Ashburton Second Urban Bridge and Associated New Road

Stormwater Concept Report

Ashburton District Council

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Date: September 2013
Reference: 306CE/Remg130503
Status: Final

Contents

Executive Summary

This report investigates land requirements for the management of the stormwater from the proposed second bridge road alignment in order to mitigate potential effects. The land requirements have been established through development of a concept stormwater design. The design outcomes include the following:

- Swale network to convey and treat stormwater during high frequency events
- Soak-pits for disposal of rainfall events exceeding the Water Quality (WQ) event located within roadside swales where disposal to ground is feasible
- Basins to attenuate flows during low frequency events (i.e. 2% AEP)

This covers land requirements for runoff treatment, management and disposal from the new road surface only, of which a total of **2.4 ha** of land is required. This is based on a conservative design approach to ensure that the land extent recommended will not result in significant problems in the future, considering stormwater management practices could change or the regulatory environment could become more stringent.

The concept has been developed with consideration of the Ashburton Urban Stormwater Strategy (AUSS) and the Ashburton Stormwater Management Plan (SMP) which is currently in development. Future detailed design of the roads stormwater management system will need to be done in accordance with the AUSS, the SMP and Ashburton global stormwater discharge consent (which should become operative by early 2014).

The proposed concept will ensure a high standard of treatment prior to discharge and minimise potential effects on Carters Creek, Ashburton River and groundwater. The proposed concept will also manage and control flood events of 2% AEP or less with no downstream increase in flood risk.

The health of the receiving environments will be a key metric used to benchmark the performance of the SMP. Hence where there is scope through this project to enhance Carters Creek, it should be taken advantage off. Improving both aquatic and terrestrial health / diversity will improve the receiving environment and aids the Council to meet the long terms objectives of the SMP.

1 Project Description

The Ashburton District Council (ADC) proposes to construct, use and maintain a new 2-lane bridge across the Ashburton River and an associated road that directly links Chalmers Avenue through ‘green fields’ to the east of Tinwald to a connection with Grahams Road, Ashburton. The proposed new bridge and associated new road is collectively referred to herein as the Ashburton Second Urban Bridge project (ASUB) (see Figure 1-1). The ASUB will provide an alternative urban route between east Tinwald and Ashburton township. The distance of the ASUB is approximately 2 kilometres (km).

