

Central Interceptor Main Project Works – Comparative assessment of proposed Lyon Avenue site and MAGS Alternative sites

Proposed Lyon Avenue Site Drawing Number AEE-MAIN-3.2 Issue D	MAGS Alternative 1 - Pipe Jacked Drawing Number LYON-SK1001 Issue C	MAGS Alternative 2 – Trenched Drawing Number LYON-SK1101 Issue C
LAND OWNERSHIP		
Crown (Ministry of Education) Multiple unit owners (St Lukes Garden Apartments (SLGA)), St Lukes Holdings Ltd	Crown (Ministry of Education) Multiple unit owners (St Lukes Garden Apartments (SLGA)), St Lukes Holdings Ltd	Crown (Ministry of Education) Multiple unit owners (St Lukes Garden Apartments (SLGA)), St Lukes Holdings Ltd
DESIGN CONSIDERATIONS		
Optimal location for connection of Edendale Branch Sewer to main Central Interceptor tunnel. Least physical works and design required to achieve objective.	Additional intermediate drop structure required at Lyon Avenue overflow (connection of Edendale Branch Sewer) results in more complex hydraulics design and additional safety considerations (additional confined space operation). As the site location in MAGS is known to flood, the shaft lids would need to be raised by approximately 1 metre and / or made watertight. Should the lids be raised, the surrounding land area could be raised to tie in with the lid levels and prevent pooling of water at that location. Consideration would need to be given to prevent diversion of water exacerbating flooding in other areas of the playing fields.	Additional connection chamber required at Lyon Avenue overflow (connection of Edendale Branch Sewer) results in additional design considerations, such as deep trench design, access bridge design, flow diversion and upstream and downstream effects on Meola Creek. As the site location in MAGS is known to flood, the shaft lids would need to be raised by approximately 1 metre and / or made watertight. Should the lids be raised, the surrounding land area could be raised to tie with the raised lid and prevent pooling of water at that location. Consideration would need to be given to prevent diversion of water causing flooding in other areas of the playing fields.
CONSTRUCTION CONSIDERATIONS		
<u>Approximate construction site area</u>	<u>Approximate construction site area</u>	<u>Approximate construction site area</u>
4050m ²	4105m ²	5020m ² Significantly larger construction site area due to trenching activities, construction access across Meola Creek, flow diversion and silt control measures.
<u>Geotechnical conditions at site</u>	<u>Geotechnical conditions at site</u>	<u>Geotechnical conditions at site</u>
Main drop shaft location – presence of basalt requiring blasting or rock breaking for excavation.	Main drop shaft location – basalt is absent resulting in less complex excavation methodology. Intermediate drop shaft location – presence of basalt requiring blasting or rock breaking for excavation. Pipe jacking has to set at about 12 metres below ground level, under the basalt layer.	Main drop shaft location – basalt is absent resulting in less complex excavation methodology. Connection chamber location – presence of basalt requiring blasting or rock breaking for excavation. The trench is located in basalt east of Meola Creek which would also require blasting or rock breaking until it crosses Meola Creek.
<u>Construction site layout</u>	<u>Construction site layout</u>	<u>Construction site layout</u>
Connection of Edendale Branch Sewer via diversion chamber and drop shaft to main Central Interceptor tunnel. Shafts constructed at 9 metres diameter, finished at 7 metres diameter. Work is contained within one site.	Connection of Edendale Branch Sewer via diversion chamber and intermediate drop shaft east of Meola Creek, and pipe jacking under Meola Creek to main drop shaft in MAGS. Access shaft to main Central Interceptor tunnel approximately 8 metres in diameter. Shafts constructed at 8.5 metres diameter, finished at 7 metres diameter. Work is divided into two sites:	Connection of Edendale Branch Sewer via diversion chamber and connection chamber east of Meola Creek, and trenching across Meola Creek to main drop shaft in MAGS. Access shaft to main Central Interceptor tunnel approximately 8 metres in diameter. Shafts constructed at 8.5 metres diameter, finished at 7 metres diameter. Work is contained within one extended site. Trenching across Meola Creek would require associated stream diversion. Potential trench depth of up to 5 to 8 metres, requiring shoring or batters. Trench depth is close to limits for this construction method resulting in heightened safety concerns. Access between Lyon Avenue and MAGS would require temporary (or permanent) bridge over Meola Creek.

