

Options Analysis Summary Report

The table below summarises all the options that have been investigated between 2010 and 2016 and refers the reader to the technical report for further details. Figure 1 below provides a schematic showing the various options investigated. Options 1 to 11 are discussed in the technical reports referred to. Option 12 and 13 are not contained in any of the design reports and is discussed further in Appendix A.

Appendix A compares the proposed preferred option to two alternative options that did not pass through the private property at 9 Astley Avenue (Option 12 and 13). As these two options were discounted early on in the design process, these options do not appear in any design reports. However, the information contained in Appendix A summarises the considerations that were undertaken at that time and reasons why they were discounted initially.

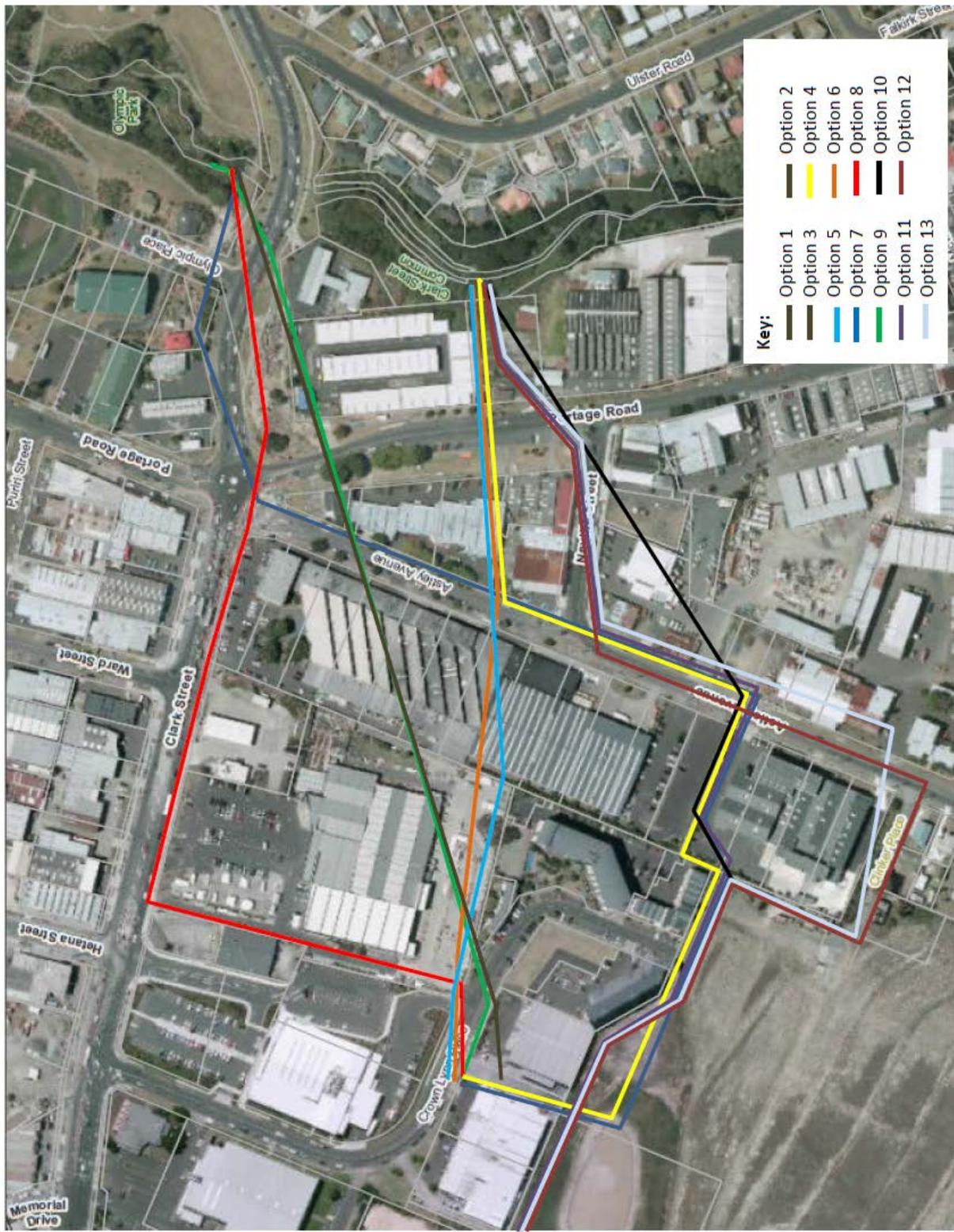


Figure 1 – Pipe Alignments Considered during Options Analysis

Option Description	Advantages	Disadvantages	Fatal Flaw/Reason for Discounting	Refer to Reference for details
<p>Option 1 – Pump and Gravity Discharge.</p> <p>Option consists of both gravity flow and pumped flow to drain the pond during the 10-Year ARI storm event.</p> <p>Included rehabilitating the existing 375 mm diameter pipe by re-lining within the existing tunnel with two pumps to boost the amount of outflow from the pond during events greater than the 2 year ARI.</p> <p>Option assumes that there is an existing 100-Year overland flow path from Crown Lynn Place to Clark St.</p> <p>Pond would be contained within the 5000 m² area allocated for it at the northern end of the park.</p>	<p>Easy to install</p>	<p>Uses existing tunnel and risk of tunnel failure/collapse is high</p> <p>High operation and maintenance cost</p> <p>Risk of pump failure during storm events</p>	<p>The privately owned timber shored tunnel which houses the existing 375 mm diameter pipe was hand dug in the mid 1920's and is between 12-15 m deep. Sections of the tunnel are known to have collapsed and the 375mm pipe is reported by the asset owner to be fully blocked now. It is recommended that this tunnel is decommissioned to resolve settlement issues. Auckland Council is working with the owners to abandon this asset.</p> <p>Any construction utilising this tunnel was discounted as the overall construction risk is high and retains the risk of tunnel collapse.</p>	<p>Synergine (Sept 2010)</p> <p>Option 1 – Pump and Gravity Discharge.</p>

<p>Option 2 – New 630 mm OD Gravity System</p> <p>Option consisted of a gravity stormwater solution for the 10-Year ARI, which requires replacing the existing 375 diameter vitclay pipe line with a new 630 OD (550 ID) PE stormwater line.</p> <p>New pipeline installed via pipe bursting of the existing 375 mm pipe within the tunnel to service the 10 year ARI event.</p> <p>Option assumes that there is an existing 100-Year overland flow path from Crown Lynn Place to Clark St</p> <p>Pond would be contained within the 5000 m² area allocated for it at the northern end of the park.</p>	<p>Does not require pumping during large storms</p>	<p>Risky construction process as during the construction of the Huhtumaki building (Clark St, New Lynn) in the late 1950's, the 90 m section of tunnel which crosses underneath the site began collapsing.