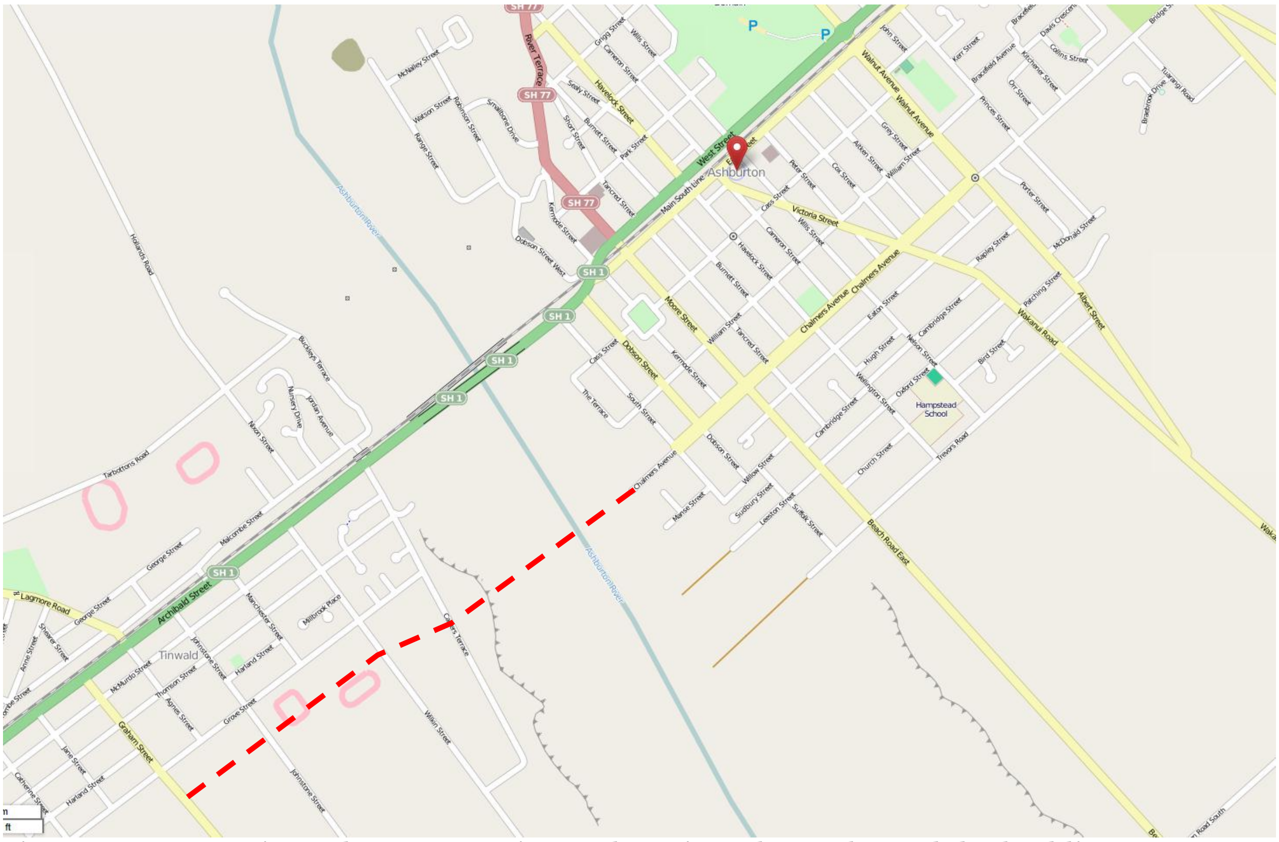

Figure 1-1: Overview Plan (approximate location shown by red dashed line)

The proposed ASUB project is only one of a number of related transport projects for the Ashburton urban area that was identified in the Ashburton Transportation Study (ATS) completed in 2006. The purpose of this study was to identify present and future transportation demands within the Ashburton study area for the 20 year period through to 2026, and to recommend measures to optimise the performance of the land transport system within Ashburton township. The proposed ASUB project is not being undertaken in isolation, but rather fits within an overall strategy for transport network improvements within the township.

ADC is seeking a new designation to include the entire infrastructure associated with the ASUB including a 2-lane bridge, traffic lanes (including cycle lanes and parking), footpaths / pedestrian connections, intersections, stormwater infrastructure, landscaping, ancillary road infrastructure (e.g.; services within the road corridor), and road construction.

The area through which the proposed designation runs is currently 'green fields', and comprises rural-residential allotments ranging in size from 4,820m² (0.4820ha) to 50,507m² (5.5070ha). The 2010 Ashburton District Plan review rezoned approximately 71.6ha of land located to the east of the current Tinwald urban boundary. 15.7ha has been rezoned to Residential C, which allows subdivision down to 360m² except where public sewage reticulation is not available, in which case 1,000m² is the minimum allotment size. 55.9ha has been rezoned to Residential D, which allows subdivision down to 4,000m² except where public sewage reticulation is not available, in which case the minimum allotment size is 10,000m² (1ha). The current Tinwald urban area is zoned Residential C.

Traffic modelling indicates that traffic volumes on key routes throughout Ashburton are likely to increase significantly by 2026 regardless of a second bridge. This is expected to result in significant congestion and delays at a number of locations, including the existing bridge and the intersection of SH1 with Moore Street (SH77).

Vehicle number plate surveys undertaken in 2006, and repeated again in 2012, confirm that the bulk of the traffic on the existing bridge during peak times is local traffic between Tinwald and Ashburton. Less than 30% of the traffic is "through traffic" on SH1. The existing state highway bridge is nearing capacity at present, but is still functioning adequately most of the time. ADC and the NZ Transport Agency (NZTA) have agreed that the traffic issue on the current bridge is primarily a local traffic issue and that the ASUB project will primarily be to serve the local traffic needs of the Tinwald and Ashburton communities. Once constructed, the ASUB will become an extension of the existing urban road network within east Tinwald and Ashburton township and will be maintained and controlled by ADC. It will not become the state highway.

Physical construction of the ASUB is not required until approximately 2026, at which time traffic congestion on the existing bridge is expected to reach a point which justifies the need for a second bridge. Traffic modelling indicates that up to 14,000 vehicles per day (vpd) are likely to use a second bridge by 2026, with between 5-10% expected to be heavy goods vehicles (HGV's). This traffic is likely to distribute amongst side roads to the north and south of the bridge and is expected to result in an overall reduction in total average travel time for all vehicles in the Ashburton urban area.

It is expected that by the time the ASUB project is required to be constructed, the environment within which the proposed designation is located will have undergone a degree of change from the current low density rural-residential land use to a land use that is in accordance with the new residential zonings within the district plan. ADC wishes to protect the route for a future bridge and associated new road before too much further development occurs. The designation for the ASUB is being sought now in order to secure the required land to ensure the project can proceed at the time that it is needed.

2 Ashburton Urban Stormwater Strategy (AUSS)

Ashburton District Council adopted the AUSS in 2009. This sets out, at a high level, the Council's future approach to managing stormwater in Ashburton. The strategy aims to manage stormwater systems in the Ashburton area to:

- Minimise flooding
- Protect receiving environments
- Meet legislative requirements
- Promote best practice solutions
- Achieve the aims of the AUSS whilst accommodating future growth and land development.

