Schedule 11: Works Requirements

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Part 1 – General provisions

1. Interpretation

(a) The Contractor shall comply with all Works Requirements and all Delivery Proposals set out in Parts 2 to 7 of this Schedule 11.

(b) Where there is an ambiguity, inconsistency, conflict of obligations or conflict in a standard, outcome or measure, between these Works Requirements, the Base Agreement, any other requirement in this Agreement or the Consent Conditions, the order of precedence set out in clause 3.3 (Precedence of documents) of the Base Agreement will apply to the extent of the ambiguity, inconsistency or conflict. For the avoidance of doubt, notwithstanding the foregoing, the parties acknowledge and agree that:

(i) the requirements set out in paragraph 19 (Weigh facility) of this Schedule 11 with respect to the required weigh facilities shall prevail over any further requirements stipulated by the New Zealand Police with respect to the weigh facilities, and nothing in this paragraph 1(b) is intended to promote any requirements of the New Zealand Police with respect to the design of the weigh facilities above the requirements stipulated in this Schedule 11; and

(ii) the Contractor is not required to construct a shared path from MacKays Crossing to Paekakariki to tie in with the existing road network, and nothing in this paragraph 1(b) is to be construed as requiring the Contractor to construct such a shared path at no extra cost to the Transport Agency.

(c) In the case of any inconsistency, the requirement to comply with the relevant Works Requirements prevails over compliance with the Delivery Proposals.

(d) For the avoidance of doubt, compliance with the Delivery Proposals but not with the Works Requirements constitutes a breach by the Contractor of the Works Requirements.

(e) In relation to all Works Requirements, the Contractor shall comply with the requirements of the following when satisfying the Works Requirements:

(i) the LTMA and all other Laws;

(ii) all applicable requirements of the Resource Management Act 1991 (including all associated designations, consents, plans, orders and conditions);

(iii) the Contractor's obligations under Schedule 6 (Resource Management Act Requirements) and shall use reasonable endeavours to assist compliance by the Transport Agency with its obligations under the Designation and under any Transport Agency Consents;

(iv) all applicable requirements of the New Zealand Building Code; and

(v) the Road Safety Audit Procedures.

(f) Except to the extent a Works Requirement directly conflicts (in which case the Works Requirement prevails), the Contractor shall comply with the requirements of the following (in the order of priority listed) when satisfying each Works Requirement:

(i) the TG RoNS Standards;

(ii) the Bridge Manual; and

(iii) Austroads; and then

(iv) all applicable AS/NZS standards.

Part 2 – Overall requirements

2. Overriding outcomes

2.1 Works Requirements

The Contractor shall ensure that the TG Project in its entirety is designed and constructed:

(a) to enable the Service Requirements to be delivered;

(b) to produce high and sustained safety outcomes (reduction in deaths and serious injuries) and to permit continuous safety improvements, which achieve and maintain no less than a four star KiwiRAP rating;

(c) to reduce travel time from MacKays Crossing to Linden;

(d) to improve travel time reliability from MacKays Crossing to Linden;

(e) to ensure high and sustained customer satisfaction (including through amenity and environmental factors) and customer service; and

(f) to provide a secure connection between Wellington and the north, able to be quickly restored following any disruptive flood or seismic event.

2.2 Delivery Proposal

The Contractor will comply and will:

(a) with respect to travel time:

(i) develop a design solution with a VISSIM-modelled median travel time for light vehicles of not greater than 18.0 minutes from MacKays Crossing (chainage 0, being approximately 20m north of the existing MacKays Crossing interchange road underpass) to Linden (chainage 28000) in both directions for the Operating Term. The traffic volumes and vehicle fleet composition input data for the model are to be based on traffic demands derived from the Traffic Modelling Report entitled "20130513_Traffic Modelling Report Final" (Rev D 29/5/13); and

(ii) to the extent reasonably practicable given the Site Conditions and associated Design Development, seek to achieve a VISSIM-modelled median travel time for light vehicles of not greater than the 17.7 minute standard achieved between the same start and finish positions for the [redacted] design;

(b) design and construct an integrated ITS system for real time Incident response and management plus the provision of Incident and other information for improved travel time reliability;

(c) align with the Transport Agency's 'Customer First' initiative to maximise the customer experience; and

(d) incorporate the following resilience initiatives for route security and quick restoration:

(i) selection of pavement types that in the event of a disruptive flood or seismic event can be opened rapidly for emergency vehicles and within the timeframes outlined in Schedule 22 (Natural Events Regime);

(ii) concrete rocklined combined drainage/rockfall containment trenches at the base of cuts where they are required in order to collect material that falls as a result of a seismic or weather event;

(iii) vegetated unreinforced embankment slopes or other seismically resilient arrangements over the Ohariu Fault zone; and

(iv) design cut slopes and bench widths through the Wainui Saddle Fault crushed material that are customised for the prevailing conditions. For clarity, the fault crush design shall incorporate a flatter overall slope angle and provision of frequent benches relative to cut slopes in adjacent Torlesse that has not been subject to fault crush.

3. Site due diligence

3.1 Works Requirement

The Contractor shall undertake all necessary due diligence of the TG Project Site conditions, features and constraints, supporting infrastructure, legal restrictions, utility supplies and all other aspects impacting on the TG Project.

3.2 Delivery Proposal

The Contractor will comply and will, as a minimum:

(a) carry out extensive geotechnical mapping;

(b) produce a robust geotechnical model;

(c) apply Good Industry Practice to inform post-earthquake performance;

(d) topographically survey key locations to verify the aerial survey model;

(e) meet with utility owners to determine the location and condition of all affected services and implement their requirements;

(f) meet with local stakeholders to address their key issues and concerns;

(g) consult with the identified parties nominated in the various Consent Conditions; and

(h) ensure it addresses the availability of local materials and skills, supply chains, weather and ground conditions within its design and construction approach.

4. Scope – Minimum requirements

4.1 Works Requirements

(a) The Contractor shall ensure that, as a minimum, the roading making up the TG Project incorporates the following:

(i) for the TG Main Alignment, a minimum four traffic Lane (two in each direction), median divided carriageway, suitable for gazetting by the Transport Agency as a motorway, shall be provided that ties into the existing State Highway 1 (**SH1**) at MacKays Crossing at the northern end and into the existing SH1 Porirua to Johnsonville Motorway at Linden at the southern end. The connections with SH1 shall take into consideration the existing Horizontal Alignment, Vertical Alignment and cross section at each end;

(ii) for the Kenepuru Link Road, a minimum two traffic Lane, median divided carriageway, with a design speed of 70 km/h, shall be provided that connects the Kenepuru interchange on the TG Main Alignment with Kenepuru Drive. The Kenepuru Link Road shall be grade separated across both the existing SH1 and the North Island main trunk railway;

(iii) for the existing SH1 immediately north of Linden extending to RP 1050/5.56, a minimum four traffic Lane (two in each direction), median divided carriageway with a design speed of 110 km/hr;

(iv) for the TG Main Alignment, intersections that are all grade separated motorway interchanges;

(v) vehicle underpasses, where not for the passage of State Highway or Local Road traffic, that are designed and constructed to be capable of use by:

(A) in relation to the landowner access to the [redacted] only, a single light vehicle in one direction, with not less than 3m vertical clearance and not less than 3m horizontal clearance;

(B) in relation to Bridge 7 and Bridge 18A, a single unit 11 metre long truck in one direction, with not less than 5m vertical clearance and not less than 5m horizontal clearance; and

(C) in all other cases, a single unit 11 metre long truck in one direction, with not less than 5m vertical clearance and not less than 6m horizontal clearance; and

(vi) stock proof boundary fences that ensure animals and livestock are contained on adjoining properties and restricted from entering the TG Operating Site.

(b) The Contractor shall use the site specific seismic hazard assessment adopted by the Transport Agency as the basis for all seismic design, being GNS reports "Estimation of Earthquake Spectra for Transmission Gully" (GNS Report No 2008/92 dated May 2008) and the updated report "Update of Peak Ground Accelerations for the Transmission Gully Project" (GNS Report No 2013/106, dated 17 June 2013) as per the requirements of the Bridge Manual.

(c) The extent of the works on the State Highway network shall be as follows:

Extent of works on State Highway network	
Northern connection to existing SH1 (MacKays Crossing end), northern tie-in	SH 1N RP 1023/6.60 (northern abutment of the MacKays Crossing road underpass)
Northbound on Ramp to existing SH1 north of MacKays Crossing	SH 1N RP 1023/6.55
Northern connection tie-in to existing SH1 (Paekakariki end), southern tie-in	SH 1N RP 1023/9.09
Eastern tie-in to SH58	RP 0/9.276 (east of Bradey Road)
Western tie-in to SH58	RP 0/9.995 (eastern side of Pauatahanui roundabout)
Connection to Porirua City Council Link Roads	Western end of the splitter island on the PCC Link Road approach to the western James Cook interchange roundabout
Southern connection to existing SH1 (Porirua end), northern tie-in	RP 1050/5.56 (North of Linden)
Southern connection to existing SH1 (Wellington end), southern tie-in	RP 1050/7.40 (South of Linden)
Northern tie-in to Kenepuru Dr	Refer to Kenepuru Link Road Designation
Southern tie-in to Kenepuru Dr	Refer to Kenepuru Link Road Designation

4.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct roading in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) incorporate the following features at a minimum:

TG Main Alignment

(i) a southbound crawler/climbing Lane on the TG Main Alignment from approximate chainage 2740 up to and over the Wainui Saddle to approximate chainage 5840 (not including the tapers);

(ii) a southbound combined auxiliary Lane and crawler/climbing Lane on the TG Main Alignment from approximate chainage 17800 at the SH58 southbound entrance Ramp lane gain to approximate chainage 19800 past the James Cook southbound exit Ramp;

