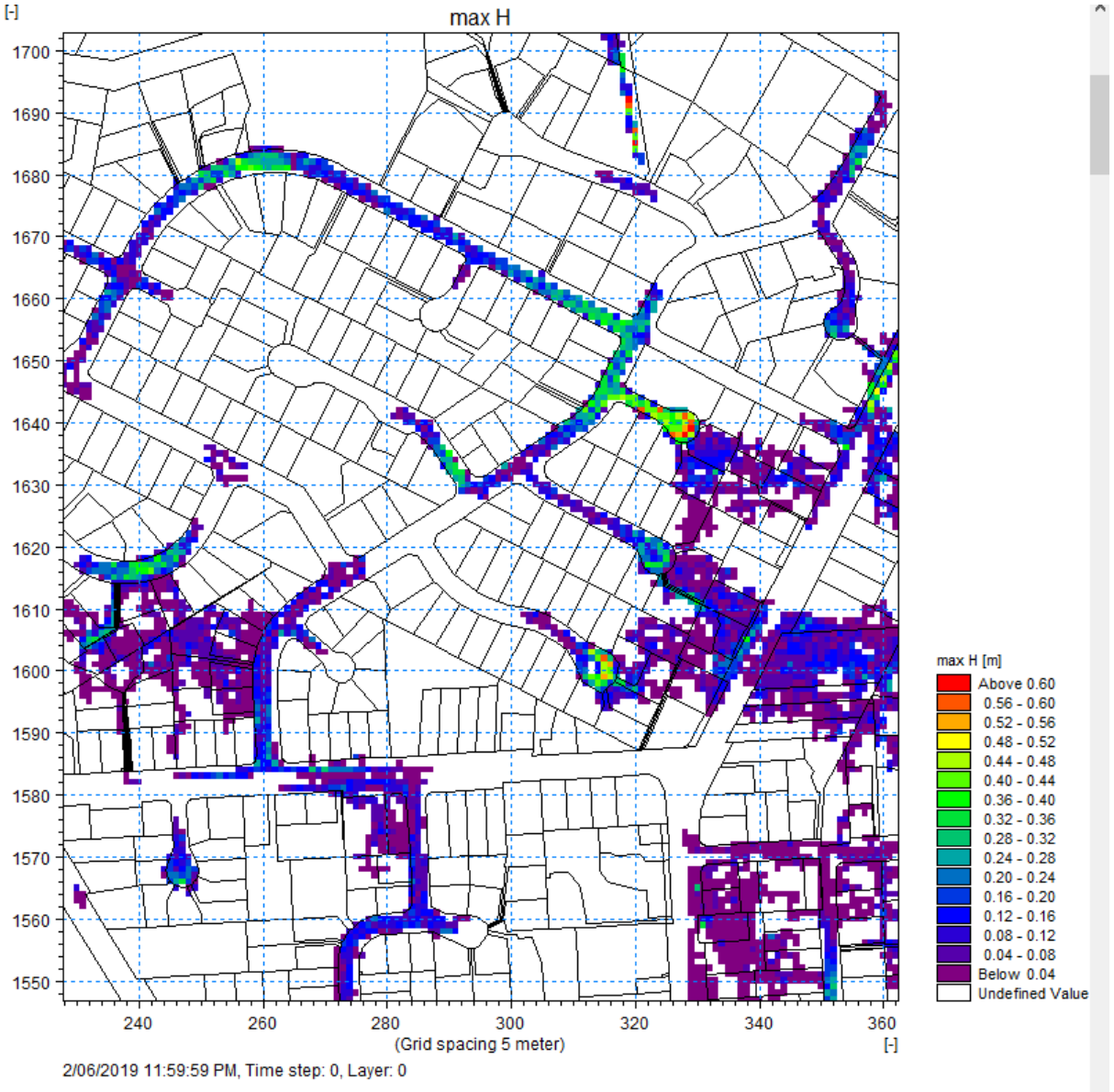
4. Woodend Rainfall – wall on Norton Place