Following on from the AUSS, ADC is currently in the process of developing a Stormwater Management Plan (SMP) for Ashburton, including Fairton, Tinwald and areas identified in the District Plan for future development. The SMP will set out in greater detail how ADC will achieve the objectives of the AUSS and forms the basis of a global stormwater discharge consent which ADC will administer. The SMP will outline the requirements for stormwater design in order to obtain stormwater discharge consent from Council (via the global discharge consent ADC will hold) and to ensure future works meets the objectives of the AUSS.

Opus has been instrumental in the development of the AUSS and the SMP and therefore has a deep understanding of how it will affect the proposed second bridge crossing. The concept design outlined in this report has been developed with that knowledge in mind to ensure it will be in line with the aspirations of the AUSS and the expected requirements of the SMP and global discharge consent.

Any preliminary detailed design that follows on from this concept design will have to done in line with the requirements of the SMP. Note however that there is potential for the requirements of the SMP and global discharge consent to change as it goes through the ECan consenting process. The implications of any such changes (should they occur) and how they affect this concept will also need to be considered prior to any further design work.

3 Existing Catchment

3.1 Existing Stormwater Drainage

3.1.1 North Bank

Currently a large diameter stormwater main discharges into a drain along Chalmers Avenue which outfalls downstream through the Ashburton flood defence embankment via a culvert fitted with a flap gate. The pipe outfalls at the intersection of Chalmers Ave and South Street. Just upstream from this point is a debris interceptor, which is used to capture coarse solids from stormwater during low flow events.

3.1.2 South Bank

There is currently no formal stormwater network on the south bank. Urban stormwater upstream in Tinwald follows the kerb and channel South East until the roads (Wilkin Street; Carters Terrace; Johnston Street and Graham Street) enter rural land. The stormwater then continues down the roads via swales or drains that run parallel to the roads. Where the proposed second bridge alignment crosses Carters Terrace, Wilkins Road, Johnstone Street and Graham Street, there is potential for urban stormwater arriving at each intersection from urban areas upstream. At the Graham Street intersection there is also a stockwater race running down the southern side of the road.

Below Carters Terrace, within the Ashburton River flood plain, there is a drain that crosses under the proposed alignment running adjacent to the area of trees. This drain accepts a small amount of urban stormwater upstream, as well as rural run-off and groundwater, if sufficiently high.

The road alignment also crosses Carters Creek, which receives both rural and urban run-off, as well as spring flow from upstream. The creek discharges downstream into Lake Hood.

3.2 Ground Conditions

As well as the Ashburton River floodplain and riverbed, the road alignment crosses a variety of silty loam soils, parts of which are underlain by clays. These soils are imperfectly drained to poorly drained with terminal infiltration rates likely ranging from 1mm/hr to 7mm/hr. The depth-to-groundwater ranges between 1-3 metres on average, but during winter months may be significantly elevated.

The Tinwald section of the road alignment is expected to encounter seasonally high groundwater and experience poor infiltration during winter months in some areas, particularly in the vicinity of Carters Creek. For design purposes it has been assumed that infiltration alone cannot be relied on for sole disposal of stormwater, requiring discharge to Carters Creek and flood attenuation to mitigate downstream effects during low frequency rainfall events.

3.3 Topography

The existing topography along the proposed road alignment can be expressed as follows:

- Chalmers Ave from South Street falls gently towards the Ashburton River (though there is an existing high point in the road, a former flood defence embankment).

- The south bank river terrace (Carters Terrace) generally falls gently south west towards the Carters Creek (though there is a high point between Carters Terrace and Wilkin Street).
- The land from Grahams Road north east towards Carters Creek is generally flat with poorly defined topography.
- The land below Carters Terrace and Chalmers Ave forms part of the Ashburton River floodplain or the river channel itself, a braided gravel channel.

Figure 1 shows relief mapping of the greater area and the proposed road alignment based on Laser Interferometry Detection and Ranging (LiDAR) data held by ADC.

