10 The preferred option

10.1 Description of the recommended preferred option

The preliminary concept design for the recommended preferred option is shown in **Figure 10-1** and **Figure 10-2**.

Option 7b is considered an upgrade to the existing highway, utilising as much of the existing pavement as possible. This option was developed to provide a minimalist treatment of straightening out the substandard bends in the steepest part of the highway.

The option has a cross section consisting of one 3.5 metre wide northbound lane and one 3.5 metre wide southbound lane with 2.0 metre wide shoulders on either side. A shoulder width of 2.0 metres is considered the minimum acceptable width to allow a maintenance truck to safely park beside the traffic lanes.

The key features of this option are:

- Option 7b is 1635 metres long
- It has grades up to 8.1 per cent in order to shorten the length required for upgrade
- The length and height of the retaining walls required for the upgrade are reduced by narrowing the shoulders to 2.0 metres. The rock face next to the shoulder in the southbound lane is softened by casting a single sided Type F concrete barrier against the rock face
- The carriageway cross section and straightened alignment are achieved by a combination of:
  - simple widening of the existing carriageway to the west in fill to provide the required shoulder widths
  - retaining walls of up to three metres high to keep the fill out of the creek line
  - cantilevered concrete structures on concrete piles where retaining walls would be too high
  - a major bridge up to 360 metres long which is required to keep the road out of the creek line
  - cutting into the rock face where the angled rock face beside the road is flattening out, requiring only minor cut
  - filling over the existing highway alignment
- An emergency stopping bay is provided adjacent to the southbound (uphill) lane approximately 500 metres south of the northern end of the upgrade.
- The section of road replaced by the proposed bridge between approximately station 500 metres and approximately station 950 metres (refer to **Figure 10-1**) will be abandoned and the existing pavement demolished. This section of road has a substandard alignment and is subject to rock falls.

10.2 Traffic and transportation issues

10.2.1 Road safety strategy

A key objective of this project is to improve road safety. The recommended preferred option improves road safety by smoothing hazardous horizontal curves and widening the road shoulders, improving safety through better visibility, resulting in less risk of accidents.

The horizontal alignment of the recommended preferred option is good, providing a 100 kilometres per hour alignment. However, the existing steep grades would remain, with a maximum grade of 8.1 per cent. The potential for higher speeds on the relatively steep downgrades in the northbound direction will be managed by limiting truck speed to 80 kilometres per hour. The different speeds for light and heavy vehicles will not present a safety issue given the low traffic volumes.

The rock face next to the shoulder in the southbound lane is softened by casting a single sided Type F concrete barrier against the rock face, helping to reduce damage to errant vehicles.

An emergency stopping bay is provided adjacent to the southbound (uphill) lane.

10.2.2 Road safety audit

A pre-construction – strategic phase audit was carried out on the recommended preferred option.

Issues raised in the audit will be investigated during concept design.

A copy of the audit report is included in **Appendix M**.

10.2.3 Traffic and transport efficiency

The current alignment has an 80 kilometres per hour speed limit, with trucks limited to 60 kilometres per hour on the steep downhill (northbound) section of the highway.

The recommended preferred option improves road transport productivity, efficiency and reliability of travel by providing a 100 kilometres per hour alignment, although trucks will be limited to 80 kilometres per hour downhill as noted in **Section 10.2.1**.

10.3 Engineering issues

10.3.1 Ground conditions

Widening of the existing road corridor will be required. Sections of fill and cut earthworks will be required.

The existing New England Highway cuttings are on the side of the hill and expose both distinctly weathered granite and slightly weathered to fresh, very high strength granite. Excavation by heavy ripping should be possible within the weathered zone. Within fresh rock, blasting is expected to be required.

Loose boulders or outcrops on the steep slopes above the existing highway may be destabilised by undercutting or vibration during excavation of adjacent cuttings.

Excavation for bridge piers within slightly weathered-fresh granite or rhyodacite will be extremely difficult and likely penetration depths will be minimal.