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<u>Construction access</u>	<u>Construction access</u>	<u>Construction access</u>
Construction access via Morning Star Place. As this is an existing residential road, no additional construction works required to provide access to proposed construction site.	Two separate construction access routes, some additional safety controls required. Construction access via Morning Star Place to construction area east of Meola Creek and via Alberton Avenue and MAGS Gate 1 to construction area west of Meola Creek. Existing MAGS access road via Gate 1 would need to be widened in part using gabions or timber pole walls on the stream banks, with associated tree removals, and resurfaced.	Construction access via Alberton Avenue and MAGS Gate 1 to construction area east of Meola Creek and via access road and bridge across Meola Creek to construction area in Crown and SLGA land west of Meola Creek. Existing MAGS access road via Gate 1 would need to be widened in part using gabions or timber pole walls on the stream banks, with associated tree removals, and resurfaced. Access bridge over Meola Creek would need to be substantial to accommodate construction trucks and heavy machinery and designed to not impede flood flows.
OPERATIONAL CONSIDERATIONS		
<u>Permanent access</u>	<u>Permanent access</u>	<u>Permanent access</u>
Permanent access via Morning Star Place.	Permanent access via Morning Star Place to permanent facilities east of Meola Creek and via Alberton Avenue and MAGS Gate 1 to permanent facilities west of Meola Creek.	Permanent access via Morning Star Place to permanent facilities east of Meola Creek and via Alberton Avenue and MAGS Gate 1 to permanent facilities west of Meola Creek. OR If temporary construction bridge is retained for permanent use, permanent access could be solely via Morning Star Place or solely via MAGS. Retention of the temporary construction bridge for permanent use has not been assessed further as the bridge and associated access road would result in significant additional long term impact on the Crown land, MAGS activities, and Roy Clements Treeway.
Permanent access required to diversion chamber and other facilities in SLGA land (within existing Watercare easement area). All weather trafficable access also required in area of Roy Clements Treeway (Crown land) for occasional inspection and maintenance activities. Easement would need to be established to secure access in Crown land.	Permanent access required to diversion chamber and other facilities in SLGA land (within existing Watercare easement area). All weather trafficable access also required in area of Roy Clements Treeway (Crown land) for occasional inspection and maintenance activities; area required is much less than for Watercare's proposed Lyon Avenue site. Permanent all-weather trafficable access required via MAGS and north of cricket nets to drop shaft and tunnel access shaft for occasional inspection and maintenance activities. Easement would need to be established to secure access in Crown land.	Permanent access required to diversion chamber and other facilities in SLGA land (within existing Watercare easement area). All weather trafficable access also required in area of Roy Clements Treeway (Crown land) for occasional inspection and maintenance activities; area required is much less than for Watercare's proposed Lyon Avenue site. Permanent all-weather trafficable access required via MAGS and north of cricket nets to drop shaft and tunnel access shaft for occasional inspection and maintenance activities. Easement would need to be established to provide access in Crown land.
<u>Operations and maintenance</u>	<u>Operations and maintenance</u>	<u>Operations and maintenance</u>
Connection of Lyon Avenue overflow enters main drop shaft close to ground level and is readily inspected from the surface.	Additional structure (intermediate drop shaft) at Lyon Avenue overflow requires additional maintenance access facilities. Connecting pipeline from intermediate drop shaft enters the main drop shaft at depth adding further complexity for inspection and maintenance. Longer length of access road would increase potential road maintenance requirements.	Additional structure (connection chamber) at Lyon Avenue overflow requires additional maintenance access facilities. Connecting pipeline between connection chamber and the main drop shaft requires further maintenance. Longer length of access road would increase potential road maintenance requirements.