</p> <p>As part of the remediation works, a 1050 mm diameter concrete stormwater pipe was jacked through the tunnel over this length to fill the tunnel void and prevent any further collapses in this section of tunnel.</p>	<p>The privately owned timber shored tunnel which houses the existing 375 mm diameter pipe was hand dug in the mid 1920's and is between 12-15 m deep. Sections of the tunnel are known to have collapsed and the 375mm pipe is reported by the asset owner to be fully blocked now. It is recommended that this tunnel is decommissioned to resolve settlement issues. Auckland Council is working with the owners to abandon this asset.</p> <p>Any construction utilising this tunnel was discounted as the overall construction risk is high and retains the risk of tunnel collapse.</p> <p>It may not be possible to burst through the section of pipe underneath the Huhtumaki building if the 1050mm diameter pipe is found too close to the existing 375mm pipe.</p>	<p>Synergine (Sept 2010)</p> <p>Option 2 – New 630 mm OD Gravity System</p>
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<p>Option 3 – New 1050 mm diameter gravity system</p> <p>Option consisted of a total gravity solution for the 100-Year ARI event and utilises a new 1050 diameter stormwater pipeline from the detention pond to Whau Creek.</p> <p>New pipeline installed via pipe jacking through the existing tunnel.</p> <p>Assumes that there is no 100-Year overland flow path available.</p> <p>Pond would be contained within the 5000 m² area allocated for it at the northern end of the park.</p>	<p>Does not require pumping during large storms.</p> <p>Reduces load on the under capacity stormwater systems in Crown Lynn Place and Clark St.</p> <p>Decreases the amount of overland flow along the Clark/Puriri overland flow path, reducing the risk of flooding in these areas.</p>	<p>Uses existing tunnel and risk of tunnel failure/collapse is high</p>	<p>The privately owned timber shored tunnel which houses the existing 375 mm diameter pipe was hand dug in the mid 1920's and is between 12-15 m deep. Sections of the tunnel are known to have collapsed and the 375mm pipe is reported by the asset owner to be fully blocked now. It is recommended that this tunnel is decommissioned to resolve settlement issues. Auckland Council is working with the owners to abandon this asset.</p> <p>Any construction utilising this tunnel was discounted as the overall construction risk is high and retains the risk of tunnel collapse.</p>	<p>Synergine (Sept 2010, Nov 2010)</p>
<p>Option 4 - Auckland Council</p> <p>Pipeline alignment through 9 Astley Avenue, along Astley Avenue and 44C Portage Road to Avondale Stream</p>	<p>This alignment does not utilise the existing privately owned timber shored tunnel alignment</p>	<p>Pipe alignment under an existing building</p> <p>Passes through 4 private properties</p> <p>Part of the proposed pipe would be beneath future buildings at 10 to 18 Astley Avenue</p>	<p>Part of the alignment passes beneath buildings. There is no geotechnical data under buildings which increases the risk of striking an unknown obstruction. If tunnelling equipment strikes an obstruction, it is inaccessible and extremely difficult to retrieve machinery.</p>	<p>GHD (April 2015)</p>