10.3.2 Flooding and drainage

Upgrading of existing transverse drainage pipes may be necessary. New transverse drainage pipes may also be required. There are no anticipated impacts on the conveyance of flows up to the 100 year ARI event and the design will achieve a 100 year ARI flood immunity.

10.3.3 Public utilities

There are no public utilities affected by the recommended preferred option.

10.3.4 Earthworks

Widening of the existing road corridor will require sections of cut and fill earthworks. The recommended preferred option will require the importation of fill as the amount of cut has been minimised due to the possibility of very hard rock.

It is expected that a large proportion of excavated material could be used as rockfill. Crushing and screening of excavated materials will be required to produce suitable rockfill.

Rockfill batters may be preferred to reduce the footprint of the proposed embankments.

10.3.5 Structures

The recommended preferred option requires a 360 metre long bridge. Sections of cantilevered roadway supported on concrete piles are proposed at either end of the bridge to eliminate the need for high and expensive retaining walls. The alignment should suit standard bridge design and construction methods, however, excavation for piers and piles may be extremely difficult if very high strength rock is encountered.

The proposed alignment limits the height of retaining walls to 3.0 metres and allows the walls to be constructed from the existing highway rather than having to access the wall foundations from below the highway.

10.3.6 Constructability

As the recommended preferred option consists predominantly of widening the existing highway, constructability becomes a major factor to be considered in the next stages of design and during construction. Construction will require the closure of one lane of the highway throughout the construction period, with traffic controlled by traffic signals. Some construction activities will require the temporary closure of the highway for periods up to 20 minutes.

10.4 Statutory planning and land-use

10.4.1 Planning and legislation

The recommended preferred option is expected to have minimal impact on regional and local development and is consistent with local and state planning policies.

10.4.2 Land-use and property impacts

Widening will be required for the construction of the recommended preferred option, but impacts of property acquisition will be minimised generally by widening to the west of the existing highway where the adjacent land is designated either road reserve or crown land.

Acquisition of a small area of private land may be required where the highway is widened to the east.

10.5 Environmental issues

10.5.1 Hydrology and water quality

Impacts on water quality in the operational phase are not expected to differ significantly from those currently occurring in relation to the existing road. Some existing drainage structures may require augmentation to achieve flood immunity, however, there are no major waterway crossings required for the recommended preferred option.

During construction, there is potential for erosion from exposed surfaces cleared of vegetation, and this would result in declines in water quality and sedimentation of watercourses. This would require management via the implementation of appropriate erosion and sediment controls during construction.

10.5.2 Terrestrial biodiversity

In the operational phase, terrestrial flora and fauna may potentially be impacted by:

- Direct impacts, including mortality through vehicle strike or vegetation clearing/loss of habitat
- Indirect impacts, including edge effects (eg reduced habitat value along a road edge) and/or barrier effects (eg isolating habitat or restricting movement).

The impact of vehicle strikes on local fauna is not likely to be significantly different to that currently occurring, noting that there are opportunities through the design process to manage fauna passage. Options include fauna exclusion fencing, overpasses and/or underpasses. Based on observations made during the fauna surveys (**Section 5.2.3.3**) the following species or groups would benefit from a combined fauna passage/exclusion fencing approach:

- Macropods and other dispersive terrestrial fauna (ie Spotted-tailed Quoll)
- Arboreal mammals (ie possums and gliders).

During the construction phase, there are a range of potential impacts that would need to be considered further during the environmental impact assessment and appropriate management and mitigation measures developed.

The potential impacts on terrestrial biodiversity associated with Option 7b are considered less than those associated with the other options. A more comprehensive overview of potential impacts associated with the option and the type of mitigation measures that could be considered is provided in Cardno (2013a; **Appendix D**).

