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5 September 2018

Attention: Pranavan Kasipillai

Dear Pranavan,

IFS 18/051 - Gilmour Street Stormwater Upgrade Phase 1: Concept Evaluation Letter Report

Introduction

The purpose of this letter is to present and evaluate two design options proposed for the upgrade of stormwater infrastructure along Gilmour Street in accordance with the proposal for Waikato District Council (WDC) IFS 18/051.

The design objectives are to intercept the overland flow paths draining across Gilmour Street thereby improving secondary flow management and reducing drainage toward flood prone private properties on the northern side of the street. Two conceptual designs have been developed, as illustrated in Attachment 1, and the performance, costs, and risks associated with each option is presented below.

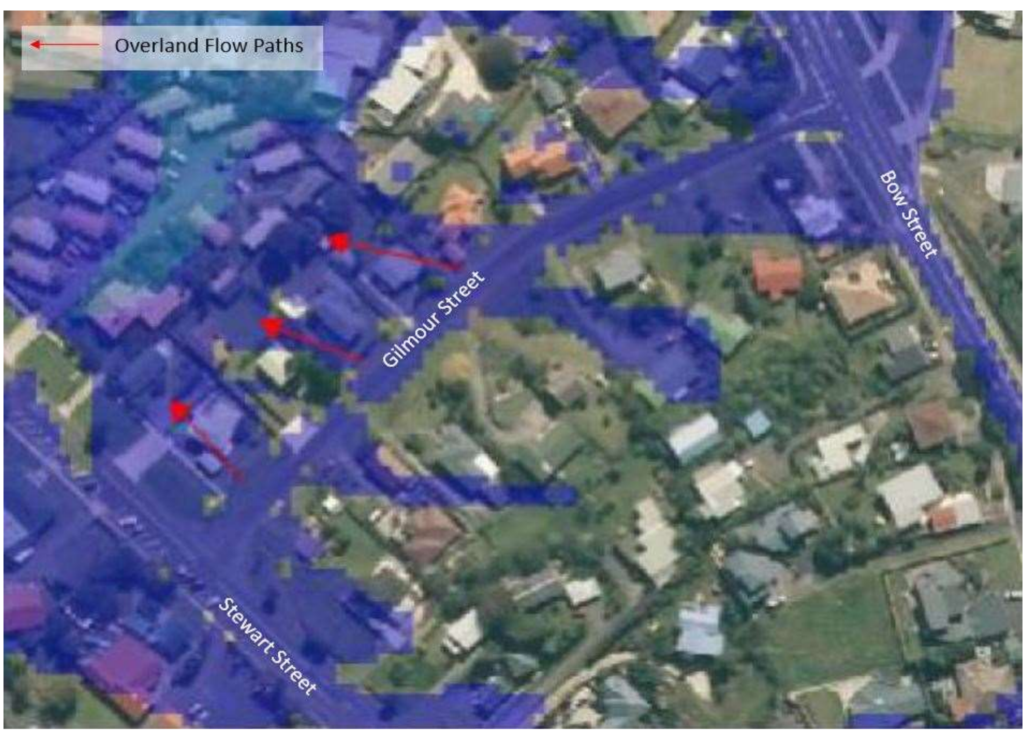

Figure 1: Existing overland flood flows (100-year return period, MPD with climate change)

Criteria

The proposed concepts are designed to meet the requirements of the Regional Infrastructure Technical Specifications (RITS). The RITS requires secondary systems such as overland flow paths to convey runoff from the 100-year average recurrence interval (ARI) event without causing undue risk or damage to downstream properties. Section 4.2.3.4 of the RITS also requires additional edge treatments and hardening of surfaces, where applicable, to ensure a 100-year design life of the system. Although roadside drainage typically includes water quality treatment, treatment methods are excluded from the current designs due to the retrofit nature of the project. Both options would not worsen water quality relative to existing conditions. Other RITS criteria may need to be exempted to meet budgetary constraints as discussed in the cost reduction opportunities below.

Methodology

The existing flood model developed by GHD and modified by Beca during previous work was used to establish design flood conditions during the 100-year ARI event. Runoff rates from the flood model were used to size the swales and pipes included in each of the conceptual design options. Each option was then three dimensionally modelled in 12d software to confirm a cross-sectional geometry that is sufficient to convey flows while fitting within the spatial constraints of the grassed verge. The model results were used to inform the concept design geometry that, once established, was updated in Mike Urban/Mike21 flood modelling software to evaluate performance and effectiveness of intercepting the overland flows. We note this model still needs to be refined.