<p>Option 5 - Auckland Council</p> <p>Pipeline alignment through Placemakers, Mitre10 Mega and 44C Portage Road to Avondale Stream (similar to Option 6 below)</p>	<p>This alignment does not utilise the existing privately owned timber shored tunnel alignment</p>	<p>Pipe alignment under existing buildings</p> <p>Passes through 4 private properties</p>	<p>An area of significant fill between 13 Crown Lynn Place and Mitre 10 Mega made this alignment unsuitable and was refined to the final preferred option presented by GHD (Option 10). The fill is up to 10 m in depth, potentially contaminated, contains large basalt blocks, brick remnants and general fill and it was determined this material is generally unsuitable for tunnelling or trenching without removal and replacement of the fill material.</p> <p>Part of the alignment passes beneath buildings. There is no geotechnical data under buildings which increases the risk of striking an unknown obstruction. If tunnelling equipment strikes an obstruction, it is inaccessible and extremely difficult to retrieve machinery.</p>	<p>GHD (April 2015)</p>
<p>Option 6 – A new route beneath Placemakers, Mitre10 Mega and 44C Portage Road to Avondale Stream.</p>	<p>This alignment does not utilise the existing privately owned timber shored tunnel alignment</p> <p>Hydraulically efficient</p>	<p>Pipe alignment under existing buildings</p> <p>Passes through 4 private properties</p>	<p>An area of significant fill between 13 Crown Lynn Place and Mitre 10 Mega made this alignment unsuitable and was refined to the final preferred option presented by GHD (Option 10). The fill is up to 10 m in depth, potentially contaminated, contains large basalt blocks, brick remnants and general fill and it was determined this material is generally unsuitable for tunnelling or trenching without removal and replacement of the fill material.</p> <p>Part of the alignment passes beneath buildings. There is no geotechnical data under buildings which increases the risk of striking an unknown obstruction. If tunnelling equipment strikes an obstruction, it is inaccessible and extremely difficult to retrieve machinery.</p>	<p>GHD (April 2015)</p>