10.5.3 Aquatic biodiversity

As discussed in **Section 10.5.1**, no major waterway crossings are proposed under the preferred option and operational phase impacts on water quality are not expected to differ significantly. Hence, the potential operational phase impacts on aquatic biodiversity and fish passage are not expected to be significantly different from the existing condition. Two culverts will require augmentation, and there may be opportunities to improve fish passage through these structures by considering 'fish friendly' features in the design of these crossings.

The key potential construction phase impacts on aquatic biodiversity relate to management of water quality impacts, and erosion and sediment control in particular.

The potential impacts on aquatic biodiversity associated with Option 7b are considered less than those associated with the other options. A more comprehensive overview of potential impacts on aquatic biodiversity associated with the option and the type of mitigation measures that could be considered is provided in Cardno (2013b; **Appendix E**).

10.5.4 Heritage

The potential heritage impacts of Option 7b are generally expected to be less than for the other options considered.

As outlined in Niche (2013a; **Appendix F**), there is potential for direct impact on two Aboriginal cultural heritage sites:

- Bolivia Hill AS1
- Bolivia Hill PAD3.

The potential for impact should be confirmed during the concept design process and avoided where reasonable and feasible.

There is potential for direct impact on two heritage sites, both memorials (Niche, 2013b; **Appendix G**). This should be confirmed through development of the concept design. Direct impacts on heritage items associated with the old Bolivia township are not anticipated, but should also be subject to confirmation at a later stage.

During the construction phase there is potential to uncover previously unidentified Aboriginal and non-Aboriginal heritage sites, relics, or artefacts.

10.5.5 Noise and vibration

The recommended preferred option follows the existing road corridor and is not likely to cause a significant change in the noise environment for the overall community. It should be noted that there are no fixed noise receivers within the study area. Whilst blasting may be required for excavation given the hard rock conditions in the area, this would be undertaken in accordance with relevant environmental guidelines and controls. If required, further investigation of any impacts of blasting would be undertaken during the concept design and environmental assessment process.

10.5.6 Visual amenity

The recommended preferred option will have a visual impact as it descends the high ground from Bolivia Hill to the flat valley towards Pyes Creek Road. Bushland and pastoral views will be maintained on the descent from Bolivia Hill.

As the recommended preferred option is based on an upgrade of the existing highway, the long-term impact could be expected to be similar to that of the existing highway apart from the provision of a new, large bridge. However, immediately following completion, the impact is likely to be greater as the wider formation will be noticeable and appear 'new'. The western edge of the 'new' corridor provides the opportunity for landscape plantings.

Urban design and landscape input in the next stage of the project will ensure the bridge and retaining walls are integrated into the existing landscape that dominates the current highly valued visual experience.

10.6 Community issues

The community raised concerns about the existing road's safety performance, with a number of specific safety issues raised along with general concerns about safety. This community focus on safety demonstrates that the project objective to "improve road safety" is generally aligned with the community expectations for the project. The recommended preferred option satisfies this objective.

Several of the route option suggestions from community members demonstrated support for the project objective "to improve road transport productivity, efficiency and reliability of travel" with initiatives such as provision of two southbound lanes or an overtaking lane and reduction of grades. While the recommended preferred option does not provide additional lanes, it does improve road transport productivity, efficiency and reliability of travel by providing a safe alignment with reduced grades and a 100 kilometres per hour design speed.

The project objective to "minimise the impact on the natural, cultural and built environment" was also supported by community members; general route option considerations were focused on ensuring environmental protection and heritage protection. The recommended preferred option satisfies this objective.

Community members that provided route option considerations noted that the cost of the proposed route should be taken into account; this reflects the fourth project objective of "Provide value for money" and demonstrates an understanding of the need for a route option that is cost effective. The recommended preferred option has the least cost of all options considered and satisfies this objective.

10.7 Social-economic issues

The upgrade is a part of a series of upgrades for the New England Highway with planning works initially focusing on a new bypass of Tenterfield and improvements to the Bolivia Hill stretch of road.