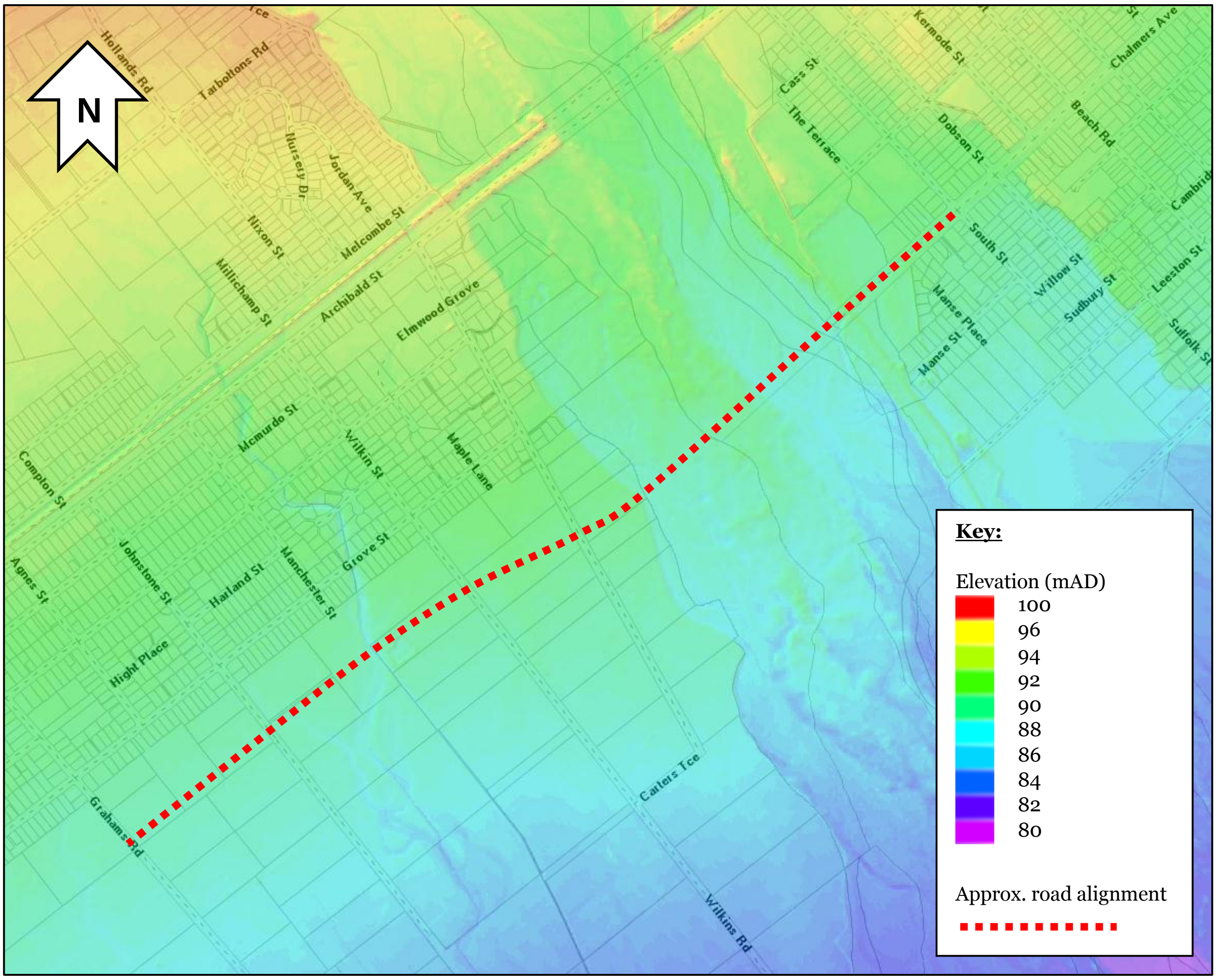

Figure 1 – Topographic relief map based on LiDAR data

3.4 Receiving Environment

Both the immediate North and South sides of the bridge will discharge to the Ashburton River, either directly or via the drain located within the southern flood plain. Further south west the receiving environment is Carters Creek, an existing road side drain or to ground via soakage.

4 Stormwater Issues

4.1 Existing Drainage Issues

4.1.1 North Bank

There are existing flooding issues known to occur at the Chalmers Ave intersection with South Street on the north bank of the bridge alignment. The flooding is due to insufficient pipe / catch-pit capacity following recent industrial / commercial development within the catchment. This is a known issue for the Council. Flooding at the intersection has been observed with the crest of the road being overtopped; the result being significant ponding upstream across the road.

4.1.2 South Bank

There is no known capacity or flooding issue on the South Bank, though ponding may occur at times due to the flat topography. Carters Creek is known have limited capacity through Tinwald, as it is constrained by the urban environment. Downstream of Tinwald we are not aware of any capacity issues on the Carters Creek, though we are aware of turbidity issues downstream at Lake Hood due to inflows from Carters Creek.

4.2 Constraints

4.2.1 Geotechnical

There are poorly drained soils and high ground water in the vicinity of the Carters Creek. The effect of high groundwater will need to be considered during the design of any stormwater system design for the proposed road alignment. It is assumed at this stage that soakage is not sufficient to deal with stormwater runoff alone, due to high winter groundwater levels and poor internal drainage. Therefore an overland flow-path needs to be provided to Carters Creek.

4.2.2 Ashburton River

The proposed bridge will have to cross over and tie into the existing ECan flood defences. It is critical that all stormwater infrastructure proposed considers flood risk from the Ashburton River and ensures that the ECan defences are not compromised. This includes installation of flap gates for any new pipes through the defences and pipe trenches being well designed to prevent water tracking back along the trench during a flood event.