(iii) a northbound crawler/climbing Lane on the TG Main Alignment from approximate chainage 4710 over the Wainui Saddle to chainage 8000;

(iv) a northbound crawler/climbing/acceleration/auxiliary Lane on the TG Main Alignment from approximate chainage 24235 through the Takapu Saddle to chainage 25795;

(v) a northbound truck arrestor bed on the TG Main Alignment located appropriately on the descent north of the Wainui Saddle in the most effective position;

<u>MacKays Crossing interchange</u>

(vi) a new ramp terminal roundabout on the western side of the TG Main Alignment at the MacKays Crossing interchange;

(vii) a new ramp terminal intersection or an upgraded, asphaltic concrete resurfaced roundabout on the eastern side of the TG Main Alignment tying into Emerald Glen Road at the MacKays Crossing interchange;

(viii) a new northbound entrance Ramp, upgraded southbound exit Ramp and upgraded northbound exit Ramp at the MacKays Crossing interchange;

(ix) a new realigned two-lane local road and tie-in to the existing SH1 south of MacKays Crossing;

<u>State Highway 58 interchange</u>

(x) two-lane roundabouts on SH58 on the eastern and western sides of the TG Main Alignment;

(xi) new southbound entrance and exit Ramps and new northbound entrance and exit Ramps at the SH58 interchange to and from the TG Main Alignment;

(xii) new realigned two-lane road and tie-ins to the existing SH58 on the eastern and western side of the TG Main Alignment;

<u>James Cook interchange</u>

(xiii) single lane roundabouts on the eastern and western sides of the TG Main Alignment at the James Cook interchange;

(xiv) new northbound entrance and exit Ramps and new southbound entrance and exit Ramps at the James Cook interchange to and from the TG Main Alignment;

(xv) a tie-in to the new Waitangirua Link Road;

<u>Kenepuru interchange</u>

(xvi) a roundabout on the eastern side of the TG Main Alignment at the Kenepuru interchange;

(xvii) southbound exit and entrance Ramps from and to the TG Main Alignment, and a northbound entrance Ramp to the TG Main Alignment, at the Kenepuru interchange; and

(xviii) a new roundabout on Kenepuru Drive at which Kenepuru Link Road shall tie into Kenepuru Drive;

(c) ensure that the realigned section of the existing SH1 at MacKays Crossing linking to the coastal route, the Kenepuru Drive roundabout, the Flightys Road extension, the road to the [redacted] property, the road into the [redacted], the access to [redacted], and the road to the graves at MacKays Crossing comply with the requirements of the relevant Territorial Local Authority (**TLA**) and are suitable to be handed over to the relevant TLA after their completion and legalisation; and

(d) use GNS reports "Estimation of Earthquake Spectra for Transmission Gully" (GNS Report No 2008/92 dated May 2008) and the updated report "Update of Peak Ground Accelerations for the Transmission Gully Project" (GNS Report No 2013/106, dated 17 June 2013) as the site specific seismic study as per the requirements of the Bridge Manual, with the exception of the "Topographic Effects" discussion and recommendations in GNS Report No 2013/106.

5. Design working life expectancy

5.1 Works Requirements

(a) The Contractor shall ensure that the design working life of the TG Main Alignment, Kenepuru Link Road, and the existing SH1 immediately north of Linden from the Service Commencement Date is not less than:

(i) for Bridges and all Culverts (excluding Temporary Culverts):

(A) for primary elements (such as piles, foundations, settlement slabs, piers, abutments, walls, beams, deck slabs, fixings for maintenance and service supports and cast-in items), 100 years;

(B) for secondary elements (such as Barriers, access supports, non-cast-in items), 50 years;

(C) for expansion joints, bearings, seismic restraints and base isolation hardware on Structures, 40 years, with each to be replaceable without the need for major modification to adjacent elements; and

(D) for all components of the Bridge deck Drainage Systems, a life to first maintenance of not less than 30 years;

(ii) for all Geotechnical Elements, 100 years; and

(iii) for all Drainage Systems, 100 years.

(b) The Contractor shall ensure all vertical surface finishes and protection coatings have a design working life that is appropriate for a road of national significance.

(c) The Contractor shall ensure all signs have a design working life that is appropriate for a road of national significance.

(d) The Contractor shall ensure that, to the extent not covered by Works Requirement 5.1(a), buildings and structures have a design life that meets the requirements of the New Zealand Building Code at a minimum.

5.2 Delivery Proposal

The Contractor will comply and will:

(a) ensure whole of life outcomes are achieved;

(b) enable a maintenance and operations response that achieves life-line route performance including by:

[redacted]

(ii) providing rock fall storage capacity at the base of cut slopes;

(iii) providing abutments with mechanically stabilised earth (MSE) fill retaining walls (either with or without piles or other abutment foundations), for Bridges 1A, 2, 3, 4, 6, 8, 13 ,14, 15, 16, 19, 20, 26 and 28; and

(iv) ensuring that any gantries or other structures that potentially could fall across the carriageway during a seismic or storm event can be readily dismantled and removed to enable passage by emergency and other vehicles;

(c) adopt a holistic approach to seismic design of different elements across the full spectrum of earthquakes;

(d) eliminate short design working life elements, including providing integral abutment Bridges so that Bridge expansion joints and elastomeric bearings are not used, except only on Bridges 19 and 20, which shall have expansion joints and shall use lead rubber bearings with a design working life of not less than 75 years and Bridge 9, which shall have elastomeric rubber bearings;

(e) provide:

(i) an initial design working life of not less than 40 years for all pavement treatments at intersections and interchanges; and

(ii) an initial design working life of not less than 25 years for all other pavement treatments, with programmed periodic maintenance/rehabilitation to meet the residual life requirements at the Expiry Date as outlined in Schedule 12 (Service Requirements);

(f) provide a corrosion coating system on all structural steelwork to ensure not less than 40 years life is provided before first maintenance is required to be undertaken following the guidelines in the HERA report R4-133;

(g) use high pressure sodium twin arc type lamps, or equivalent, with average lamp life of 40,000 hours for 150W lamps and 55,000 hours for 250W lamps for all road lighting; and

(h) design above carriageway sign gantries for a design working life of not less than 50 years and design buried foundations for these structures to achieve a durability-only design working life of not less than 100 years. Other signage support structures at the side of the road shall be designed as Importance Level 2 with a design working life of not less than 40 years.

Part 3 – Roading

6. Road design components

6.1 Works Requirement

The Contractor shall ensure that, as a minimum, the road design for the TG Roads delivers the following outcomes:

(a) a Horizontal Alignment that complies with the TG RoNS Standards, TM-2503 and Austroads;

(b) a Vertical Alignment that complies with the TG RoNS Standards, TM-2503 and Austroads, except that in relation to the Ramps, subject to clause 6.1(i):

(i) a downhill gradient of not steeper than -6.6% shall be allowable with respect to the Kenepuru Link Road southbound exit Ramp, provided that a safe stopping distance is provided to the point defined by the back of the maximum expected queue length;

(ii) an uphill gradient of not steeper than 6.7% shall be allowable with respect to the Kenepuru Link Road northbound entrance Ramp;

(iii) a downhill gradient of not steeper than -8.0% shall be allowable with respect to the SH58 northbound exit Ramp, provided that a safe stopping distance is provided to the point defined by the back of the maximum expected queue length; and

(iv) an uphill gradient of not steeper than 8.5% shall be allowable with respect to the SH58 southbound entrance Ramp, provided that the entrance Ramp is configured as a lane gain into an auxiliary Lane;

(c) co-ordination of the Horizontal Alignment, the Vertical Alignment and the highway surface drainage:

(i) to ensure a curvilinear alignment is achieved for appearance and comfort; and

(ii) to avoid the occurrence of aquaplaning and flooding on the carriageway in accordance with the TG RoNS Standards and TM-2502;

(d) cross section widths, slopes and side protection, including the median and any median Barrier, that are designed in accordance with the TG RoNS Standards, TM-2503 and Austroads, except that, along the southbound carriageway of the existing SH1 alignment [redacted], a localised median shoulder width of not less than 0.6m may be used;

(e) cut and fill slopes shall be designed in accordance with the TG RoNS Standards, TM-2503, Austroads and the Bridge Manual;

(f) superelevation, warp rates and camber that are designed in accordance with the TG RoNS Standards, TM-2503, TM-2501, Austroads and the NRB Design Guide 1977;

(g) sight distances that are designed in accordance with the TG RoNS Standards, TM-2503 and Austroads;

(h) in relation to intersections:

(i) TG Main Alignment intersections that are all designed in accordance with the TG RoNS Standards, TM-2503, Austroads and the Bridge Manual; and

(ii) all other intersections that are designed in accordance with Austroads;

(i) Ramps that are constructed so that ramp metering systems can be installed at a later date without the need for any major infrastructure changes, such as physical changes to the Ramps;

(j) vehicle underpasses, where included with respect to the passage of State Highway or local road traffic, that comply with the requirements of the Bridge Manual and Austroads;

(k) lighting of all channelised intersections and interchanges that is designed in accordance with AS/NZS 1158, with a minimum lighting category of V3;

(l) lighting of the vertical curve at the Wainui Saddle that is designed in accordance with AS/NZS 1158, with a minimum lighting category of V3;

(m) connecting and off-road pedestrian and cyclist facilities that are designed in accordance with Austroads and NZ Supplement to Austroads GTEP: Part 14; and

(n) intersection and interchange layouts and performance to satisfy the appropriate level of service requirements as defined in Austroads Part 3: "Guide to Traffic Management" and the outputs from the agreed traffic model.