<p>Option 7 – Pipeline alignment through 9 Astley Avenue, along Astley Avenue, Clark Street to the Wolverton Street culverts.</p>	<p>Hydraulically efficient Passes through only 1 private property</p>	<p>Number of deep shafts Overall length and consequently cost and time to construct Significant existing services on Clark St</p>	<p>Significant existing services on Clark St (600mm West Lynn Branch sewer diversion, 750mm New Lynn Main Sewer, 1300mm Huia watermain)</p>	<p>GHD (April 2015)</p>
<p>Option 8 – Pipeline through existing easement between Clinker Place and Clark Street then new pipeline down Clark Street to the Wolverton Street culverts.</p>	<p>Alignment avoids existing buildings Passes through only 1 private property</p>	<p>Hydraulically inefficient alignment and consequently larger pipeline required Crosses a number of significant services on Clark St</p>	<p>Not considered further due to issues with levels and services crossings Significant fill between 13 Crown Lynn Place and Mitre 10 Mega (see details above) made the first pipe section unsuitable.</p>	<p>GHD (April 2015)</p>
<p>Option 9 – Online replacement of existing tunnel to discharge at the Wolverton Street culverts.</p>			<p>Privately owned timber shored tunnel needs to be abandoned – refer to details above. It is recommended that this tunnel is decommissioned to resolve settlement issues. Auckland Council is working with the owners to abandon this asset. Any construction utilising this tunnel was discounted as the overall construction risk is high and retains the risk of tunnel collapse.</p>	<p>GHD (April 2015)</p>

Option 10 - GHD Preferred Option		Passes through 3 private properties	This alignment was revised to avoid going diagonally beneath future buildings planned at 10 to 18 Astley Avenue.	GHD (April 2015)
Option 11 - AC Preferred Option	The GHD Preferred Option was revised to avoid going diagonally beneath future buildings planned at 10 to 18 Astley Avenue. Further reasons summarised in option comparison (Appendix A)			AC (July 2016) Options Analysis Summary Report (February 2017, Appendix A)
Option 12 – Alternative option (road) Option disregarded early in the design process. Pipe alignment that followed the boundary of 1 – 9 Astley Avenue, along Clinker Place, and then along Astley Avenue		A longer length of pipeline will increase the overall cost of the project, reduce the gradient of the pipeline and therefore reduce the operational efficiency.		Refer to details in the Appendix (Option Comparison) Options Analysis Summary Report (February 2017, Appendix A)

<p>Option 13 - Alternative option (private property)</p> <p>Option disregarded early in the design process</p> <p>Pipe alignment that followed the boundary of 1 – 9 Astley Avenue, along Clinker Place, and then within the private property boundary of 34 – 40 Astley Ave</p>		<p>A longer length of pipeline will increase the overall cost of the project, reduce the gradient of the pipeline and therefore reduce the operational efficiency.</p>	<p>Refer to details in the Appendix (Option Comparison)</p> <p>AC Options Summary (February 2017, Appendix A)</p>
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Appendix A - Option Comparison

During the very early stages of the design process an alignment that followed the boundary of 9 Astley Avenue, along Clinker Place, and then along Astley Avenue was evaluated and then disregarded. As this occurred very early on in the design process, these options do not appear in any design reports. However, the table below summarises the consideration that was undertaken at that time. The table below refers to the current proposed option and two alternative options which are shown as Option 12 and Option 13 in Figure 1.

	Current proposed option	Alternative option (road)	Alternative option (private property)	Impact
	Option 11	Option 12	Option 13	
Pipeline length	673m at a gradient of 0.6%	Approx. 780m at a gradient of 0.54%	Approx. 780m at a gradient of 0.54%	A longer length of pipeline will increase the overall cost of the project. While cost estimates for this option have not been thoroughly evaluated, installation of an additional 110m of pipeline alone would cost \$600K based on the rates used for the preliminary design estimate. Additionally the increase in length would reduce the gradient of the pipeline. This would reduce the operational efficiency, and increase the maintenance costs of the pipeline. Potentially the reduction in gradient may have required an increase in the pipe diameter to provide sufficient capacity in the pipe, however this was never calculated.
Service diversions required	36m of Watercare 1300mm diameter water main	218m (min) of Watercare 1300mm diameter water main	36m of Watercare 1300mm diameter water main	All options require the relaying of the water main directly above where the tunnel passes. Alternative option (road) would require the full length of the water main adjacent to the pipeline to be relayed due to the risk of the tunnelling works damaging the water main. This is unlikely to be viable as it would require a