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COSTS		
<u>Cost comparison relative to Lyon Avenue site</u>	<u>Cost comparison relative to Lyon Avenue site</u>	<u>Cost comparison relative to Lyon Avenue site</u>
N/A	Additional costs of around \$1.12M associated with construction site activities. Main tunnel length shortened by approximately 65 metres with potential cost reduction of \$1.17M. Overall cost neutral. Note that this excludes costs associated with securing property access rights.	Additional costs of around \$895,000 associated with construction site activities. Main tunnel length shortened by approximately 65 metres with potential cost reduction of \$1.17M. Overall, potential cost reduction of approximately \$275,000 compared to proposed Lyon Avenue site. Note that this excludes costs associated with securing property access rights.
POTENTIAL EFFECTS		
Land use effects	Land use effects	Land use effects
<u>Residential activities:</u>	<u>Residential activities:</u>	<u>Residential activities:</u>
<p>Limited separation from residential neighbours (approximately 15 metres to closest), with associated noise and vibration construction effects and loss of amenity.</p> <p>Construction access via Morning Star Place passes through residential area, with associated noise effects from heavy vehicles. Traffic management measures to be implemented to minimise potential effects on pedestrian access and safety.</p> <p>Permanent access requirements would have little effect on residential activity at SLGA as the normal access requirements would be infrequent (around one vehicle per month) and via an established residential access road.</p>	<p>Limited separation from residential neighbours (approximately 15 metres to closest) at the diversion chamber and intermediate drop shaft, with associated noise and vibration construction effects and loss of amenity. Construction of the main drop shaft and access shaft in MAGS would occur further away from SLGA apartments but nearer to residential townhouses at 17 Lyon Avenue (located approximately 50m north of the construction area, across Meola Creek).</p> <p>Construction access road passes immediately adjacent to the dormitories of the MAGS School House boarding hostel ("School House"). At some points, the access is only a couple of metres or less from the buildings. Potential for adverse noise effects if no acoustic barrier (fence) is implemented. Depending on the location and nature of fencing and traffic management, the construction access has the potential to impact on pedestrian safety and on access to and parking at School House. As the heavy vehicle traffic volumes for this option would be slightly less than for the trenched option (which involves access only via MAGS), the potential effects on School House would be slightly less, but not significantly so as the same issues of pedestrian safety, noise and access would apply.</p> <p>Permanent access requirements would have little effect on residential activity at School House as the normal access requirements would be infrequent (around one vehicle per month) and via the school access road. Security arrangements for access through the school and locked fence gates would need to be agreed with MAGS.</p>	<p>Limited separation from residential neighbours (approximately 15 metres to closest) at the diversion chamber and connection chamber, with associated noise and vibration construction effects and loss of amenity. Construction of the main drop shaft and access shaft in MAGS would occur further away from SLGA apartments but nearer to residential townhouses at 17 Lyon Avenue (located approximately 50m north of the construction area, across Meola Creek).</p> <p>Construction access road passes immediately adjacent to the dormitories of the School House boarding hostel ("School House"). At some points, the access is only a couple of metres from the buildings. Potential for adverse noise effects if no acoustic barrier (fence) is implemented. Depending on the location and nature of fencing and traffic management, the construction access has the potential to impact on pedestrian safety and on access to and parking at School House.</p> <p>Permanent access requirements would have little effect on residential activity at School House as the normal access requirements would be infrequent (around one vehicle per month) and via the school access road. Security arrangements for access through the school and locked fence gates would need to be agreed with MAGS.</p>
<u>School activities:</u>	<u>School activities:</u>	<u>School activities:</u>
No adverse effects on school activities as the construction site is located east of Meola Creek in an area that is not used for school activities.	Construction access via MAGS Gate 1 would conflict with existing use of access road for school activities including access to School House, playing fields and sports pavilion. Potential effects on residential activities at School House are noted above. Construction area adjacent to cricket nets would impact on use of playing fields for summer and winter sports and training activities.	Construction access via MAGS Gate 1 would conflict with existing use of access road for school activities including access to School House, playing fields and sports pavilion. Potential effects on residential activities at School House are noted above. Construction area adjacent to cricket nets would impact on use of playing fields for summer and winter sports and training activities. The construction impacts of this option would be greater than the pipe-jack option due to the additional land requirements for trenching activities and access.