6.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) with respect to the horizontal geometry of the TG Main Alignment:

(i) provide at least 3000m radii between approximate chainages 2600 and 7300;

(ii) provide at least 950m radii between approximate chainages 7300 and 8200;

(iii) provide at least 3000m radii between approximate chainages 8200 and 11200;

(iv) provide at least 850m radii between approximate chainages 11200 and 24900; and

(v) provide at least 180m sight distance past Barriers and other sight line obstructions on the edge of both northbound and southbound TG Main Alignment carriageways in horizontal curves between approximate chainages 0 and 28000, except for in the following instances:

(A) between chainages 5100 and 5900 on the northbound carriageway, where 177m sight distance would be acceptable;

(B) between chainages 25000 and 26000 on the northbound carriageway, where 167m would be acceptable; and

(C) on the Linden interchange northbound semi-directional ramp, where 154m sight distance would be acceptable;

(c) with respect to the vertical geometry of the TG Main Alignment:

(i) limit the longitudinal gradient to a maximum of 6.5% between approximate chainages 0 and 2800;

(ii) limit the longitudinal gradient to a maximum of 6.5% between approximate chainages 5500 and 17200;

(iii) limit the longitudinal gradient to a maximum of 6.5% between approximate chainages 19000 and 27000;

(iv) provide a stopping sight distance of 165m to an object height of 0.2m on the northbound carriageway between chainages 5100 and 5900, being the stopping sight distance required for 110 km/h with a 2s reaction time and 0.46g m/s^2 deceleration rate on a level gradient, plus incremental gradient corrections as necessary up to 183m for -7%;

(v) provide a stopping sight distance of 183m to an object height of 0.2m on the southbound carriageway between chainages 4700 and 6000, with the exception of chainage 4820, where a momentary stopping sight distance of 180m would be acceptable;

(vi) provide at least 209m sight distance to an object height of 0.2m over crest vertical curvature of the road surface between approximate chainages 8400 and 10100;

(vii) provide at least 209m sight distance to an object height of 0.2m over crest vertical curvature of the road surface between approximate chainages 15200 and 16100;

(viii) provide at least 183m sight distance to an object height of 0.2m over crest vertical curvature of the road surface between approximate chainages 18300 and 19300, with the exception of approximate chainages 19480 and 19120, where a momentary stopping sight distance of 177m would be acceptable; and

(ix) provide at least 209m sight distance to an object height of 0.2m over crest vertical curvature of the road surface between approximate chainages 24900 and 27000;

(d) with respect to the cross-section of the TG Main Alignment:

(i) provide a median width (between edge lines) of at least 4.0m between approximate chainages 690 and 2700;

(ii) provide a median width (between edge lines) of at least 3.0m between approximate chainages 2700 and 7300;

(iii) provide a median width (between edge lines) of at least 4.0m between approximate chainages 7300 and 15800;

(iv) provide a median width (between edge lines) of at least 4.0m between approximate chainages 18700 and 26200;

(v) provide a median drain to collect and discharge surface water and to prevent surface water flowing from the higher superelevated carriageway across the median to the lower superelevated carriageway where there is a risk of aquaplaning; and

(vi) provide a minimum clearance between median Barriers and edge line of 1.5m (measured to the centre of wire rope Barriers);

(e) with respect to the sight distance to exit Ramps at all interchanges:

(i) provide a minimum of 306m to zero object height at exit ramps with no preceding auxiliary Lane (excluding the MacKays Crossing northbound exit Ramp);

(ii) provide a minimum of 214m to zero object height at exit ramps preceded by an auxiliary Lane (excluding the MacKays Crossing southbound exit Ramp); and

(iii) for the MacKays Crossing southbound exit ramp, provide a sight distance that is no worse than that provided by the current exit Ramp;

(f) with respect to the horizontal geometry of all interchange Ramps, provide exit and entrance Ramps that conform to the layouts specified in the TCD Manual Part 10 for all interchanges, except only with respect to the upgrade of the existing MacKays Crossing southbound exit Ramp, in relation to which the Contractor shall provide a 150m long auxiliary Lane, preceded by a stepped out marking conforming to layout dimensions and taper rate that are to be agreed with the Transport Agency, and including a new island nose with the position to be agreed with the Transport Agency;

(g) with respect to the vertical geometry of all interchange Ramps, provide exit and entrance Ramps that conform to the guidelines of AGRD Part 4C and the details of the TCD Manual Part 10, except only:

(i) with respect to the new MacKays Crossing northbound entrance Ramp, the Contractor will provide a sight distance of at least 114m to an object height of 0.2m over the crest vertical curvature of the road surface as it crosses the North Island main trunk railway;

(ii) with respect to the vertical geometry of the existing MacKays Crossing southbound exit Ramp, northbound entrance Ramp, and northbound exit Ramp, where the Contractor will not change the vertical geometry except as required to tie in locally to new works; and

(iii) past the Kenepuru northbound entrance Ramp, where the Contractor will provide an auxiliary acceleration Lane between approximate chainages 24200 and 25800 to mitigate speed differentials at the uphill merge;

(h) with respect to the cross-sections of all interchange Ramps:

(i) apply a standard crossfall of 3%;

(ii) apply a maximum superelevation of 6%;

(iii) apply adverse crossfall of 3% only where necessary to eliminate potential aquaplaning and with due regard to the minimum radii for which adverse crossfall is acceptable;

(iv) apply a maximum superelevation development rate of 2.5% per second;

(v) provide a minimum general traffic Lane width of 3.5m;

(vi) provide a minimum outer (LHS) shoulder width of 2.0m; and

(vii) provide a minimum inner (RHS) shoulder width of 1.0m;

(i) with respect to the Kenepuru interchange northbound entrance Ramp, the minimum outside shoulder width shall be 3m from where the Ramp and through edge lines are 4.3m apart (i.e., the equivalent of point Z shown in Figure 2.6(a) of the TCD Manual Part 10) to the end of the gore, being the point of intersection of the edge lines (i.e., the equivalent of point X shown in Figure 2.6(a) of the TCD Manual Part 10). Downstream of the end of the gore, the shoulder may taper at 2% from 3m wide to 1m wide adjacent to the auxiliary Lane;

(j) with respect to the horizontal geometry of the Kenepuru Link Road (excluding intersection geometry):

  (i) provide at least 200m radii; and

  (ii) provide a minimum sight distance of 73m past sight line obstructions on the inside of horizontal curves, except past obstructions in the median on the inside of horizontal curves where a minimum sight distance of 70m will be provided;

(k) with respect to the vertical geometry of the Kenepuru Link Road:

  (i) limit the longitudinal gradient to a maximum of 10%; and

  (ii) provide a sight distance of at least 110m to an object height of 0.2m over crest vertical curvature of the road surface;

(l) with respect to the cross-section of the Kenepuru Link Road:

  (i) apply a standard crossfall of 3%;

  (ii) limit the maximum superelevation to 7.2%;

  (iii) apply adverse crossfall of 3% only where necessary to eliminate potential aquaplaning and with due regard to the minimum radii for which adverse crossfall is acceptable;

  (iv) apply a superelevation development rate of 2.5% per second;

  (v) provide a general traffic Lane width of at least 3.5m;

  (vi) provide a shoulder width of at least 1.5m;

  (vii) provide a median width (between edge lines) of at least 1.8m; and

  (viii) provide clear widths of at least 5.5m, measured between Barriers, in both traffic directions;

(m) with respect to the horizontal geometry of SH1 at Linden:

  (i) provide at least a 1500m radius between approximate chainages 600 and 900, the latter chainage being the point at which the new TG Main Alignment ties into the existing SH1 alignment;

  (ii) provide at least a 400m radius between approximate chainages 1500 and 1800, where the existing SH1 alignment is adjusted to allow the Bridge 27 pier to land in the median; and

  (iii) provide a sight distance of at least 155m past sight line obstructions on the inside of horizontal curves between approximate chainages 1500 and 1800, where the existing SH1 alignment is adjusted to allow the Bridge 27 pier to land in the median;

(n) with respect to the vertical geometry of SH1 at Linden:

(i) limit the longitudinal gradient to a maximum of 6.5%; and

(ii) provide a sight distance of at least 305m to a zero object height over crest vertical curvature of the road surface between approximate chainages 0 and 800;

(o) with respect to the cross-section of SH1 at Linden:

(i) apply a standard crossfall of 3%;

(ii) limit the maximum superelevation to 6% between approximate chainages 0 and 1500;

(iii) limit the maximum superelevation to 7% between approximate chainages 1500 and 1800;

(iv) apply adverse crossfall of 3% only to curve radii greater than 3000m and only where necessary to eliminate potential aquaplaning;

(v) apply a superelevation development rate of 2.5% per second;

(vi) provide a general traffic Lane width of at least 3.5m;

(vii) provide a shoulder width of at least 3.0m, which width will be maintained across Structures less than 30m long, but may be reduced to 2.5m across Structures longer than 30m;

(viii) provide a median shoulder width of at least 1.0m [redacted]

(ix) provide a median width (between edge lines) of not less than 4.0m;

(x) at Bridge 26 (Collins Avenue), provide sufficient width between the faces of the Bridge Barriers for four parallel 3.5m wide Lanes southbound and three parallel 3.5m wide Lanes northbound, plus shoulders and median widths as set out in paragraphs 6.2(o)(vii), (viii) and (ix) above;

(xi) provide a median drain to collect and discharge surface water and to prevent surface water flowing from the higher superelevated carriageway across the median to the lower superelevated carriageway where there is a risk of aquaplaning; and

(xii) provide a clearance between median Barriers and edge line of at least 1.5m (measured to the centre of wire rope Barriers and foot of rigid Barriers), except only with respect to the two specific locations where there are sign gantries with legs in the central median and the location where the Bridge 25 pier is located in the central median, where a clearance of 1m shall be permitted;

