NDRRA Additional Drainage and Slope Remediation

Minhman Nguyen

MAY 2019
01
Introduction
Pilbeam Drive (5km) is the sole thoroughfare road to the Fraser Park Lookout on Mount Archer, Rockhampton.

At 604 m above sea level, Mount Archer is the highest peak and provides spectacular views of the city and the surrounding ranges.

There are approximately 40 residential properties on Mount Archer.

An average number of 100 people visit Mount Archer daily.
Tropical Cyclone Debbie

- In 2017, Tropical Cyclone Debbie caused widespread damage to the Capricorn region.
- Heavy rainfall and the prevalence of geological discontinuities on Mount Archer, caused landslips/rock falls to occur along Pilbeam Drive.
- The rainfall also resulted in pavement failures.
NDRRA Restoration Programs are joint Commonwealth/State funded programs that provide financial assistance to affected Councils for the recovery of assets that have been severely affected by a disaster event.

Cardno was to effectively monitor and manage the budget.

Road must be re-opened to public by 31st May 2019.

<table>
<thead>
<tr>
<th></th>
<th>APPROVED</th>
<th>CURRENT CONTRACT VALUE</th>
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<tbody>
<tr>
<td>REPA</td>
<td>$770,000.00</td>
<td>$1,840,000.00</td>
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<tr>
<td>Betterment</td>
<td>$1,410,000.00</td>
<td>$1,850,000.00</td>
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<tr>
<td>RRC Contribution</td>
<td>$472,000.00</td>
<td>$472,000.00</td>
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<tr>
<td>RRC Complimentary Works</td>
<td>$205,000.00</td>
<td>$205,000.00</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$2,652,000.00</strong></td>
<td><strong>$4,367,000.00</strong></td>
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02

Slope Stabilization
Damage Assessment

- Cardno undertook an initial assessment and identified 18 affected slips.
- Cardno submitted request for funding based off an indicative cost of treatment.
- Once approval amount finalized - Geotechnical engineers were engaged to assess the risk levels of the slips and also recommend a treatment for each slip.
- Report generated with ARL’s.
Contract Awarding

- Cardno were engaged to provide designs for the slips and drainage works.
- Contractor appointed based on all sites to be shotcrete with 0.5m nails.
- The contract was awarded to JRT. Cardno undertook preconstruction scoping with JRT.
Descaling / Issues

- Descaling was the first construction works carried out on the slips.
- This helped determine the exact sizes of the slips and appropriate treatment for each.
- Geotechnical engineers were engaged again to allocate appropriate treatments for the slips.

Issues

- Slip Treatments in Tender vs Onsite
- Original shotcrete treatment no longer feasible
- Majority sites increased in area
- Descaling nominal depth increased
- Proposed treatment would blow the budget – ARL to from report to be prioritized
Descaling Examples
Treatments

- Treatments identified include the following;
- Greenax mesh with hydromulch.
- Tecco mesh with shotcrete.
- Tecco mesh with fibrecrete.
- Tecco mesh only
- Hydromulch only
Greenax Mesh With Hydromulch (Site 123)

- Greenax mesh is typically appropriate for clay / soil faces where promotion of vegetation growth is suitable.
- Soil nails are required to be installed prior to the Greenax mesh installation to improve stabilization – Min 1.5m nails
- Hydromulch is required to be sprayed over the Greenax as it provides the mesh with a layer of fire protection.
Pre-construction and Construction Examples

Original slip

Descaling works

Greenax mesh installation

Hydromulch spraying
Post-construction examples

- Greenax only installed
- Greenax with hydromulch
Tecco Mesh with Shotcrete (Site 98)

- Tecco mesh is typically appropriate for slips with rocky surfaces. It acts as a fence netting by stopping chunks of rocks falling onto the road.
- Soil nails are required to be installed prior to the Tecco mesh installation to improve stabilization – Min 1.5m nails
- To act as scour protection in future events, shotcrete was used in areas of concentrated water flow.
Pre-construction and Construction Examples

Original slip

Descaling works

Concentrated water flow

Shotcrete works
Post-construction Examples

Tecco mesh installed

Shotcrete
Tecco Mesh With Fibrecrete (Site 74)

- Fibrecrete was sprayed on this slip due to the nature of the slip. The slip is made up of layers of rocks.
- Fibrecrete acts as a reinforcement to the slip making it safer to drill holes without collapsing or endangering the workers – 50mm thick
- Tecco mesh was then installed over the fibrecrete and nails ranged from 1.5m – 6m until competent ground was encountered.
- Slip was prioritized to start treatment ASAP once descale exposed the type of rock. Managing the budget on this was crucial in determining what Council had left.
Pre-construction and Construction Examples

Original slip

Descaling works

Fibrecrete works

Tecco mesh installation
Post-construction Example

Lat: -23.343784
Long: 150.582528
Facing: North-East
Tecco Mesh Only (Site 22)

- Typical rocky surface for Tecco Mesh to be used.
Pre-construction and Construction Examples

Original slip

Descaling works

Holes drilling

Soil nail installation
Post-construction Examples

Lat: 23.350133
Long: 150.575271
Facing: North-East

Lat: 23.34589
Long: 150.56569
Facing: South
Hydromulch Only (Site 105)

- Due to few slips blowing out in cost – Removal of works had to be made.
- Call was made to cull the remaining Greenax treatment and substitute with Connect Timber Hydromulch treatment after laying back face.
- Connect Timber Hydromulch act an erosion control mechanism and vegetative reinforcement.
Pre-construction and Construction Examples

Original slip

Descaling works

Hydromulch application
Post-construction Example
03

Drainage Works
Site Assessment

- It was identified during scoping – 3km longitudinal concrete drains to be installed as part of Betterment
- Few types of drains had to be determined site by site basis
Longitudinal Concrete Channels

Three types of concrete channels were selected to be constructed, namely:

- 1.2m wide flat bottom drain
- Type 28 - 1m wide vee drain
- Type 1 - Barrier kerb & channel
1.2m Wide Flat Bottom Drain (Site 139)

- Match existing
Pre-construction and Post-construction Examples
This type of concrete channel was selected - water drains off easily from the slips.