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No impact on school activities arising from permanent works.	Shaft lids and permanent all-weather access road would remain at the site. Permanent works could be designed to minimise impacts on school playing fields (e.g. surfacing and ground levels to tie in with surrounding land, but noting need to consider consequential effects of overland stormwater flows in other areas). Main impact is that no buildings could be constructed in the area of the shafts and access road, potentially affecting future school development options.	Shaft lids and permanent all-weather access road would remain at the site. Permanent works could be designed to minimise impacts on school playing fields (e.g. surfacing and ground levels to tie in with surrounding land, but noting need to consider consequential effects of overland stormwater flows in other areas). Main impact is that no buildings could be constructed in the area of the shafts and access road, potentially affecting future school development options. Building development on land above the connection pipe may also be restricted depending on final depth.
<u>Recreational activities:</u>	<u>Recreational activities:</u>	<u>Recreational activities:</u>
Local effect on recreation and amenity values during construction due to proximity of works to public walkway and need for temporary diversion of the walkway between the Roy Clements Treeway and SLGA and the St Lukes commercial centre.	Local effect on recreation and amenity values during construction due to proximity of works to public walkway. Effects on school recreational activities noted above.	Local effect on recreation and amenity values during construction due to proximity of works to public walkway and temporary closure of the boardwalk along Meola Creek during construction works. Effects on school recreational activities noted above.
Traffic effects	Traffic effects	Traffic effects
<u>Traffic:</u>	<u>Traffic:</u>	<u>Traffic:</u>
Morning Star Place represents good option for traffic and pedestrian safety during construction. Additional construction traffic would be well within capacity of Morning Star Place and St Lukes Road.	Morning Star Place represents good option for traffic and pedestrian safety during construction. Additional construction traffic would be well within capacity of Morning Star Place and St Lukes Road. This option would result in lower construction traffic volumes on Morning Star Place compared to the proposed Lyon Avenue site (less than half). Construction access via MAGS would require operating restrictions and associated traffic management measures to avoid peak school hours and minimise adverse traffic and pedestrian safety effects of construction traffic on Alberton Avenue. Additional construction traffic is well within capacity of Alberton Avenue. Construction access via MAGS would conflict with school activities - including parking and access for School House, service access to the sports pavilion and maintenance access to the playing fields.	No traffic effects on Morning Star Place if all construction access is via MAGS. Construction access via MAGS would require operating restrictions and associated traffic management measures to avoid peak school hours and minimise adverse traffic and pedestrian safety effects of construction traffic on Alberton Avenue. Additional construction traffic is well within capacity of Alberton Avenue. Construction access via MAGS would conflict with school activities - including parking and access for School House, service access to the sports pavilion and maintenance access to the playing fields.
<u>Parking:</u>	<u>Parking:</u>	<u>Parking:</u>
Temporary loss of 22 visitor car parks at the western end of Morning Star Place during construction. This is anticipated in existing resource consents for SLGA.	Temporary loss of 22 visitor car parks at the western end of Morning Star Place during construction. This is anticipated in existing resource consents for SLGA. Construction access road via MAGS Gate 1 would conflict with access to parking areas at School House. If construction access is fenced with acoustic barrier to mitigate potential noise effects, access to informal parking areas around the dormitories would be lost for the duration of the construction works.	Temporary loss of 22 visitor car parks at the western end of Morning Star Place during construction. This is anticipated in existing resource consents for SLGA. Construction access road via MAGS Gate 1 would conflict with access to parking areas at School House. If construction access is fenced with acoustic barrier to mitigate potential noise effects, access to informal parking areas around the dormitories would be lost for the duration of the construction works.

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Effects on pedestrians	Effects on pedestrians	Effects on pedestrians
Access via existing boardwalk along Meola Creek would be maintained during construction. A temporary pedestrian access to the south of the construction area would be established to provide access between the Roy Clements Treeway and St Lukes commercial area.	Access via existing boardwalk along Meola Creek and access to the south of the construction area (and east of Meola Creek) would be maintained during construction. Existing pedestrian access via MAGS access road to School House and to rear of sports pavilion would be affected during construction. Pedestrian management measures or alternative pedestrian access would need to be established.	Access via existing boardwalk along Meola Creek would require closure during construction due to access road and temporary bridge and trenching activities. Alternative pedestrian route around the site could be long. Existing pedestrian access via MAGS access road to School House and to rear of sports pavilion would be affected during construction. Pedestrian management measures or alternative pedestrian access would need to be established.