(p) provide additional lighting to that required by AS/NZS 1158 on the TG Main Alignment:

(i) at the truck arrestor bed, in order to provide clear indication to truck operators and other road users if occupied;

(ii) at the taper of every crawler Lane, in order to clearly illuminate the start of that Lane;

(iii) through the Wainui Saddle between approximate chainages 4850 and 6050 in order to provide mitigation of the reduced sight distance through the vertical crest curve; and

(iv) along the TG Main Alignment between the SH58 interchange and the James Cook interchange;

(q) provide interchange layouts and modelled performance at the MacKays, SH58, James Cook and Kenepuru interchange intersections to satisfy the "Level of Service A" requirements as defined in Austroads Part 3: "Guide to Traffic Management" using the composite "All Vehicles" outputs from the SIDRA intersection models for the "AM Peak", "Interpeak" and "PM Peak" periods in the years 2020 and 2045 based upon traffic demands derived from the Traffic Modelling Report entitled "20130513_Traffic Modelling Report Final" (Rev D 29/5/13), except only in the following cases, where the requirement shall be to satisfy "Level of Service B" requirements:

(i) MacKays interchange – Eastern Roundabout, "All Vehicles" in the AM Peak, Interpeak and PM Peak periods in the years 2020 and 2045;

(ii) SH58 interchange – Western Roundabout, "All Movements" in the Interpeak period in the year 2020 only;

(iii) James Cook interchange – Western Roundabout, "All Vehicles" in the AM Peak period in the year 2045 only; and

(iv) Kenepuru interchange – Eastern Roundabout, "All Vehicles" in the AM Peak, Interpeak and PM Peak periods in the years 2020 and 2045; and

(r) provide an intersection layout and modelled performance at the Kenepuru Drive roundabout to satisfy the "Level of Service B" requirements as defined in Austroads Part 3: "Guide to Traffic Management" using the composite "All Vehicles" outputs from the SIDRA intersections models for the "AM Peak", "Interpeak" and "PM Peak" periods in the years 2020 and 2045 based upon traffic demands derived from the Traffic Modelling Report entitled "20130513_Traffic Modelling Report Final" (Rev D 29/5/13), except only in the PM Peak period in the year 2045, where the requirement shall be to satisfy the "Level of Service C" requirements.

7. Road safety

7.1 Works Requirements

The Contractor shall design and construct the TG Project in accordance with Safer Journeys and utilising a Safe System approach, including the Road Safety Audit Procedures.

7.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) design and construct the TG Project to meet or exceed a KiwiRAP four star rating;

(c) include consideration during the design process of:

(i) safety in design principles;

(ii) seismic resilience and safety;

(iii) construction safety; and

(iv) operator safety;

(d) undertake, and implement the recommendations of, internal peer reviews prior to each formal Road Safety Audit;

(e) resolve all moderate (and higher) safety concerns raised during Road Safety Audits;

(f) implement the outcomes of the "Safety in Design" workshops for both the construction phase and the Operating Term; and

(g) for all pavement surfacings, meet or exceed the requirements of NZTA Specification T/10: 2013.

8. Overweight and over-dimension motor vehicles

8.1 Works Requirements

(a) The Contractor shall allow in its design and construction of the TG Main Alignment and the existing SH1 immediately north of Linden (including all Bridges, Culverts, interchanges and intersections) and all associated facilities for Overweight Loads and Over-dimension Loads.

(b) The Contractor shall provide an envelope for Over-dimension Loads of not less than 6m vertical clearance and not less than 12m horizontal clearance.

8.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11; and

(b) run tracking curves through each intersection to ensure provision of suitable over-dimension clearance envelopes through horizontal and vertical geometry, with the exception of the existing Bridge underpass at MacKays Crossing.

9. High Productivity Motor Vehicles

9.1 Works Requirements

(a) The Contractor shall allow in its design and construction of the TG Main Alignment and Kenepuru Link Road (including all Bridges, Culverts, interchanges and intersections) and all associated facilities for the impact of High Productivity Motor Vehicles (**HPMV**).

(b) For the geometric layout of the TG Main Alignment and Kenepuru Link Road, the Contractor shall utilise a design vehicle that is a 25 metre long HPMV, except in the case of horizontal geometry only, where an 18m semi-trailer as described in LTNZ publication 'RTS18 New Zealand on-road tracking curves for heavy motor vehicles, August 2007' shall be used.

9.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) where the requirements for storage length may apply to the geometric layout, use an Austroads 25m long B Double vehicle as the design vehicle for that specific purpose only;

(c) provide pavements designed to include 1% annual average daily traffic (**AADT**) being HPMVs; and

(d) demonstrate compliance with tracking curves through each intersection to ensure adequate horizontal geometry.

10. Barriers

10.1 Works Requirement

(a) The Contractor shall ensure that all Barriers:

(i) on the TG Main Alignment (including interchanges) comply with the TG RoNS Standards and NZTA Specification M23 *Specification for Road Safety Barrier Systems*; and

(ii) on Kenepuru Link Road and the existing SH1 immediately north of Linden (including interchanges) comply with the requirements of NZTA Specification M23 *Specification for Road Safety Barrier Systems*.

(b) All Barriers shall provide a minimum Test Level 4.

10.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) provide wire rope Barriers in the median, with the exception of:

(i) the existing SH1 at Linden, where the existing median Barrier may be retained where appropriate;

(ii) where concrete Barriers are required adjacent to Bridge piers and sign gantry supports;

(iii) Kenepuru Link Road; and

(iv) the new two Lane local road connection to the existing SH1 south of MacKays Crossing;

(c) carry median Barriers uninterrupted across all TG Main Alignment Bridge decks;

(d) provide Barriers along both outer shoulders over the full length of the TG Roads;

(e) provide concrete Barriers along outer shoulders at the base of cuts as shown on drawings TG-DRG-S11-AL-4421 and TG-DRG-S11-AL-4422 in Appendix 4 (Drawings) to this Schedule 11;

(f) undertake a risk analysis, in accordance with the method in the Bridge Manual, to determine where higher than Test Level 4 is required;

(g) not alter the type, test level, or extent, or materially alter the position, of the Barriers shown on the drawings in Appendix 4 (Drawings) to this Schedule 11, except to reflect the lengths of need or to increase the test levels of protection required; and

(h) provide a raised median for the length of Kenepuru Link Road.

11. Utilities

11.1 Works Requirements

(a) The Contractor shall ensure that suitable provision is made for utilities for current and future use, for both roading requirements and commercial requirements.

(b) In addition to making suitable provision for utilities that the Contractor considers necessary for performance of the Service Requirements, the Contractor shall also provide:

(i) dedicated for the Transport Agency's use at its sole discretion:

(A) along the full length of the TG Main Alignment, four continuous 100mm diameter ducts and two continuous 150mm diameter ducts;

(B) along the full length of the Kenepuru Link Road, two 100mm diameter ducts and one 150mm duct; and

(C) continuous fibre optic cabling capable of transmitting ultra fast broadband,

with each to contain an appropriate draw cable; and

(ii) the Transport Agency with access to each such Transport Agency-dedicated duct, through concrete duct utility chambers not less than every 500m, with all primary chambers (being no more than 1000m apart) being of sufficient size to draw and splice cables and having removable man-hole covers.

(c) The Contractor shall provide the Transport Agency with safe access to the Transport Agency-dedicated ducts at the utility chambers without any Lane closures being required.

(d) The Contractor shall ensure all utilities are suitably protected *in situ*.

(e) The Contractor shall at all times comply with the requirements set out in:

(i) any Network Utility Agreements;

(ii) the National Code of Practice for Utility Operators' Access to Transport Corridors (10 November 2011, as amended February 2013); and

(iii) the Network Utilities Management Plan (**NUMP**).

(f) The Contractor must:

(i) demolish completely, and dispose of, all foundations of transmission towers 1 to 48 that are inside the TG Project Site, but will be outside of the TG Operating Site, and make good the site; and

(ii) demolish down to 800mm below the finished ground level all foundations of transmission towers 1 to 48 (and other tower or poles) that are inside the TG Operating Site,

once Transpower has decommissioned the 110kV MacKays to Pauatahanui electricity transmission line and removed the line conductors, towers and poles.

11.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) provide at least the following ducting:

(i) along the TG Main Alignment:

(A) two 100 mm diameter ducts for the ITS fibre backbone as per NZTA ITS-02-01;

(B) one 100 mm diameter duct for roadside equipment power requirements;

(C) one 100 mm diameter duct for ultra-fast broad-band; and

(D) two 150 mm diameter ducts for future use;

(ii) along the Kenepuru Link Road:

(A) one 100 mm diameter duct for travel demand management;

(B) one 100 mm diameter duct for roadside equipment power requirements;

(C) one 150 mm diameter duct for future use; and

(D) ducting to enable the installation of real-time bus scheduling information infrastructure in the future;

(c) provide primary chambers installed at no more distant than 1000m centres and secondary chambers so that the maximum distance between chambers is no more than 500m. The primary chambers shall be located behind the vehicle Barrier off the road with maintenance vehicle parking that allows routine access without the requirement to close Lanes. The secondary chambers shall be located behind the vehicle Barrier off the road;

(d) install all ducting and chambers in accordance with the requirements of the Transport Agency's Intelligent Transport Systems Specifications;

(e) accommodate the restrictions and constraints of Transpower retained transmission towers and lines over the TG Main Alignment;

(f) design and construct the proposed mitigation measures for each utility conflict as per Appendix 8 (Utility mitigation measures) to this Schedule 11;

(g) include the major utility conflicts on the construction staging drawings and develop and maintain an accurate programme of relocations to be undertaken; and

(h) provide new access points where required to each utility within the TG Operating Site in accordance with each utility provider's requirements.