4.2.3 Future Planning

The proposed stormwater system must allow for projected increases in rainfall, as well as any effects from further intensification or development of the catchment upstream, plus any future ADC stormwater projects that could overlap with the proposed bridge drainage and existing network.

The stormwater concept proposed has been sized to accommodate the road alone, assuming all upstream discharges are dealt with elsewhere and will not contribute to the road corridor during events of 2% AEP or less. Initially an alternative option to provide a communal system was considered, but it was ruled out due to the significant increase in land that would be required. This is in line with ADC's preferred approach for handling future development, where the developer is responsible for their own stormwater management (subject to following ADC guidelines), as opposed to ADC developing offsite communal stormwater systems.

4.2.4 Services

There is an existing sewer main crossing the existing drain on Chalmers Ave forming a restriction that can trap debris. The proposed road alignment and stormwater design will need to accommodate the sewer pipe which at this location has minimal cover.

The proposed northern end of the bridge as it currently stands would require partial piping of the Chalmers Ave drain.

Stormwater drainage at the southern end of the road will need to accommodate flows from the existing roadside swales, either collecting the upstream flows or passing them on downstream if they are not dealt with upstream of the road in the future.

5 Proposed Stormwater Concept

5.1 Stormwater Philosophy

- Accommodate or resolve existing ADC capacity issues where possible
- Provide effective treatment prior to discharge during high frequency events
- Aim to discharge to the Ashburton River or its flood plain wherever possible (to reduce discharge to Carters Creek)
- Utilise soakage wherever feasible
- Manage overland flow paths during the 2% AEP rainfall event (and lesser events).
- No flooding of the road corridor during a 10% AEP rainfall event
- Ensure good drainage during routine events to minimise wetting of the road sub-base.

5.2 Design Methodology

This report is only intended to outline the concept design; therefore no detailed hydraulic/hydrological analysis has been undertaken. However, calculations have been carried out to confirm the feasibility of the concept based on general design approaches (for example swale and soak-pits every 100m) and to provide greater confidence in the extent of land required. The approach in general has been conservative to ensure that the land extent recommended is such that it will not result in significant problems in the future.

The swales have been designed with a trapezoidal cross-section. The area of the swale that will be utilised for stormwater treatment / conveyance have been designed with 1:5 slopes. Above the water quality depth, the swales are then graded at 1:4 and can include a retaining wall (up to a maximum of 0.5m) on the road boundary (where the cut is greatest) to reduce land take. LiDAR data has been used to assess available fall and required swale grades.

5.2.1 Design Rainfall

ADC design rainfall was used plus a 16% allowance for projected climate change. This rainfall has been developed specifically for Ashburton based on local rainfall data and yields more conservative rainfall values compared to NIWA's HIRDS.

Though not yet formally adopted by ADC (it will be adopted as part of the SMP process), this rainfall has been used to ensure that in the future the stormwater design will be consistent with the SMP and ADC stormwater design guidance.

5.2.2 Assumptions

- Upstream areas of greenfield land or future development areas do not / will not contribute to the road alignment and its associated stormwater system. This assumption is considered reasonable as ADC's preference is for upstream development areas to manage their own stormwater discharges.

- The road pavement has been assumed to be 21m wide and 100% impervious. This is conservative, as the typical carriageway width (including footpaths) is likely to be 20.6m.
- Terminal infiltration rates for greenfield/pervious areas have been assumed to be 1.5mm/hr. This is based on LandCare Research soil parameters for the relevant soil class and supported by local knowledge of the area.
- Soak pits have been assumed to be ineffective during low frequency events due to elevated groundwater. This is considered a reasonable assumption as groundwater in Tinwald is known to be seasonally high following high depth winter rainfall events.
- Infiltration through swales adjacent to the road has been assumed to be a maximum of 10mm/hr. This is considered to be at the lower end of rates expected based on prior experience testing soil media infiltration rates, and ensures conservative design.
- 16% increase in rainfall has been included due to projected climate change. This is the value recommended by ECan for stormwater design and the ADC stormwater design guide (in development).
- Basin sizes are assumed to be 12% of the contributing catchment area. This is based on prior design experience and the proposed ADC stormwater design guide (in development).

5.3 Proposed Concept

5.3.1 North Side – Chalmers Ave. and South Street Intersection

In order to accommodate the proposed road alignment, the existing Chalmers Ave drain will need to be filled and replaced with pipework to maintain stormwater conveyance to the Ashburton River. The new pipeline should be sized to allow for future upgrades of the upstream network and with an aim to improve existing flooding issues at the intersection (if not resolved by the time of construction). This may require the upgrade of existing catch-pits serving the intersection.