Effects on vegetation and ecology	Effects on vegetation and ecology	Effects on vegetation and ecology
Much of the vegetation within the proposed designation area would require removal. This includes 107 individual trees of varying types, size and age. Wider Roy Clements Treeway area is identified as an area of ecological significance in draft Unitary Plan. Construction site is assessed as being of moderate ecological value by project ecologist. Reduction in value associated with vegetation removal, but noting reinstatement landscaping and ecological mitigation plantings proposed to offset effect.	Requires the removal of around 46 individual trees and an area of approximately 240m ² of generally low quality mixed native vegetation. Work required to establish construction access through MAGS may also impact on adjacent trees. Wider Roy Clements Treeway area is identified as an area of ecological significance in draft Unitary Plan. This area extends across Meola Creek, to include riparian vegetation on left bank of stream. Vegetated part of construction site is assessed as being of moderate ecological value by ecologist. Open area of MAGS field would hold little ecological value. Reduction in value associated with vegetation removal, but noting reinstatement landscaping and ecological mitigation plantings could be undertaken to offset effect.	Requires the removal of around 54 individual trees and an area of approximately 240m ² of generally low quality mixed native vegetation. Work required to establish construction access through MAGS may also impact on adjacent trees. Wider Roy Clements Treeway area is identified as an area of ecological significance in draft Unitary Plan. This area extends across Meola Creek, to include riparian vegetation on left bank of stream. Vegetated part of construction site is assessed as being of moderate ecological value by ecologist. Open area of MAGS field would hold little ecological value. Trenching works would affect greater area of riparian vegetation compared to pipe jacked option. Reduction in value associated with vegetation removal, but noting reinstatement landscaping and ecological mitigation plantings could be undertaken to offset effect.
Effects on landscape	Effects on landscape	Effects on landscape
Removal of mature vegetation, construction site screening and construction activities would have more than minor effects on visual amenity and landscape character of Roy Clements Treeway. Mitigation of effects on-site would be required through design and landscape plantings, but this would take time to achieve.	Works required for construction of shafts and access roads both west and east of Meola Creek would require removal of mature vegetation. These works, along with construction site screening would have more than minor effects on existing visual amenity and landscape character. Mitigation of effects would be required through design and landscape plantings on both sides of Meola Creek, but this would take time to achieve. The overall area of vegetation affected is less than for the proposed Lyon Avenue site.	Works required for construction of shafts and access roads both west and east of Meola Creek and trenching across Meola Creek would require removal of mature vegetation. These works, along with construction site screening would have more than minor effects on existing visual amenity and landscape character. Mitigation of effects would be required through design and landscape plantings on both sides of Meola Creek, but this would take time to achieve. The overall area of vegetation affected is less than for the proposed Lyon Avenue site.
Effects on Meola Creek	Effects on Meola Creek	Effects on Meola Creek
Minor potential for effects associated with surface construction works. Erosion and sediment control measures would be established on site to minimise potential for discharge of sediment laden water to Meola Creek during construction.	Minor potential for effects associated with surface construction works. Erosion and sediment control measures would be established on site to minimise potential for discharge of sediment laden water to Meola Creek during construction.	Minor potential for effects associated with surface construction works. Erosion and sediment control measures would be established on site to minimise potential for discharge of sediment laden water to Meola Creek during construction. Effects on Meola Creek during trenching works with temporary stream diversion required, and associated risks with flood events. Temporary access bridge over Meola Creek would need to be designed so that it does not impede flood flows or result in erosion around bridge footings.

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Cultural heritage effects	Cultural heritage effects	Cultural heritage effects
Site in modified area with no recorded archaeological evidence.	Site in modified area with no recorded archaeological evidence.	Site in modified area with no recorded archaeological evidence.