12. Shared use paths, pedestrians and cyclists

12.1 Works Requirements

(a) The Contractor shall provide for the safe and efficient movement of pedestrians and cyclists at intersections.

(b) The Contractor shall ensure no pedestrians or cyclists are permitted on the TG Main Alignment.

(c) The Contractor shall ensure that each shoulder of the SH1 coastal route between MacKays Crossing and Paekakariki within the extent of the works described in Works Requirement 4.1(c) is no less than 2m wide, in order to permit safe use by on-road cyclists.

(d) The Contractor shall ensure no pedestrians or cyclists are permitted on the Kenepuru Link Road.

12.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) provide a shared path across Lanes Flat under Bridges 14 and 15 for pedestrians and cyclists that is not less than 3m wide;

(c) erect signs prohibiting pedestrian and cyclist access to the TG Main Alignment at MacKays Crossing, the SH58 interchange and the James Cook interchange;

(d) erect signs to direct pedestrians and cyclists along designated routes;

(e) erect pedestrian Barrier fences where the shortest path or easiest path would cross the TG Main Alignment at grade; and

(f) erect signs prohibiting pedestrian and cyclist access from the Kenepuru Drive intersection on to Kenepuru Link Road.

13. Signs, delineation and pavement marking

13.1 Works Requirement

The Contractor shall ensure that the design and construction of the roading provides every road User with safe and effective continuous guidance throughout the TG Project designed and constructed in accordance with:

(a) the Land Transport Rule: Traffic Control Devices 2004 and subsequent amendments;

(b) the Traffic Control Devices Manual; and

(c) the Manual of Traffic Signs and Markings,

as if the Contractor were the Road Controlling Authority.

13.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) provide high performance long life (HPLL) line marking with audio tactile profiles that comply with the TG RoNS Standards; and

(c) provide advance exit Ramp Signage for an auxiliary Lane exit (in accordance with Works Requirement 13.1) for southbound traffic at MacKays Crossing heading to the existing SH1 coastal route.

14. Traffic integration

14.1 Works Requirements

(a) The Contractor shall ensure that all TG Main Alignment, Kenepuru Link Road and existing SH1 immediately north of Linden traffic integrates safely and efficiently with the connecting road network.

(b) For the Linden southern merge/diverge of the TG Main Alignment with the existing SH1, the Contractor shall provide a layout that provides capacity and efficiency of movement for the predicted AADT numbers, ensuring that the TG Main Alignment is the dominant route regardless of traffic volume distribution.

(c) Furthermore, in terms of the Highway Classification System, the Contractor shall ensure that the TG Main Alignment is capable of classification as a national strategic high volume route and the existing SH1 north of Linden shall be classified as a Regional Strategic Route, with a lower inferred level of service.

14.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11; and

(b) provide a full multi-lane motorway to motorway divergence of the TG Main Alignment with clear advance warning Signage on the approach to the Linden northbound diverge with the existing SH1.

15. Maintenance Accessways and Public Access Track

15.1 Works Requirements

(a) The Contractor shall provide all-weather 4WD maintenance access in accordance with paragraph 15.1(b) (the **Maintenance Accessways**) and a continuous public access track along the full length of the TG Main Alignment in accordance with paragraph 15.1(c) (the **Public Access Track**).

(b) The Maintenance Accessways shall:

(i) be included within the TG Project Site;

(ii) exclude access by the public (other than through Belmont Regional Park);

(iii) enable all-weather 4WD maintenance vehicle access of a minimum width of 3m to:

(A) all wetland stormwater treatment ponds, all key drainage elements and all structural elements;

(B) all Transpower towers within the TG Project Site, until such time as they are removed; and

(C) all key utilities including the Greater Wellington Regional Council bulk watermain and Vector Limited's gas main, where access exists at the Execution Date;

(iv) have a preferred maximum gradient of 1 in 6 (16.7%) (but an absolute maximum gradient of 1 in 4 (25%)); and

(v) have a minimum horizontal clearance and minimum vertical clearance of 5m for each connecting underpass,

and shall otherwise comply with the requirements of the Urban and Landscape Design Framework (ULDF).

(c) The Public Access Track shall:

(i) be included within the TG Project Site but may utilise existing tracks that are outside the TG Project Site to provide continuity along the TG Main Alignment;

(ii) be a minimum width of 1m, including clearance to adjacent vegetation;

(iii) be designed to an appropriate scale, gradient and standard for recreational use and to ensure quality of experience and public safety; and

(iv) exclude use for maintenance or third party services (other than in Belmont Regional Park),

and shall otherwise comply with the requirements of the Urban and Landscape Design Framework (ULDF).

15.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the Maintenance Accessways and the Public Access Track in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) provide detours of the existing utility maintenance tracks as required during construction of the TG Main Alignment and maintain the existing standard of all-weather 4WD maintenance vehicle access within the TG Project Site until the Transpower towers are removed; and

(c) provide a Public Access Track that will:

   (i) integrate with existing tracks and trails in adjacent regional or forest parks;

   (ii) have a natural ground surface (i.e., are not required to be formed or metalled);

   (iii) have variable gradients that respond to the topography of the TG Main Alignment; and

   (iv) provide stream crossings as required that are natural (fords).

16. Location referencing

16.1 Works Requirements

(a) The Contractor shall comply with the requirements of the Location Referencing Management System Manual (SM051, July 2004 and subsequent amendments) in all respects (including Bridge information system structure numbering for all Bridges, Major Culverts and tunnels and with respect to location referencing).

(b) The 28km length of the TG Main Alignment will commence from a new reference station (RS) at the northern abutment of the MacKays Crossing underpass (existing route position – RP 1023/7.210). For the purposes of design and data collection, centre-line chainages shall start from this point, being 0.0m. This position equates to a chainage of 260m on the Transmission Gully consented scheme design.

16.2 Delivery Proposal

The Contractor will comply.

17. Emergency Services

17.1 Works Requirements

(a) The Contractor shall provide fire service water storage ponds with safe all-weather vehicular access for New Zealand Fire Service personnel for fire-fighting purposes, with the size and frequency to be ascertained by the Contractor through discussions with the Transport Agency and the New Zealand Fire Service.

(b) The Contractor shall provide New Zealand Police traffic enforcement bays on the TG Main Alignment in both directions at locations agreed with the Transport Agency and the New Zealand Police:

(i) between SH58 and Linden (with at least two bays for each direction); and

(ii) between MacKays Crossing and the SH58 interchange (with at least three bays for each direction).

The clearance shall be such that police personnel and any vehicle occupants are at a safe distance from the live traffic Lanes on the TG Main Alignment.

(c) The Contractor shall provide for Emergency Services requirements following consultation with the appropriate Emergency Services.

17.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) provide a sealed median over the full length of the TG Main Alignment to allow, if required in an emergency situation, turnaround or contraflow under appropriate traffic control;

[redacted]

(d) use VMS messaging to warn of Incidents ahead and facilitate Emergency Service access in accordance with paragraph 18.2(j)(v) and 18.2(j)(vi); and

(e) provide maintenance access and enforcement bays on the TG Main Alignment in the approximate locations as shown in Appendix 4 (Drawings) to this Schedule 11.

18. Intelligent Transport Systems (ITS), weather station and traffic monitoring stations

18.1 Works Requirements

(a) The Contractor shall provide Users with sufficient ITS information throughout the extent of the TG Project Site to ensure Users are provided with suitable advance warning of any events that may impact their journey, such as:

(i) VMS provided at all interchanges, key decision points and merges for traffic management purposes;

(ii) internet protocol (IP) web cameras provided at all interchanges, key decision points and merges for traffic management purposes; and

(iii) where appropriate, vehicle over-height detection and warning systems (VOW).

(b) The Contractor shall provide CCTV monitoring incorporating PTZ cameras at all interchanges and at the Emergency Services turnaround with a continuous (24/7) live connection (all digital and visual data) available to the WTOC, incorporating number plate identification of stationary vehicles in the vicinity of the CCTV cameras. [redacted]

(c) The Contractor shall provide continuous traffic monitoring stations between all interchanges and on all on Ramps and off Ramps of the TG Main Alignment using technology that provides an equivalent or better level of accuracy in comparison with that usually achieved by dual loop continuous telemetry traffic monitoring stations. Each such monitoring station shall:

(i) report back to the WTOC; and

(ii) be consistent with the Traffic Monitoring Method.

(d) The Contractor shall provide an ITS managed and CCTV monitored (median break) Emergency Services turnaround approximately 4-7 km north of the SH58 interchange that is able to cater for a Barrier to Barrier maximum swept path of not less than 25m.

(e) The Contractor shall install a weather monitoring station, provided by the New Zealand Meteorological Service to provided technical specifications, at the Wainui Saddle.

(f) The Contractor shall ensure that the movement of people and freight across the wider roading network is optimised to deliver an efficient, integrated transport network. This shall include ensuring that:

(i) all traffic flows and movements within the TG Project Site are able to be monitored continuously (24/7) on a real time basis by a traffic operations centre;

(ii) the traffic operations centre is able to deliver traffic operations services that improve journey reliability as well as improve safety for road users, including by:

(A) actively monitoring and managing the roads within the TG Project Site; and

(B) providing, and making available, accurate, reliable, relevant, useful and timely traveller information services to road users before and during their journey; and

(iii) infrastructure is designed and installed that will permit the Contractor to deliver the Service Requirements with respect to traffic operations.