Also, it allows for the existing road which is narrow to be widened.

Additional funds was provided by RRC for the road widening.
Pre-construction and post-construction examples

Pre-construction

Post-construction
This type of concrete channel was selected - matches the existing channel.

Also, it allows for the existing road which is narrow to be widened whilst allowing room for a future shared path.
Pre-construction and Post-construction examples
ISSUE - Asbestos Water Main

- During the trenching of the longitudinal drains at the saddle, asbestos water mains were encountered.
- Fitzroy River Water engaged Cardno and JRT to design and construct new 1.2km HDPE water main while construction was happening.
- Cardno was engaged by FRW to manage the project together with the NDRRA project – Additional $350,000 of FRW work.
- Programme was to remain the same with road to be opened 31st May.
Pre-construction and Construction Examples

Pre-construction

Construction
04

Conclusion
Conclusion

- Summary of challenges encountered:
  LANDSLIPS
  - Initial pick ups were done through visual without geo investigation
  - Budget for NDRRA works was severely underestimated for that reason
  - Contractor won work based off price for all slips to be shotcrete with 0.5m nails
  - Several slips blew the budget on predicted due to redrilling and nature of exposed rock

- FRW 1.2km watermains to be added to program:
- Increased Council complimentary works of different kerb types / road widening. Also additional longitudinal drains to connect between existing.
- With all additional work – Program was to remain the same and road to be opened by 31st May
Conclusion

Final Summary

- Good relationship with JRT
- Good relationship with RRC
- Maintained clear communication both with client and contractor to enable the project was successful.
- Reliable Cardno team – Special thanks to:
  - Scott Yarrow (Inspector),
  - Lord Appiah-Mensah (Site Engineer),
  - Chris Hegarty (Senior Engineer / Principal)
- Road set to open to public on 31st May, however minor road patches to be managed through localized Traffic Control until Mid June 2019.
- Stuck with the budget, my prioritizing all rockfall slips to have a treatment (Higher ARL), the remainder have either Greenax or Hydromulch due to soil surface.
# Key Personnel - Cardno

<table>
<thead>
<tr>
<th>Cardno Key Staff</th>
<th>Role</th>
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<tbody>
<tr>
<td>Steven McMillan</td>
<td>Project Manager - Natural Disaster Relief And Recovery</td>
</tr>
<tr>
<td>Minhman Nguyen</td>
<td>Project Engineer</td>
</tr>
<tr>
<td>Scott Yarrow</td>
<td>Site Inspector</td>
</tr>
<tr>
<td>Lord Appiah-Mensah</td>
<td>Graduate Civil Engineer</td>
</tr>
<tr>
<td>James Wong</td>
<td>Civil Engineer</td>
</tr>
<tr>
<td>Pramod Thakur</td>
<td>Senior Geotechnical Engineer</td>
</tr>
<tr>
<td>Poka Kilaverave</td>
<td>Geotechnical Engineer</td>
</tr>
<tr>
<td>Christopher Hegarty</td>
<td>Senior Civil Engineer</td>
</tr>
<tr>
<td>Gerry Moore</td>
<td>Senior Civil Designer</td>
</tr>
<tr>
<td>Trudie Bradbury</td>
<td>Principal Engineering Geologist</td>
</tr>
<tr>
<td>Andrew Williams</td>
<td>Senior Principal Engineering Geologist</td>
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<tr>
<td>Adele Willett</td>
<td>Drafter</td>
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## Key Personnel – RRC & JRT

<table>
<thead>
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<th>Rockhampton Regional Council Key Staff</th>
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<tbody>
<tr>
<td>David Bremert</td>
<td>Civil Works Manager - Civil Operations</td>
</tr>
<tr>
<td>Ruwan Weerakoon</td>
<td>Project Manager - NDRRA Reconstruction</td>
</tr>
<tr>
<td>Michael O’Keeffe</td>
<td>Manager - Rockhampton Regional Waste and Recycling</td>
</tr>
<tr>
<td>Corrie Claassen</td>
<td>Civil Works Manager - Civil Operations</td>
</tr>
<tr>
<td>Andrew Collins</td>
<td>Manager Project Delivery - Regional Services</td>
</tr>
<tr>
<td>Karyn Beck</td>
<td>Commercial Accounting Supervisor - Finance</td>
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<table>
<thead>
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<th>JRT Key Staff</th>
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<tr>
<td>James Gallagher</td>
<td>General Manager</td>
</tr>
<tr>
<td>Brenden Cooper</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Steve May</td>
<td>Site Supervisor</td>
</tr>
<tr>
<td>Rodney Wust</td>
<td>Site Engineer</td>
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Safety is a core value at Cardno and our Zero Harm safety program fosters an environment of clear accountability, shared responsibility, risk awareness and effective communication. Our program underpins all operations and is responsive to the needs of our clients. We are focused on continually improving our safety culture and the management systems that reinforce our commitment to zero harm. Cardno operates an occupational health and safety management system that has been certified to AS4801 and OHSAS18001.
THANK YOU

For more information:
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www.cardno.com