Overall, having regard for the social and economic fabric of the 'region' that the upgrade will serve and the broader set of road works that constitute the overall New England Highway upgrade, several potential economic, social and environmental benefits associated with the project were previously identified.

Identified major regional outcomes include:

- Improving the safety of the New England Highway and encouraging inland travel via the New England Highway
- Minimising congestion along this passage of roadway and improving the safety of travel
- Stimulation of the local economy – business and industry will benefit from the works. The improved road will provide a wider employment base for local residents particularly for younger residents
- Increased visitation and support for tourism and retail based employment.

The recommended preferred option ensures these outcomes are achievable.

10.8 Preliminary concept design estimate of cost

10.8.1 Cost estimating approach

The approach to estimating the cost of the recommended preferred option was much the same as for the shortlisted options (refer to **Section 9.4**). However, at this stage of the project, RMS policy is to use probabilistic estimation techniques using Monte Carlo analysis to determine a contingency for the preferred option.

Two estimates were produced as follows:

- The P50 cost value is an estimate of the project cost based on a 50 per cent probability that the cost will not be exceeded. The P50 estimate is one with equal chance of project overruns or under runs up until when the project scope can be finalised.
- The P90 cost value is an estimate of the project cost based on a 90 per cent probability that the cost will not be exceeded at any stage.

Details are included in the Cost Estimate Report in **Appendix K**.

As certainty with design detail, quantities, and rates improve, the proportion of contingency in the estimate will diminish. The reported preliminary concept design cost estimate therefore includes a relatively large allowance for risk and unknowns.

10.8.2 Cost estimate

The P50 and P90 cost estimates for the recommended preferred option are shown in **Table 10-1**.

Table 10-1 Preferred option cost estimate

	Base Cost	P50	P90
Preferred Option 7b	$36,000,000	$45,000,000	$60,000,000

The probabilistic P90 estimate confirms the original estimate for Option 7b (refer to **Section 9.4).**

10.9 Economic appraisal

The P90 cost estimate has been used in the economic evaluation. The P90 estimate is the same as the estimate used in the previous assessment for Option 7b (refer to **Section 9.5**). The results of the analysis are therefore as previously assessed. The results are shown in **Table 10-2**.

Table 10-2 Economic analysis of preferred Option 7b

	Preferred Option 7b
NPV* ($ million)	-$24.1
BCR*	0.52

*NPV = Net Present Value
*BCR = Benefit Cost Ratio

10.9.2 Sensitivity analysis

A sensitivity analysis was conducted on key parameters used to underpin the model to test the robustness of inferences made. Sensitivity tests were conducted on the following parameters:

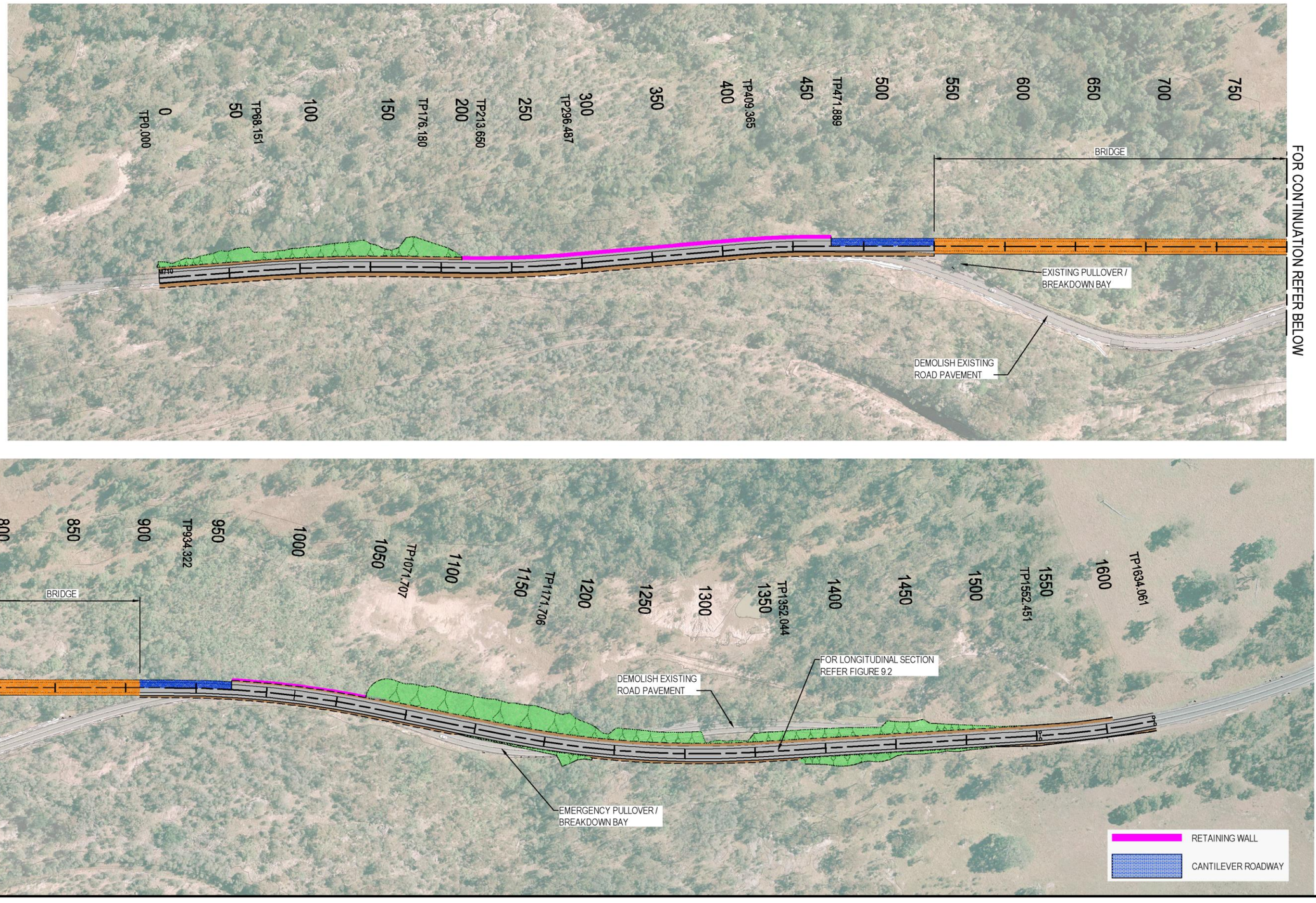
- Construction costs; plus or minus 20 per cent
- Road user costs, plus or minus 20 per cent
- High discount rate; 7 per cent.

The results of the economic appraisal are shown in **Table 10-3**. For simplicity, only the Benefit Cost Ratio results have been generated.

Table 10-3 Sensitivity analysis (Benefit Cost Ratio)

	Base Case	7% discount rate	Increased Capex (+20%)	Decreased Capex (–20%)	Road User Cost (+20%)	Road User Cost (–20%)
Option 7b	0.52	0.38	0.45	0.67	0.39	0.68

The results suggest that the economic appraisal results are relatively insensitive to the variables tested under the different scenarios.



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BOLIVIA HILL UPGRADE
ASSESSMENT OF ROUTE OPTIONS
FIGURE 10.1 - PREFERRED OPTION PLAN