18.2 Delivery Proposal

The Contractor will comply and will:

(a) provide the Contractor's ITS Solution, which at a minimum shall comply with the network architecture drawing set out in Appendix 10 (Contractor's ITS Solution architecture) to this Schedule 11;

(b) ensure that the Contractor's ITS Equipment is fully compatible with WTOC's ICT System;

(c) ensure that, in the event that any other ITS equipment (for example the Telepath system and the Radio Rebroadcast system) is configured within WTOC's ICT System, it is fully compatible with WTOC's ICT System;

(d) be responsible for the specification and development of the Contractor's ITS Equipment drivers and their configuration within WTOC's ICT System;

(e) configure WTOC's ICT System to incorporate the relevant Contractor's ITS Equipment configuration and associated workflow and algorithm based incident response plans and user interface in accordance with Schedule 24 (WTOC Arrangements);

(f) be responsible, where necessary, for the provision of additional server and network communications infrastructure capacity as may be required to support the configuration of WTOC's ICT System to accommodate the Contractor's ITS Equipment, its configuration, user interface and data requirements;

(g) be responsible for the specification and development of a data extract for export of data from WTOC's ICT System to the Contractor's own data warehouse for data storage, analysis and reporting purposes;

(h) provide a network interface between the Contractor's network communications and the WTOC network communications and infrastructure;

(i) provide offsite back-up systems for the Contractor's ITS Equipment in the event that the main WTOC building is unavailable but WTOC's ICT System (including any backup WTOC's ICT System servers) continues to operate;

(j) provide the following ITS infrastructure:

(i) no fewer than the CCTV IP web cameras referenced in the following table, in each case located close to the edge Barrier but outside its deflection, with at least one such camera to be capable of viewing the weigh facility:

No.	Location	Direction	Approximate Chainage
1	MacKays Crossing interchange	Northbound	0
2	Arrestor bed	Northbound	3160
3	Wainui Saddle	Southbound	5400
4	Emergency Services turn around	Southbound	10680
5	SH58 southbound exit Ramp	Southbound	16640
6	SH58 eastern roundabout	Southbound	17220
7	SH58 western roundabout	Northbound	17330
8	James Cook eastern roundabout	Southbound	19900
9	James Cook western roundabout	Northbound	19970
10	James Cook northbound exit Ramp	Northbound	20400
11	Kenepuru southbound exit Ramp	Southbound	24510
12	SH1 southern tie-in, Linden merge	Southbound	27700

and in relation to each such camera:

(A) the camera shall be connected and configured within WTOC's ICT System for 24/7 operation;

(B) the camera and link shall be fully compatible with WTOC's ICT System;

(C) monitoring and operation shall be able to be carried out using WTOC's ICT System, including an incident detection system to ensure visibility of traffic flows and conditions can be provided through the use of WTOC's ICT System; and

(D) web camera images shall be capable of being displayed via the Transport Agency's public facing website;

[redacted]

[redacted]

[redacted] [redacted]

[redacted] [redacted]

[redacted] [redacted]

(iii) the weather monitoring station, provided by the New Zealand Meteorological Service, at the Wainui Saddle, which shall have a 24/7 live connection to the WTOC;

(iv) no fewer than four Visibility Sensors, each of which:

(A) has a 24/7 live connection to the WTOC;

(B) is fully compatible with WTOC's ICT System; and

(C) is monitored and operated using WTOC's ICT System;

(v) Type C (4-line) VMS as follows:

(A) on SH1 southbound, north of the MacKays Crossing exit ramp;

(B) on the TG Main Alignment southbound, north of the SH58 exit Ramp; and

(C) on the TG Main Alignment northbound, south of the James Cook exit Ramp;

(vi) Type D (2-line) VMS as follows:

(A) on SH1 southbound, north of the MacKays Crossing entry ramp;

(B) on the TG Main Alignment southbound, north of the Wainui Saddle;

(C) on the TG Main Alignment northbound, south of the Wainui Saddle;

(D) on the TG Main Alignment southbound, north of the James Cook exit Ramp;

(E) on the TG Main Alignment northbound, south of the SH58 exit Ramp;

(F) on SH58 westbound, east of the TG Main Alignment;

(G) on SH58 eastbound, west of the TG Main Alignment;

(H) on the TG Main Alignment southbound, north of the Kenepuru Link Road exit; and

(I) on SH1 (Johnsonville Porirua Motorway) northbound, south of the TG Main Alignment diverge;

(k) use VMS Signage:

(i) to warn Users of adverse weather conditions;

(ii) to warn Users of slow moving vehicles ahead;

(iii) to warn Users of increased risk after an earthquake; and

(iv) to advise Users of current expected journey times,

with all VMS Signage:

(v) to be connected and configured within WTOC's ICT System for 24/7 operation;

(vi) to be fully compatible with WTOC's ICT System;

(vii) to have message displays controlled based on a response plan configured within WTOC's ICT System; and

(viii) to have a battery back-up system (provided at the VMS and access switches) in order to remain operational in the event of power failure;

[redacted] [redacted]

(m) monitor earthquakes using four integrated Accelerometers each having a 24/7 live connection to the WTOC;

(n) connect the vehicle over-height detection and warning systems (VOW) to WTOC's ICT System, and ensure it is fully compatible with and configured with the WTOC's ICT System;

(o) provide a fully redundant communications network (physical and logical) with strategically located access switches (with uninterruptible power supply battery back-up), and network monitoring connected to WTC's ICT System; and

(p) provide systems and connections as necessary to allow for integration with WTOC operations.

19. Weigh facility

19.1 Works Requirements

The Contractor shall provide an off-carriageway weigh pit on SH58 located to the west of the SH58 interchange and located within Pt Lot 1 DP76425, Sec 1 SO 38167 and Sec 2 SO 38167, which has a total HCV trip diversion of not more than 5km, and shall ensure that the SH58 weigh pit facility incorporates the following as a minimum:

(a) appropriate fencing, that can in the event of non-attendance by New Zealand Police staff be locked and fully secured;

(b) sufficient Signage to enable the New Zealand Police to divert vehicles in accordance with their legal enforcement requirements;

(c) sufficient lighting to enable the safe operation of the facility at all times of the day or night;

(d) an enforcement standard single axle weigh pad, with 30m long and 7.5m wide flat areas on the approach and departure sides of the weigh pad;

(e) one or more control buildings that contain toilet, wash and kitchen facilities, and an aggregate of at least 50m^2 of secure lock up space for shared use by the New Zealand Police and the Transport Agency, including provision of appropriate office furnishing and computer broadband connection;

(f) appropriate drainage;

(g) a CCTV PTZ camera controllable by the WTOC; and

(h) provision for the safe and efficient movement of vehicles, including leaving the State Highway, driving to the weigh pit site, entering and exiting the weigh pit site and returning to the State Highway.

19.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11; and

(b) provide a SH58 weigh facility that includes the following specifications:

(i) Signage on the TG Main Alignment located south of SH58 for northbound traffic and north of SH58 for southbound traffic, with an LED open element that will direct all HCVs to the off-carriageway weigh pit on SH58 when remotely operated from the SH58 weigh pit by the New Zealand Police, plus local fixed plate signage;

(ii) a layout suitable for HPMV ingress/egress in a forward gear;

(iii) toileting facilities for HCV driver use during inspections; and

(iv) one or more control buildings that:

(A) consist of a standard 10.8m x 3.6m Portacom or similar, lockable office building and a 6.0m x 3.0m Portacom or similar fitted-out as a toilet/shower block;

(B) contain services provision, including power, communications, mains water, waste water septic tank; and

(C) contain connection to national fibre-optic cabling capable of transmitting ultra-fast broadband.

20. Site geotechnical engineering

20.1 Works Requirements

(a) The Contractor shall apply:

(i) the Bridge Manual to the design and construction of all Geotechnical Elements (whether related to an item in the Bridge Manual or to any other Geotechnical Element not expressly stated to be covered in the Bridge Manual);

(ii) the Site Specific Seismic Hazard Assessment (GNS Science Consultancy reports 2008/92 and their recommendations and the Update of Peak Ground

Accelerations for the Transmission Gully Project GNS Science Consultancy reports 2013/106 and their recommendations) to the design and construction of all Geotechnical Elements, with the exception of the “Topographic Effects” discussion and recommendations in GNS Report No 2013/106; and

(iii) route Importance Level 3 generally in the application of requirements of the Bridge Manual.

(b) The Contractor shall ensure that:

(i) the design acknowledges and makes allowance for all geotechnical constraints of the TG Project Site and immediately surrounding areas;

(ii) each Geotechnical Element is designed to remain in equilibrium, both local and global, so that the intended function and specific performance of each Geotechnical Element remains unimpaired, except in so far as displacement during seismic events is acceptable under the Bridge Manual;

(iii) deformations associated with engineered cut and fill construction and with natural slopes affecting the TG Project are controlled so that the intended function and performance of the TG Project are achieved;

(iv) the design of all Geotechnical Elements seeks to minimise the impact on any adjacent infrastructure, the structure they provide support to, highway design features, road users, waterways or private property;

(v) the geotechnical design makes due allowance for the effects of inherent uncertainties related to the properties of soil and rock, hydrological variations, and seismicity;

(vi) the geotechnical design makes due allowance for the limitations inherent with design methods, soil and rock modelling, and adopted design approaches;

(vii) Geotechnical Elements are designed to be resilient when subjected to design Limit State events as set out in the Bridge Manual or AS/NZS 1170 and NZS 1170.5 such as those associated with earthquakes, rainfall and flooding; and

(viii) durability, robustness, resilience and the control of deformations are inherent in geotechnical design so as to meet the Service Requirement for the expected service life of the relevant highway feature.

(c) The Contractor shall provide suitable maintenance access to all Geotechnical Elements.