The design will also need to consider the existing gross pollutant trap and its by-pass arrangement. Where the road narrows, a new drain is proposed to convey stormwater to save cost on pipework. A new outlet through the Ashburton flood defence embankment will be required to replace the existing one located under the proposed road embankment.

Stormwater from the bridge will fall back towards Chalmers Ave and discharge into a central swale (Figure 2). The central swale will need an area of **0.1 ha** to ensure there is enough capacity to cope with the runoff from the bridge and road surface. This area will be formed within the central median and, rather than be raised as the existing media on Chalmers Ave, it will be depressed. This will provide stormwater treatment of flows prior to discharge to the proposed pipework (replacing the Chalmers Ave Drain) via shallow low velocity flow through grass and an element of infiltration through a soil media. The outlets in the swale will be slightly raised so that most routine rainfall events can entirely infiltrate through the soil media. This will ensure a higher standard of treatment prior to discharge for minimal additional cost. The lowest areas of the swale most prone to water logging should be landscaped to aid maintenance and enhance treatment. Trees may also be planted within the swale.

Figure 2 – An example of an infiltration basin / swale located within a central median

5.3.2 South Side – Grahams Road to Carters Terrace

5.3.2.1 Carters Terrace to Ashburton River

Where the road crosses the Ashburton River flood plain, runoff from the road surface will be discharged below the terrace to an existing drain using roadside swales. It is recommended that **0.3 ha** of land be reserved for stormwater treatment along this section of the road corridor. A basin is not necessary as the swales and existing drains should adequately treat and discharge stormwater directly to the river. Preference is to discharge stormwater to the Ashburton River flood plain wherever feasible so it can discharge to land or the Ashburton River which is a less sensitive receiving environment compared to Carters Creek.

5.3.2.2 Carters Terrace to Carters Creek

Once the road reaches Carters Terrace, run-off will shed towards Carters Creek utilising road-side swales with periodic soak-pits to aid disposal (where ground conditions are found to be suitable through geo-technical testing). A continuous flow path via swales and pipework at intersections will be provided to Carters Creek (Figure 3). A basin will be provided at Carters Creek to attenuate flows from the road corridor during flood events. The basin will not be designed as a treatment system as run-off from routine events is not expected to reach the basin. It will only serve to hold back peak flows during low frequency events.

Figure 3 – Example of a road side swale adjacent to State Highway 1 in Tinwald

A catchment area of 27.4 ha is estimated to contribute to this section north of the proposed road (both existing and future growth areas). The swales have been designed to accommodate both the flow from this catchment area and road and convey it to Carters Creek. This section experiences the highest flow rates. To reduce the cross-sectional width of this swale, small retaining walls (up to 0.5m height) were included on the far-bank (edge of the road reserve) to reduce land requirements.

Above the design flow depth, the swale slope increased to 1:4 to further reduce swale widths. To accommodate only the road, two identically sized roadside swales (either side of the road) would be required. This option requires **0.8 ha** of land for swales and a further **0.3 ha** for an attenuation basin.

5.3.2.3 Johnstone Road to Carters Creek

Stormwater from Johnstone Road will follow swales back to Carters Creek in similar fashion to the Carters Terrace to Carters Creek section, utilising road-side swale and soak-pits (where ground conditions are suitable) with a flow path to Carters Creek.

Ensuring there is an adequate flow path to Carters Creek is essential should the soak-pit performance be compromised occasionally due to high groundwater. The attenuation basins adjacent to Carters Creek will be provided for such occasions when the capacity of the swales and soak-pits are exceeded, for example during a 2% AEP rainfall event.

A total of **0.3 ha** should be allocated for the swale network and a further **0.1 ha** for the basin.

5.3.2.4 Johnstone Road to Grahams Road

Through this section it is intended that runoff will be directed towards Grahams Road and then follow an existing roadside drain to the south east. Based on the LiDAR the swales will be particularly flat, having to drain at an estimated grade of 1:1200. Due to the flat grade of the swale, as much stormwater as is possible would be sent to ground, whilst still providing an overland flow path to the storage area adjacent to Grahams Road for low frequency events. The storage area would then in turn discharge to the existing drain on Grahams Road.

Two identically sized roadside swales with periodic soak-pits on either side of the road are proposed. This would require **0.4 ha** of land for to the swale network and a further **0.1 ha** for the attenuation basin prior to the existing roadside drain.