			Chorus Fibre optic cable between junction boxes		lengthy shut down of the water main which Watercare would not permit (shut down limited to 3 days). Furthermore the temporary shafts for this option may require relocating the water main, for which there is insufficient space in the carriageway. Division of the fibre optic cable must be undertaken between junction boxes and Chorus quoted that the smallest diversion would cost in the order of \$1 million. The service diversion / relocation for this option make it not viable. Note that other services that would also have to be managed are not evaluated or discussed here.
Traffic Disruption to Astley Avenue	Approx. 25 weeks of reduction to single lane	Full closure of Astley Avenue between Hill Crescent and Neville Street for approx. 27 weeks		Approx. 27 weeks of reduction to single lane	Due to the size of the shafts required, alternative option (road) can only be constructed if a full road closure is put in place. The shafts would need to be open for approximately 6 months, which would restrict all traffic access to the properties along this section of Astley Avenue – an unacceptable level of disruption to the surrounding business. Auckland Transport has indicated that a full road closure over a prolonged period would not be acceptable. Both of the other options will require a single lane closure for 25-27 weeks however access to all properties will be maintained and hence disruption significantly less.
Land access required (where the pipe passes through)	9 Astley Avenue 10-20 Astley Avenue	10-20 Astley Avenue 44c Portage Road		9 Astley Avenue 32 – 40 Astley Ave 10-20 Astley	Alternative option (road) has the lowest land access impact. Alternative option (private property) would pass (as tunnel) through the south eastern corner of 9 Astley Avenue, and then require a large shaft to be constructed in the access way of 34 – 40 Astley Ave (Whitecliffes) and maintained there for a period of 5 months. From this shaft the tunnel would then have had to pass beneath existing buildings along that side of Astley

	44c Portage Road		Avenue 44c Portage Road	Avenue. The closure of Whitcliffes access was evaluated as excessively disruptive and tunnelling beneath existing buildings carries a much higher level of risk than tunnelling under open ground. Due to these factors this alignment was viewed as not viable.
Duration for construction of full pipeline	57 weeks	66 weeks	66 weeks	The programme for the alternative options was never developed, however on a pro rata basis the addition of 110m of pipeline would increase the project duration by 9 weeks.
Overall project cost estimate	\$10.4M	\$13.8M	\$12.1M	A detailed cost estimate has not been carried out on the alternative alignments. However the turnout cost of the project would be expected to increase. The alternative option (road) includes costs for the service diversion / relocation and compensation that would be required. Alternative option (private property) includes for an increase in the injurious affection and building repair required for the works within the property. Both alternative options include for an increase in the overall pipe length and project duration. These costs are estimates and have not been compiled to the same level of accuracy as those for the current proposed option, however they are sufficiently accurate for early concept identification purposes.

References

Synergine. (2010). Crown Lynn Precinct Infrastructure Design - Design Report. Auckland: prepared by Synergine for Waitakere City Council.

Synergine. (2010). Crown Lynn Precinct Infrastructure Design – Resource Consent Drawings. Auckland: prepared by Synergine for Waitakere City Council.

Synergine. (2010). Crown Lynn Precinct Infrastructure Design - Overland Flowpath Report - Design Report. Auckland: prepared by Synergine for Waitakere City Council.

GHD (2015). Clinker Place SHA Stormwater Pipeline – Scheme Design Report (Draft for Information). Auckland: prepared by GHD for Auckland Council.

Auckland Council (2016). Clinker Place SHA New Stormwater Pipeline – Preliminary Design Report. Auckland: prepared by Healthy Waters Design Office for Auckland Council.