(d) The Contractor must ensure that not less than four Accelerometers are placed at the locations along the TG Main Alignment specified in the Accelerometer Design Plan, being an item of Reviewable Design Material. Each Accelerometer shall be a “Canterbury Seismic Instruments Limited CUSP-3 Series Strong Motion Accelerograph”, with at least the following functionality:

(i) provide real-time results 24/7 to the WTOC;

(ii) be integrated into the project ITS system;

(iii) provide pre-event and post-event memory for recording ground motion;

(iv) be assembled and protected within waterproof housing; and

(v) be provided with a permanent power source, with provision of a battery to provide uninterrupted power supply for at least 24 hours,

or an accelerometer of equivalent functionality and accuracy.

20.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) develop the design in accordance with:

(i) the Geotechnical Design Philosophy Statement set out in Appendix 5 (Geotechnical Design Philosophy Statement) to this Schedule 11; and

(ii) its Finalised Geotechnical Design Report;

(c) apply topographic amplification factors in slope design as detailed in the Geotechnical Design Philosophy Statement;

(d) undertake a rigorous geotechnical assessment to determine geotechnical constraints of the site and immediate surrounding areas, and apply this to the design of all Geotechnical Elements;

(e) during the design of each Geotechnical Element, evaluate and take into account:

(i) static equilibrium of local and global stability mechanisms to provide suitable performance and function of each Geotechnical Element to satisfy the operational, maintenance and design life requirements and obligations;

(ii) whole of life considerations through both the Contract Term and the required design working life;

(iii) seismic resilience including provision for elements to be potentially out of equilibrium temporarily during earthquake events during which deformation is permitted to occur up to the performance limits defined by the Bridge Manual. Deformation of cut and filled slopes will be assessed using either the Jibson method or the Bray and Travasarou 2007 method, whichever is most appropriate for the relevant slope in accordance with Good Industry Practice; and

(iv) mitigation of impacts on any adjacent infrastructure, the structure they provide support to, highway design features, Users, waterways or private property per the Bridge Manual design requirements;

(f) make due allowance for:

(i) the effects of inherent uncertainties related to the properties of soil and rock, hydrological variations and seismicity in accordance with the Bridge Manual. This includes the utilisation of probabilistic methods during detailed design to demonstrate the design consideration of uncertainty; and

(ii) limitations inherent with design methods, soil and rock modelling and adopted design approaches;

(g) provide concrete rocklined combined drainage/rockfall containment trenches at the base of cuts as shown in drawings TG-DRG-S11-AL-4421 and TG-DRG-S11-AL-4422 in Appendix 4 (Drawings) to this Schedule 11 to collect material that weathers from the cut face or falls as a result of a seismic or weather event;

(h) provide a concrete side protection Barrier in addition to the rockfall containment trenches provided in accordance with paragraph 20.2(g) above along the eastern shoulder of the TG Main Alignment from chainage 4500 to chainage 5500 (inclusive), to collect material that weathers from the cut face or falls as a result of a natural event;

(i) provide vegetated unreinforced embankment slopes or other seismically resilient arrangements over the Ohariu Fault zone;

(j) employ a robust vegetation strategy for embankment slopes to minimise erosion;

(k) carry out foundation treatment for embankments including both drainage and foundation strengthening;

(l) install basal geotextile reinforcement where liquefaction potential is confirmed and requires mitigation at SH58 and MacKays Crossing, and localised geotextile where weak saturated gravels occur near streams;

(m) provide embankment toe scour protection where scour potential is confirmed;

(n) provide seismic resilience following major events to satisfy the Bridge Manual;

(o) install geogrid reinforcement in the upper layers of embankments in accordance with drawing TG-DRG-S11-GT-2401 in Appendix 4 (Drawings) to this Schedule 11 to protect pavements from settlement and slope instability effects;

(p) install geogrid reinforcement at cut/fill transitions in steep natural topography (>30^{o} to the horizontal) and at the interface between existing and widened embankments in accordance with drawing TG-DRG-S11-GT-2401 in Appendix 4 (Drawings) to this Schedule 11 to reduce the likelihood of cracking and/or settlement;

(q) construct concrete crestal drains at the top of cuts and lined berm drains, specifically including on any cuts on the eastern side of the TG Main Alignment from chainage 4500 to chainage 5500 inclusive, to mitigate water runoff and gravel flows;

(r) provide cut slopes and bench widths through the Wainui Saddle fault crushed material that are customised for the prevailing conditions. For clarity, the fault crush design shall incorporate a flatter overall slope angle and provision of frequent benches relative to cut slopes in adjacent Torlesse that has not been subject to fault crush;

(s) provide uniformly finished cut slope surfaces in combination with rock bolting, reinforced shotcrete and rockfall mesh treatment to mitigate consequences of local instability mechanisms in poor quality rock;

(t) provide Geobrugg debris catch fence (or equivalent) and deflection fences, including specifically providing within the Designation a debris deflection fence in the eastern upper tributary of the Te Puka stream at approximate chainage 4600, to mitigate debris and gravel flow;

(u) install and monitor instrumentation to validate the performance of the Geotechnical Elements, where appropriate. Instrumentation shall include piezometers, settlement plates, horizontal profile gauges, survey prisms, inclinometers, extensometers and seismic accelerometers; and

(v) for slopes with a cut slope height of 30m or more, and with overlying steep natural terrain, implement a means of obtaining a digital record of the slope condition for use during the Operating Term.

21. Pavements and surfacing

21.1 Works Requirements

(a) The Contractor shall ensure all pavements are designed, constructed and maintained (during the construction period) to ensure safety and ride quality and to support the overriding outcomes described in Works Requirement 2.

(b) The Contractor shall determine appropriate pavement design loadings.

(c) The Contractor shall ensure its design methodology with respect to pavements and surfacing accords with the following:

(i) pavement design complies with Austroads 2004 and the NZ Supplement; and

(ii) design for fatigue cracking of all pavements considers initial surfacing and all subsequent resurfacings in accordance with Austroads 2004 and the NZ Supplement.

(d) The Contractor shall ensure all pavements comply with or exceed the pavement surfacing requirements set out in Appendix 2 (Pavement Surfacing Requirements) to this Schedule 11 at the Service Commencement Date.

21.2 Delivery Proposal

The Contractor will comply and will:

(a) as a minimum, design and construct pavements in accordance with the pavement types and spatial extent of the pavement types shown in drawings:

(i) TG-DRG-S11-PV-1401 to 1404 (inclusive);

(ii) TG-DRG-S11-PV-1406 to 1409 (inclusive);

(iii) TG-DRG-S11-PV-1413 and 1414;

(iv) TG-DRG-S11-PV-1419;

(v) TG-DRG-S11-PV-1429 to 1431 (inclusive);

(vi) TG-DRG-S11-PV-1435 to 1439 (inclusive);

(vii) TG-DRG-S11-PV-1441;

(viii) TG-DRG-S11-PV-1443 and 1444;

(ix) TG-DRG-S11-PV-1454 to 1457 (inclusive);

(x) TG-DRG-S11-PV-1459 to 1461 (inclusive), (with chainages not covered in those drawings being deemed to have the same pavement types as those indicated in the drawings provided for the chainages on either side of those absent chainages) and TG-DRG-S11-PV-2401 and TG-DRG-S11-PV-2402, within a design tolerance of a maximum reduction of 10mm in the subbase layer only;

(b) in the event that the Contractor seeks a Change to any pavement type that is outside the tolerances permitted in accordance with paragraph 21.2(a), or there is no pavement design contained within the drawings specified in paragraph 21.2(a) for the relevant location, the Contractor shall develop the pavement design in accordance with:

(i) the Pavement Design Philosophy Statement set out in Appendix 6 (Pavement Design Philosophy Statement) to this Schedule 11;

(ii) its Finalised Pavement Design Report;

(iii) a CIRCLY pavement design analysis (using a design reliability factor of 95%) that complies with the following:

Section	DESA per Lane (million)	Highest cumulative damage factor to be not greater than
Transmission Gully		
MacKays interchange	22.2	0.50
TG – MacKays Crossing to SH58	22.2	0.60
SH58 interchange	27.2	0.80
TG – SH58 to James Cook	19.9	0.60
James Cook interchange	13.4	0.40
TG – James Cook to Linden	17.7	0.50
Kenepuru interchange	15.9	0.40
Kenepuru Link Road	8.8	1.00
Existing SH1		
SH1 – South of MacKays Crossing interchange	10.6	0.3
SH1 – South of Linden interchange	37.9	0.40
SH1 – North of Linden interchange	25.1	0.70
Local and Access Roads		
Local and access roads. Includes Flightys and Van Cruchten.	4.6	1.00

Note: The DESA per Lane values and the Highest Cumulative Damage Factors in the above table are exclusive of any allowance for construction phase trafficking where the pavement is used as a haul road and/or for construction traffic.