Construction cost estimates were based on the conceptual layout and cross-sectional details of each design option. For increased robustness, the cost estimate was completed by quantity surveyors. Because of the level of detail associated with conceptual design and in order to estimate the maximum likely cost, many assumptions were made during both the design and cost estimating procedures. Design assumptions include elements proposed for resilience, robustness, risk mitigation and longevity of the design that may not fit within budgetary constraints. These assumptions also include potential utility impacts that significantly affect the cost. These items are listed as provisional costs in the estimates included under Attachment 2.

Design Alternatives

Option 1 – Continuous Swale with Driveway Culverts

Option 1 consists of a continuous planted swale extending along the north-western side of the carriageway from 3 Gilmour Street to 12 Stewart Street. Piped crossings connect the swale at each driveway and walkway to convey the 100-year ARI runoff between swale sections. In order to prevent runoff from flowing down driveways, small grated drains (MeaDrains) are proposed to cut-off and discharge overland flow to the swale.

Option 2 – Swale Draining to Carrier Pipe

Option 2 consists of a system of smaller swales which drain via scruffy dome structures into a carrier pipe below ground. The length of swale is the same as that proposed for option one, however the size of the swale will be reduced since it is segmentally drained at each driveway crossing. Grated driveway drains are also proposed in this option to intercept any flow draining down the driveways from the roadway.

Concept Comparison

The advantages and disadvantages of the two concepts are summarized in Table 1 below. A ranking is provided to indicate the preferred option in each category. A sum of the rankings is provided where the lowest score indicates the preferred option.

Table 1: Concept Evaluation

Criteria	Option 1 – Continuous Swale		Option 2 – Carrier Pipe	
	Consideration	Rank	Consideration	Rank
Cost	▪ Lower capital construction cost ($283,000 to $356,700)	1	▪ Higher capital construction cost ($467,100 to $528,200)	2
Performance	▪ Effectively intercepts overland flow ▪ Performance heavily reliant on maintenance along the entire length of the swale.	2	▪ Effectively intercepts overland flow ▪ Performance is less reliant on maintenance. ▪ Opportunity for additional connections from private properties or future development such as improvements to the drainage on the upstream side of the road.	1
Risks	▪ Significantly higher costs associated with risks ($54,400). ▪ Less flexible to manage unforeseen risks. ▪ Construction of swale will likely require diversion of AC watermain ▪ Larger swale will conflict with and could require relocation of 2 utility poles ▪ Roadway should have a concrete edge beam due to proximity of swale ▪ Significant increase of risk to properties at the bottom end of the swale in a culvert blockage scenario. ▪ Risk of upper reaches scouring and requiring rock lining ▪ Risk that property owners want more crossings (i.e. pedestrian accesses)	2	▪ Lower cost associated with risks ($14,400) ▪ Conflict with AC watermain at two locations ▪ Smaller swale can be manipulated to avoid utility pole conflict ▪ Concrete edge beam not required to protect road edge as swales are smaller ▪ Reduced risk of inlet blockage ▪ Reduced potential to overflow ▪ Lesser risk of upper reaches scouring and requiring rock lining ▪ Risk that property owners want more crossings (i.e. pedestrian accesses.) ▪ Risk of problems in the future at the pavement reinstatement joint (existing to new). Will ultimately need to reseal entire road.	1

Criteria	Option 1 – Continuous Swale		Option 2 – Carrier Pipe	
	Consideration	Rank	Consideration	Rank
Maintenance	■ Driveway culverts require more frequent maintenance than domes to prevent blockage ■ Planted swales require more maintenance than grass swales	2	■ Debris build-up is mitigated with a dome ■ Maintenance costs for the carrier pipe ■ Planted swales require more maintenance than grass swales ■ Pavement reseal is more difficult with number of manholes in roadway	1
Constructability	■ Roadway disruption limited to shoulder work (easier traffic maintenance plan) ■ Operating equipment in close proximity to watermain could damage the asset. ■ Replacement culverts will disturb larger extent of driveways.	1	■ Significant excavation of the roadway has a larger disruption that will require traffic routing. ■ Operating equipment in close proximity to watermain could damage the asset. ■ Existing utility pole bases will require protection in place.	2
Environment	■ No additional water quality treatment provided. Swales are too short and steep to meet treatment standards (no change from existing). ■ Higher risk of conveying contaminants/sediment to the estuary as a result of concentrated/erosive flows.	2	■ No additional water quality treatment provided. Swales are too short and steep to meet treatment standards (no change from existing). ■ Less chance of scour and erosion conveying sediment to estuary. ■ More likely that swale could be modified to improve water quality performance.	1
Health & Safety	■ Potential contact and disposal of hazardous material (AC watermain) ■ Higher hazard for cars driving off driveways with a deeper swale. Requires traversable culvert ends. ■ May need kerb to protect traffic. ■ Low hazard associated with greater water volumes ponding in swale	2	■ Potential contact and disposal of hazardous material (AC watermain) ■ Numerous areas of deeper excavation associated with manhole structures ■ Maintenance in confined spaces associated with carrier pipe ■ Less water volume and depths stored on surface features	1
Public perception	■ Unaesthetic appearance of large swale and ponding ■ Temporary disconnection of water services	1	■ Reduced road frontage dedicated to swale ■ Limited road access during construction	2