5.3.2.5 Summary

The areas required for stormwater management are summarised in Table 1 below:

Table 1 –Land area required for stormwater management for the new road surface

Section	Peak Discharge (l/s)	Swale Area (ha)	Basin Area (ha)	Total Area (ha)
Chalmers Ave to Ashburton River	86	0.1	N/A	0.1
Carters Terrace to Ashburton River	30	0.3	N/A	0.3
Carters Terrace to Carters Creek	71	0.8	0.3	1.1
Johnstone Road to Carters Creek	30	0.3	0.1	0.4
Johnstone Road to Grahams Road	40	0.4	0.1	0.5
Total Section	257	1.9	0.5	2.4

The maximum swale widths for each section are listed in Appendix 1. The swales from Carters Terrace to Carters Creek are further broken into subsections, as this component crosses over a couple of existing roads.

5.3.3 Basin Form

The proposed basins will act to manage flows during low frequency rainfall events and serve predominantly to attenuate flows discharging to the receiving environment to mitigate any downstream increase in flood risk or increased channel erosion. During routine rainfall events they will receive only small amounts of water and will generally be dry.

These areas can, therefore, be treated more as amenity space that is infrequently flooded following significant rainfall events. They can be formed and landscaped as required by ADC to provide amenity space, so long as the required attenuation volume can be achieved.

6 Land Requirements

Sufficient land will be required to accommodate the proposed swales on the south side of the bridge, as well as an area of land adjacent to the Carters Creek (both sides) to manage run-off during low frequency events. Retaining walls, up to 0.5m height, have been allowed for to minimise land take for the swales required.

Attenuation basins are proposed on both banks of Carters Creek resulting in land required on both sides. If ADC want to combine the two basins into a single basin to reduce the number of affects property owners, an inverted siphon would be required under Carters Creek. In our view inverted siphons should be avoid wherever possible due to the associated maintenance risks.

On the north side of the bridge, sufficient space needs to be allowed to accommodate the proposed drain. The wide central median will be used for stormwater treatment negating the need for any additional space at this location.

Areas of land required for attenuation and conveyance are shown in the appended drawings (Appendix 2).

7 Assessment of Effects

7.1.1 Contamination of Groundwater / Surface Water

The proposed road is intended to provide an alternative route for Ashburton locals to using State Highway 1. The proposed road is therefore not creating a new source of contaminants (when looking at the bigger picture), but simply moving some from an existing location (though there will be future increases in traffic).

The discharge of stormwater from a road has the potential for an adverse effect on groundwater and surface water through the discharge of contaminants commonly found in road runoff.

The proposed stormwater system will provide a high standard of stormwater treatment prior to discharge, and overall, the effect is considered beneficial, as currently stormwater contaminants from the State Highway are receiving very little, if any, stormwater treatment prior to discharge.

Infiltration to ground via swale inverts is the preferred stormwater treatment approach, as filtration through topsoil media ensures excellent removal of contaminants (particularly Total Suspended Solids (TSS), hydrocarbons and metals), achieves a better standard of treatment than sedimentation alone, and better mimics a natural flow regime by reducing frequency of discharge to waterways. Road side swales will also trap a hydrocarbon spill at source in the soil lining. This approach greatly reduces the frequency of stormwater discharge to waterways; this alone significantly mitigates downstream effects regardless of treatment efficiency.

The swale topsoil media will be targeted to treatment of TSS, hydrocarbons and metals. TSS and particulate matter will be removed via sedimentation and filtration. The use of a 200-300mm fine soil media with a target infiltration rate of 150mm/hr or less will ensure excellent TSS removal. Similarly, this will also ensure excellent removal of metals and hydrocarbons. Disposal via infiltration to ground (for routine rainfall events) will also mitigate thermal pollution issues in receiving watercourses.

The treatment of the stormwater discharge via roadside swales is expected to have a less than minor effect on groundwater or surface water quality.

7.1.2 Flooding / Erosion

The uncontrolled discharge of stormwater can have an adverse effect on downstream flood risks, on erosion of riverbeds / banks due to the velocity of the discharge, and the potential for flooding adjacent properties.

7.1.2.1 Carters Creek

Preference has been given to reducing the frequency of discharge to Carters Creek in line with the SMP, as this watercourse is considered more sensitive than the Ashburton River to urban stormwater discharges. Attenuation of flows to Carters Creek has also been proposed to avoid exacerbating existing flood flows and channel erosion.

The use of infiltration through grassed swales and periodic soak-pits will prevent discharge to Carters Creek from all but the most significant rainfall events or during times of exceptionally high groundwater.

The aim would be to capture the full Water Quality (WQ) event (defined as 18mm for Ashburton) within the swales for infiltration to ground. Events exceeding this depth would then flow via the swales to periodic soak-pits for disposal to ground, or to the proposed attenuation basins, if the capacity of the soak-pits is exceeded or groundwater is exceptionally high.

The use of vegetated swales will ensure any flow conveyed to Carters Creek will do so at a low velocity to enable coarse suspended solids to settle out prior to being attenuated in the basins proposed.

7.1.2.2 Adjacent Properties

The proposed stormwater concept has been designed to ensure sufficient land is set aside to ensure flood events are contained within the attenuation basins and swales without adversely affecting adjacent properties through overland flows.