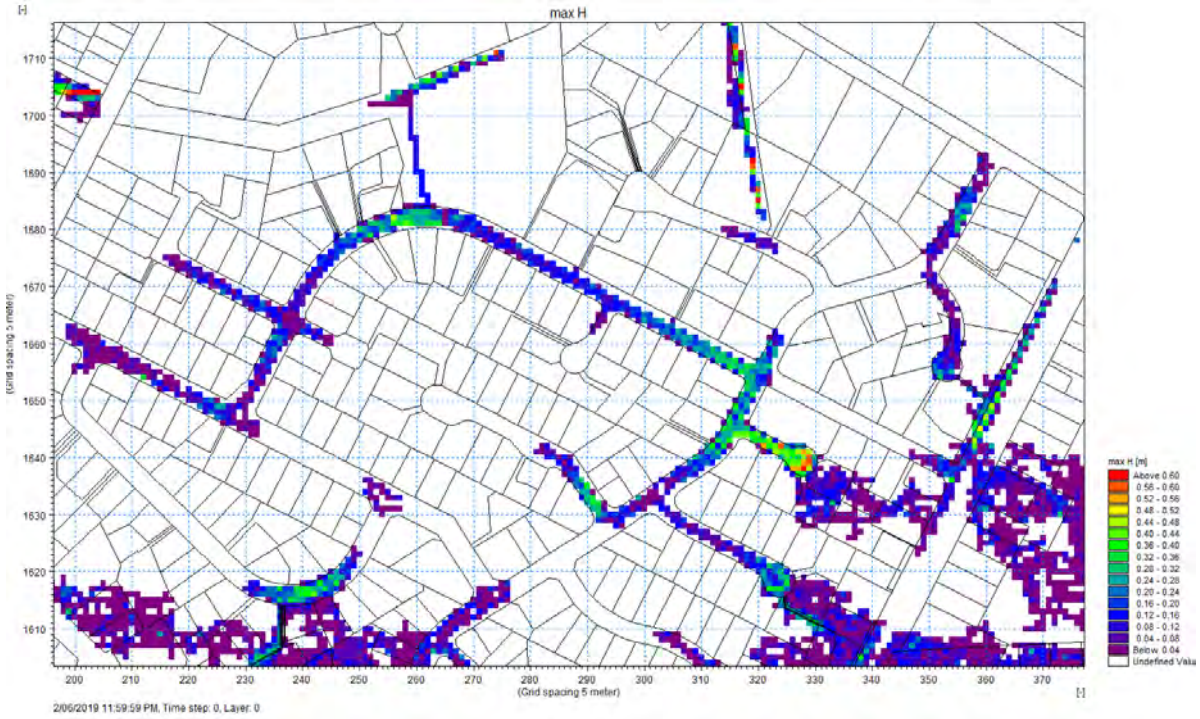
5. Woodend Rainfall – 0.2m speedbump



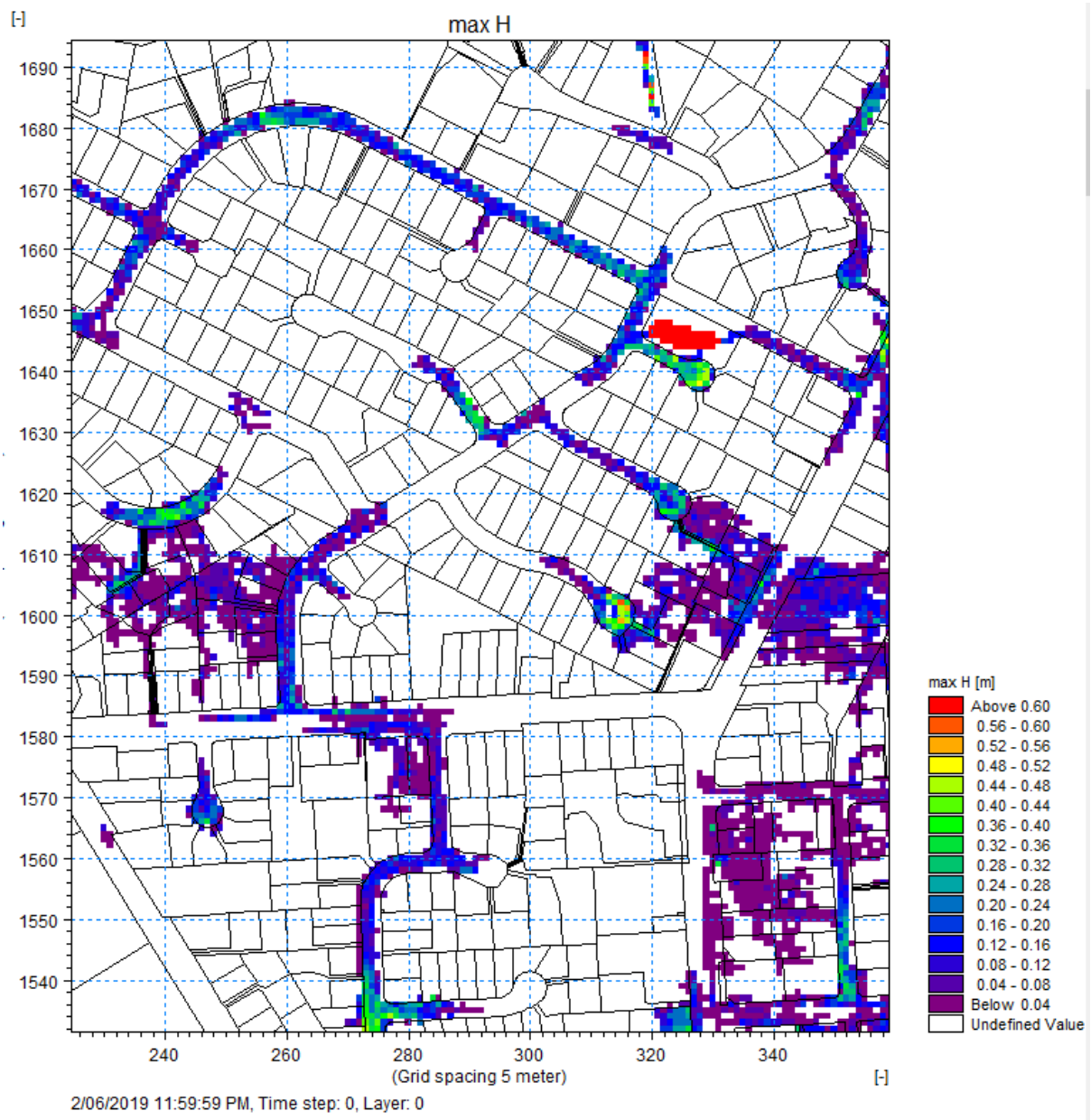
6. Woodend Rainfall – 0.2m speedbump Hewitts Road



7. Woodend Rainfall – 0.2m Speedbump and Swale through Grange View Park



8. Woodend Rainfall – Basin in Norton Reserve



9. Woodend Rainfall – Swale through Norton Reserve