Noise effects	Noise effects	Noise effects
<p>Works would generally comply with construction noise standards at adjacent apartments, except for period during excavations through basalt and during shaft construction, and would require management measures.</p> <p>Construction access via Morning Star Place would generate additional noise from heavy vehicles. This aspect of the work is expected to comply with the construction noise standards.</p>	<p>Works would generally comply with construction noise standards at adjacent apartments, except for period during excavations through basalt and during shaft construction. Would not be significantly different to effects of proposed Lyon Avenue site, due to works required for intermediate drop shaft and to make connections. From a noise perspective, the MAGS Alternative - pipe jacked option is preferred over the trenched option.</p> <p>Construction access road via MAGS Gate 1 would generate noise effects from heavy vehicles. A two metre high acoustic barrier would be required to achieve acceptable noise levels at School House. The design and location of this would need to take into account requirements for access to and amenity of the dormitories of School House.</p>	<p>Works would generally comply with construction noise standards at adjacent apartments, except for period during excavations through basalt for trench and connection chamber construction. Rock breaking for trenching works would extend duration of noisy site activities compared to proposed Lyon Avenue site, due to works required for connection chamber and to make connections.</p> <p>Construction access road via MAGS Gate 1 would generate noise effects from heavy vehicles. A two metre high acoustic barrier would be required to achieve acceptable noise levels at School House. The design and location of this would need to take into account requirements for access to and amenity of the dormitories at School House.</p>
Vibration effects	Vibration effects	Vibration effects
Excavation in basalt, either by mechanical rock breaker or blasting, would result in some short term disturbance at adjacent SLGA apartments.	Excavation in basalt, either by mechanical rock breaker or blasting, would result in some short term disturbance at adjacent SLGA apartments. Would not be significantly different to effects of the proposed Lyon Avenue site due to works required for construction of intermediate drop shaft.	Excavation in basalt, either by mechanical rock breaker or blasting, would result in some short term disturbance at adjacent SLGA apartments. Would not be significantly different to effects of the proposed Lyon Avenue site due to works required for construction of connection chamber and trenching through basalt on the eastern side of Meola Creek.
Groundwater and settlement effects	Groundwater and settlement effects	Groundwater and settlement effects
<p>Not expected to cause adverse effects on adjacent buildings or structures.</p> <p>The differential movements between building pads of SLGA are estimated to be less than 5mm, equivalent to a distortion of less than 1:3000; well below the commonly applied limit of 1:2000 and highly unlikely to be noticeable or cause anything other than minor cosmetic effects, even at the more sensitive parts of the building.</p> <p>The estimated settlement levels would be within the limits of the proposed consent conditions, but would trigger other requirements of the consent conditions relating to building condition surveys, analysis, monitoring, implementation of trigger levels and contingency planning.</p>	<p>Not expected to cause adverse effects on adjacent buildings or structures.</p> <p>The main drop shaft and access shaft on the MAGS playing fields are far enough away from the SLGA buildings so as to cause no settlement risk to SLGA buildings. Similarly construction of the diversion chamber and trenching between the diversion chamber and intermediate drop shaft are relatively shallow and will have no significant impacts on the deeper groundwater or cause settlement to the SLGA buildings.</p> <p>Because the intermediate drop shaft will need to extend below the basalt it will draw down groundwater in the Puketoka Formation. The potential settlement effects of constructing an intermediate drop shaft near the existing Lyon Avenue overflow for the pipe jacked option will be similar to the effects of shaft construction for the proposed Lyon Avenue site. The effects of this drop structure on the Block B and Block C areas will be similar to the proposed Lyon Avenue site; i.e. negligible.</p>	<p>Not expected to cause adverse effects on adjacent buildings or structures.</p> <p>The main drop shaft and access shaft on the MAGS playing fields are far enough away from the SLGA buildings so as to cause no settlement risk to SLGA buildings. Similarly construction of the diversion chamber and trenching between the diversion chamber and connection chamber are relatively shallow and will have no significant impacts on the deeper groundwater or cause settlement to the SLGA buildings.</p>