7.1.2.3 Ashburton River

The proposed discharge of stormwater to the Ashburton River represents a tiny proportion of the overall storm flows in the Ashburton River catchment. The Ashburton River catchment is a significantly different catchment to the local environment around Carters Creek. There is less potential for peak flows within the Ashburton River to coincide with stormwater discharges from the proposed road. The proposed discharge of stormwater to the Ashburton River is unlikely to affect channel erosion or peak flood flows within the river due to small proportion of stormwater that will be discharged into the Ashburton River. Discharge to the river floodplain will also be attenuated via the proposed swale, which will encourage disposal to ground prior to reaching the floodplain.

The effect of the proposed discharge on the Ashburton River flood levels and / or on erosion within the riverbed is expected to be less than minor.

7.1.3 Resource Consent for Stormwater Discharge

Consent to discharge stormwater from the proposed second bridge crossing and associated road is expected to be done under the Ashburton global stormwater discharge consent. It is expected that ADC will lodge with ECan the application for the global consent by early 2014 at the latest. This consent application will contain an Assessment of Effects on the Environment (AEE).

Under the ADC global stormwater discharge consent, new stormwater discharges into the ADC stormwater network will be required to comply with the intentions of the SMP and the conditions of the global resource consent. Non-compliance with the SMP and / or the global resource consent would require any new stormwater discharge to be consented separately by ECan.

The proposed concept design for stormwater discharge outlined in this report is expected to be in keeping with the intentions of the SMP and the conditions of the global consent, namely limiting discharge to greenfield (or less) to mitigate downstream flood impacts or increased channel erosion, and treatment of the Water Quality event via either attenuation (sedimentation) or discharge to ground (sedimentation and filtration).

The aquatic health of Carters Creek is expected to be a key indicator of the SMP's effectiveness through periodic ecological surveys and sediment quality sampling. The disposal of routine stormwater events to ground will help protect the Carters Creek.

The Ashburton global stormwater discharge consent is expected to be operative for a number of years prior to the proposed ASUB project being constructed. Therefore the detailed design of the proposed stormwater system for the ASUB project will be undertaken in accordance with the requirements of the SMP and the global resource consent conditions.

7.1.4 Recommended Conditions

No conditions are proposed, as the stormwater discharge is expected to be designed and approved under the future Ashburton global stormwater discharge consent.

8 Conclusions

The land required for stormwater treatment of the proposed road and bridge alignment is comprised of:

- Swale networks to convoy, infiltrate and treat stormwater during high frequency events
- Soak-pits to provide stormwater disposal during higher frequency events (once the WQ event is exceeded)
- Attenuations basins to attenuate flow during low frequency events (2% AEP)

Swales can be constructed at flatter grades than pipework without consequence and therefore enable gravity discharge to Carters Creek. Swales do, however, require additional land, but also achieve additional objectives through providing stormwater treatment, attenuation and visual amenity.

Attenuation basins are proposed, as soakage alone may not be sufficient for total disposal of stormwater run-off. The basins proposed will provide flood attenuation during low frequency events to mitigate any downstream increase in flood risk or channel erosion. The basins can be landscaped and treated as amenity space, given they would flood infrequently following only significant rainfall events.

A total of **2.4 ha** of land is required for the road alignment, if runoff from the road surface alone is collected.

The health of the receiving environments will be a key metric used to benchmark the performance of the SMP. Hence where there is scope through this project to enhance Carters Creek, it should be taken advantage off. Improving both aquatic and terrestrial health / diversity will improve the receiving environment and aids the Council to meet the long terms objectives of the SMP.

Appendix 1 – Swale and Basin Design

Data for the swale and basin design for runoff from the new road surface is shown in Table 3 below:

	Section	Peak Discharge (l/s)	Swale Length (m)	Max Swale Width (m)	Swale Area (ha)	Total Swale Area (ha)	Basin Area (ha)	Total Area (ha)
Option 1	Chalmers Avenue to Ashburton River	86	160	7.7	0.12	0.12	N/A	0.12
	Floodplain to Ashburton River	30	300	5.4	0.16	0.32	N/A	0.32
	Floodplain to Carters Terrace	17	170	5.3	0.09	0.18	N/A	0.18
	Carters Terrace to Wilkins Road	45	280	5.6	0.16	0.31	N/A	0.31
	Wilkins Road to Carters Creek	71	250	5.7	0.14	0.28	0.25	0.53
	Johnstone Road to Carters Creek	30	300	5.4	0.16	0.32	0.11	0.43
	Johnstone Road to Grahams Road	40	400	4.9	0.19	0.39	0.14	0.53

Table 2 –Baseline investigation

Appendix 2 – Land Requirements

Refer to the Land Requirement Plans contained in Volume B

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