Criteria	Option 1 – Continuous Swale		Option 2 – Carrier Pipe	
	Consideration	Rank	Consideration	Rank
	■ Reconstruction of driveways		■ Temporary disconnection of water services	
Cost Reduction Opportunities	■ Eliminate MeaDrains ■ Reconstruct driveways in-kind ■ Less able to reduce swale depth as it is governed by culvert cover	2	■ Eliminate MeaDrains ■ Abandon pipes in place to negate the need for driveway reconstruction. ■ Open inlets could replace scruffy dome/manhole structures at a higher risk of blockage ■ Reduce swale depth to allow grass instead of plants ■ Locate carrier pipe below verge instead of beneath the carriageway	1
Combined Score (Lower is preferred)		15		12

Cost Reduction Opportunities

Many of the assumptions noted above significantly affect the cost. There is some potential to reduce or eliminate some of the costly elements associated with each option during detailed design. Since these items need to be further investigated to determine feasibility, they are included in Attachment 2 for the purposes of developing a conservative cost estimate and identifying performance risks. Refer to the details and assumptions included in Attachments 1 and 2 for more details.

Option 1 – Continuous Swale with Driveway Culverts

- AC Main Diversion: The elevation of the watermain is unknown and will need to be potholed prior to construction. Even without a direct spatial conflict with the main there is a risk of damaging the asset due to a reduction in cover and the operation of construction equipment in close proximity. WDC have advised that any costs for this work would be covered under their programme of water supply renewals.
- MeaDrains: Small secondary MeaDrains are assumed to be more cost efficient than the large sizes that would be required to convey the 100-year flowrate between swale sections. This assumption will be confirmed during detailed design. There is also a potential to eliminate the MeaDrains on some or all of the driveways by grading them to divert flow towards the swale rather than promoting drainage to the north (as in the existing condition).
- Driveway Reconstruction: Replacement of driveway culverts has a greater extent of disturbance and will demolish the majority of existing driveways. It has been assumed that private driveways will be reconstructed with concrete to appease public perception of these works, however costs could be reduced by replacing driveways in kind.
- Walkway reinstatement: It is assumed that all private pedestrian crossings/accesses will be reinstated. This assumption will be confirmed during detailed design.

Option 2 – Swale Draining to Carrier Pipe

- AC Main diversion: See description under Option 1.
- MeaDrains: Grading or bunding existing driveways could eliminate the need for cut-off drains on some or all of the driveways.
- Driveway reconstruction: Existing driveway culverts can be abandoned in-place to eliminate any driveway disturbance and thus reconstruction and disposal costs associated with the project. Any MeaDrains or small works could be installed by saw-cutting and reinstating only disturbed areas of the driveway rather than the full extents.
- Walkway reinstatement: See description under Option 1.
- Swale Planting: 3:1 swale batters are proposed in Option 1 due to spatial constraints. With the lower capacity required for Option 2 swales, there is potential to adjust the geometry of some sections to allow for grass coverage rather than planting. Grass coverage will reduce both construction and maintenance costs.
- Concrete edge beam: Reduced swale widths in Option 2 allow for a greater distance of separation between the swales and the edge of roadway. The concrete edge beam may be eliminated in areas where the swale can be located a minimum setback from the edge of pavement.
- Relocate carrier pipe: Locating the pipe in under the grass verge instead of beneath the roadway could minimise or avoid disturbance of paved areas however this is subject to a more detailed assessment of clearances to structures and utilities, the gradient of the grass verge, and the resulting cover. Current practice is to locate the pipe beneath the roadway.

Recommendations

In light of budgetary constraints, Option 1 is recommended as the preferred option for detailed design. It is strongly recommended that we review the costs and risks together in order to determine which elements should be incorporated into the budget and design.

Yours sincerely,

Anna McKay
Stormwater Engineer

on behalf of

Beca Limited

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Britta Jensen, Opus

Attachments

Attachment 1 – Concept Drawings
Attachment 2 – Cost Estimates