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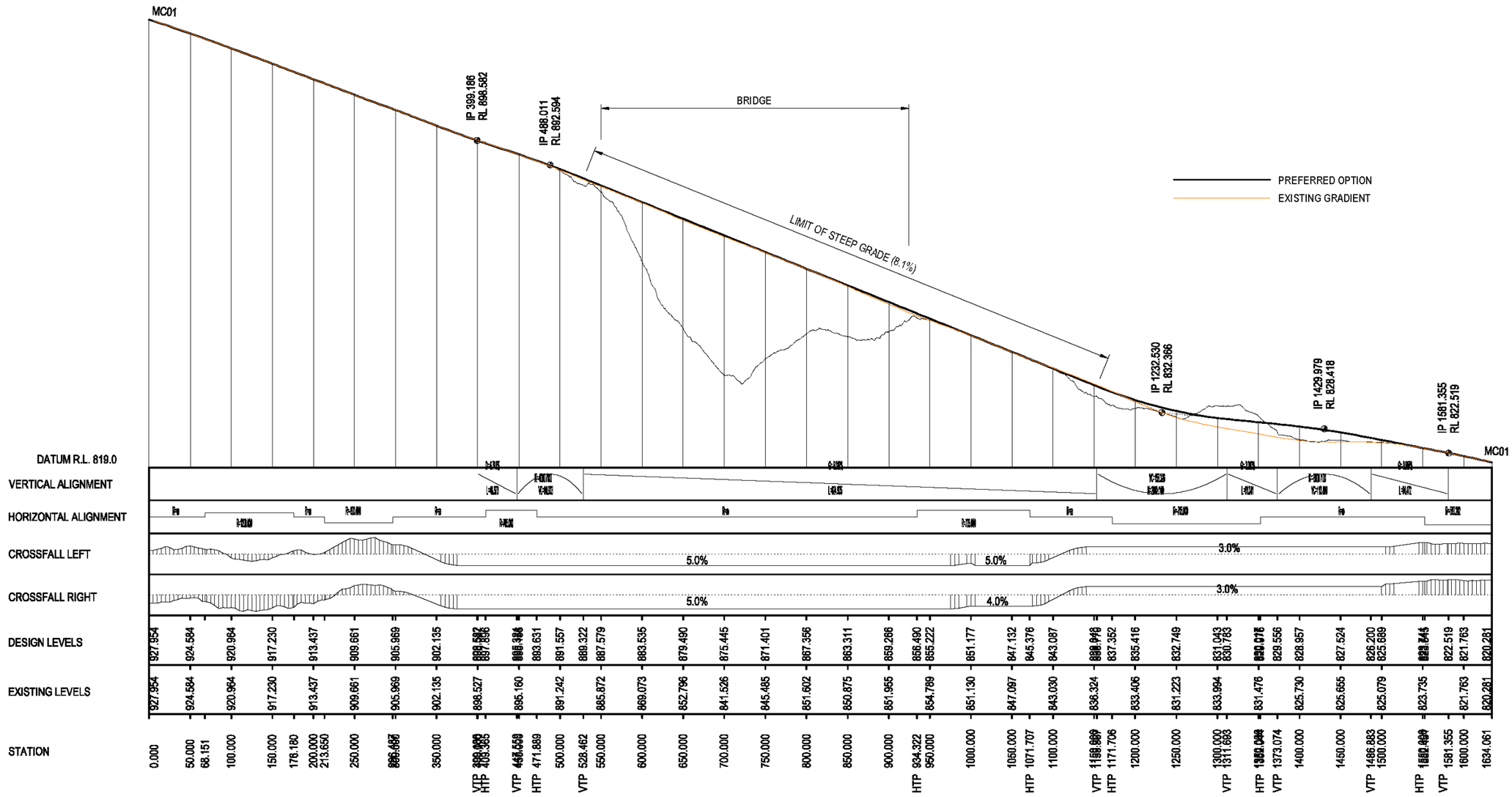

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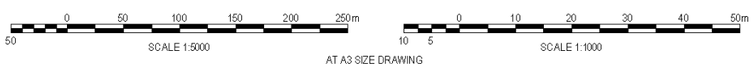

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BOLIVIA HILL UPGRADE

ASSESSMENT OF ROUTE OPTIONS

FIGURE 10.2 - PREFERRED OPTION LONGITUDINAL SECTION

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