(c) ensure asphalt materials and construction comply with the requirements of NZTA M/10 2013 and subsequent amendments;

(d) make allowance for the use of the pavements where used as a haul road and / or for construction traffic;

(e) provide a design subgrade Californian Bearing Ratio strength of ≥10% for the subgrade;

(f) for all TG Main Alignment and Kenepuru Link Road pavements, include either a lime and cement modified subbase or cement modified subbase, and a cement modified basecourse;

(g) for the TG Main Alignment, including the Ramps and SH1 near MacKays Crossing and roads to be vested in the TLA, provide a chipseal surfacing. The chipseal binder for grades ≥ 5% and the Ramps will be polymer modified;

(h) for the TG Main Alignment south of chainage 25,500 and for the existing SH1 at Kenepuru and Linden, provide Open Graded Porous Asphalt (OGPA) surfacing, with a chipseal pavement waterproofing beneath the OGPA;

(i) for all interchanges and roundabouts (except for the roundabouts on SH58 and on Kenepuru Drive), include polymer modified structural asphaltic concrete with a polymer modified Stone Mastic Asphalt (SMA) wearing course. The thickness of the asphalt layers will be at least 130mm;

(j) for Kenepuru Link Road, except for the Bridges and the roundabout on Kenepuru Drive, include a prime, a 3/5 two coat seal, and at least 40mm of SMA wearing course, noting the risk of shoving / slipping of the SMA on the basecourse;

(k) design and construct the pavement for Kenepuru Drive intersection to Porirua City Council requirements and a standard comparable to Kenepuru Link Road;

(l) bitumen seal the median, the full width of shoulders and down the outer edge of the embankment to at least level with the bottom of the basecourse to prevent water infiltration;

(m) provide four longitudinal pavement subsoil drains along the median and along the outer edge of the pavement over the full length of the TG Main Alignment;

(n) install drainage blankets and/or herringbone drains as required to mitigate water infiltration from the cutting subgrade into the pavement;

(o) resurface:

  (i) the southbound exit ramp approach at MacKays Crossing; and

  (ii) the eastern roundabout after the southbound exit at MacKays Crossing circulating Lane to provide a pavement that caters for the future increase in traffic volumes based on the data provided in the Traffic Modelling Report entitled “20130513_Traffic Modelling Report Final (Rev D 29/5/13)”;

(p) extend the concrete apron on the eastern roundabout after the southbound exit at MacKays Crossing to accommodate HPMV tracking; and

(q) provide a concrete apron at the link road entrance to the eastern roundabout after the southbound exit at MacKays Crossing to accommodate HPMV tracking.

Part 4 - Structures

22. General requirements

22.1 Works Requirements

(a) The Contractor shall adopt best value for money, whole of life solutions for all Structures, fences, walls, gantries, signs, lighting columns and CCTV masts.

(b) The Contractor shall ensure all Structures, fences, walls, gantries, signs, lighting columns and CCTV masts are safe, functional, high quality and durable and require no more than a normal level of maintenance.

(c) The Contractor shall balance sound engineering and good aesthetics in a cost effective manner in its design and construction of all Structures, fences, walls, gantries, signs, lighting columns and CCTV masts.

(d) The Contractor shall incorporate the Crime Prevention through Environmental Design (CPTED) principles and the design principles included in the Urban Landscape and Design Framework (ULDF).

(e) Due to the high risk of earthquakes, the Contractor shall adopt seismically robust structural forms with high levels of redundancy. The seismic design philosophy for all Structures shall follow the requirements of Table 5.1 of the Bridge Manual.

(f) The Contractor shall provide suitable maintenance access to all structures.

22.2 Delivery Proposal

The Contractor will comply and will:

(a) adopt a design approach that considers the use of vegetated engineered fill in preference to a retained structure;

(b) avoid the use of shotcrete if other practical alternatives exist, but if shotcrete is used then utilise best practice techniques to ensure visibility and corresponding visibility effects will be reduced, including using reasonable endeavours to match the colour and texture of adjoining areas and employing shadow lines along the edges;

(c) provide underpasses that allow visibility from one end to the other without recesses or hidden places;

(d) provide underpasses that seek to maximise light, amenity and visibility;

(e) provide underpasses that have appropriate internal lighting levels;

(f) provide underpasses that are constructed from robust, long-life, vandal-proof materials to minimise maintenance;

(g) provide Drainage Systems that mitigate flooding, ponding of water and dripping from overhead surfaces;

(h) provide a top rail on TL5 concrete Barriers to allow improved visibility for road users, and reduced visual impact of the structure;

(i) provide high durability, long lasting coatings for structural steel complying with the Bridge Manual and other applicable standards and guidelines;

(j) provide noise walls made of high quality, durable, and attractive finishes without intricate details that would distract drivers, and faces that will be visible to adjacent property owners to be of a high quality design finish;

(k) provide design solutions that achieve a high quality durable and attractive finish, without high maintenance requirements;

(l) provide structures with clean structural lines and neat concrete finishes; and

(m) provide mechanically stabilised earth abutment walls and retaining walls with concrete-panel facings complying with the Bridge Manual, with the gap between the structures and the MSE wall to be minimised, and the top of the mechanically stabilised earth wall to line up with the abutment cap if applicable.

23. Bridges and Major Culverts

23.1 Works Requirements

(a) The Contractor shall ensure that all Bridges and Major Culverts:

(i) are classified as Importance Level 3 in the application of the requirements of the Bridge Manual (except only in relation to Bridge 9, which shall have an Importance Level 1);

(ii) have shoulder widths between the edge line and the face of the safety Barrier of not less than 3.0m except:

(A) for Bridges longer than 30m, where a shoulder width of not less than 2.5m is acceptable;

(B) adjacent to crawler or climbing Lanes (which does not include the southbound weaving Lane on the TG Main Alignment between SH58 and the James Cook interchange), where a shoulder width of not less than 1.0m is acceptable;

(C) on Ramp Bridges, where the shoulder widths shall not be less than the matching distance between the edge line and the face of the safety Barrier upstream and downstream of the Bridges;

(D) on the James Cook interchange Bridge (Bridge 16), where a shoulder width of not less than 1.5m is acceptable; and

(E) [redacted], where the shoulder widths shall be not less than the matching distance between the edge line and the face of the safety Barrier upstream and downstream of the Bridges;

(iii) have vertical and horizontal clearances based on the “Preferred Minimums” listed in Figure A2 of the Bridge Manual, but extended with respect to the TG Main Alignment to the extent required to allow for the requirements of Works Requirement 8. Horizontal clearances shall make allowance for “working width”, as defined in Austroads Part 6. Vertical clearances shall allow appropriate provision for settlement and road surfacing overlays;

(iv) comply with the Bridge Manual requirements with respect to steel nosings on Bridges, except only with respect to Bridges and Major Culverts on the Maintenance Accessways with similar geometry and function to the Bridges numbered 5, 7, 10, 11 and 12 where concrete slab-type superstructures are employed;

(v) have surfaces that fully meet the Service Requirements; and

(vi) satisfy utility authority requirements, which the Contractor shall ascertain from the Network Utility Agreements. Provision shall be made in accordance with urban design best practice and in accordance with the NUMP.

(b) The Contractor shall make due allowance for mid-range climate change in accordance with Ministry for the Environment *Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand,* 2nd Edition, May 2008 when determining waterway areas.

(c) The Contractor shall ensure the most current site specific seismic hazard assessment adopted by the Transport Agency is applied in accordance with the Bridge Manual.

(d) The Contractor shall ensure that all Bridge substructures resist the impact of landslides and/or ground movement on the trafficability of the Bridge.

(e) The Contractor shall use corrosion protection systems that permit the Transport Agency to overcoat after the Expiry Date with high durability long lasting corrosion protection systems.

23.2 Delivery Proposal

The Contractor will comply and will:

(a) adopt the proposed Bridge and foundation configurations and the nominated construction materials in accordance with Appendix 4 (Drawings) to this Schedule 11 and the Bridge Schedule in Appendix 7 (Bridge Schedule) to this Schedule 11;

(b) ensure Bridges intended for use by construction traffic are designed to Load Combination 4 (traffic overload case) for serviceability and ultimate limit state effects, in accordance with the Bridge Manual, and also ensure that construction vehicle gross and axle mass, position on Bridge, position with respect to other vehicles and speed is compliant with the design assumptions, in order to avoid structure overstress;

(c) use Barriers in the median across the full length of all TG Main Alignment Structures;

(d) progressively construct the replacement Bridge 26 (Collins Avenue) while maintaining not less than two three metre wide traffic Lanes in each direction on SH1 and at least one three metre wide traffic Lane on Collins Avenue at all times, unless otherwise agreed with the Transport Agency (with respect to SH1) or the Wellington City Council (with respect to Collins Avenue);

(e) provide a low level Bridge crossing of the Horokiri Stream at the Bridge 9 location to provide continuous access to the [redacted] local road, to the Transport Agency backland and to the [redacted]. Bridge 9 shall:

(i) have an Importance Level 1 in accordance with the requirements of the Bridge Manual, except as specifically modified below;

(ii) provide a single carriageway, with a minimum width of 7.5m, complete with concrete or timber kerbs and edge marker posts, and be capable of carrying a fully laden logging truck;

(iii) be designed to withstand a 1 in 50 year flood event, which may overtop the Bridge deck but without significant damage to the structure or the adjoining stream environment;

(iv) provide a waterway capacity capable of passing a 1 in 25 year flood event without water overtopping the Bridge deck; and

(v) include suitable provision for fish passage;

(f) for Bridges that exceed the Bridge Manual for length (including Bridges 25, 27 and 28) or skew (including Bridge 16) of integral Bridges, evaluate the effect of superstructure length change on supporting piles and provide adequate measures to ensure the Bridge approaches remain serviceable for not less than the Operating Term;

(g) ensure the proposed utility Culvert (at approximate chainage 20550) is designed and constructed as a Major Culvert;

(h) for the existing Greater Wellington Regional Council (GWRC) Tunnel No. 3 at approximate chainage 23175, undertake dilapidation surveys to record the condition of the tunnel before and after construction, plus demonstrate by finite element analysis that the anticipated strains from both construction and when in operation (including overweight and HPMV loading) will not adversely impact this structure;

(i) if weathering steel is being considered at any particular site, undertake site-specific chloride level studies as defined in HERA Report R4-97:2005 of not less than one year to establish if weathering steel is an appropriate alternative material, including for the mild steel superstructure elements on Bridges 3, 19, 20 and 28. If the first year corrosion rate, including microclimate effects, as calculated in accordance with HERA Report R4-133 is greater than 50µm, weathering steel must not be used;

(j) design and construct all Bridge abutments (including any soil nailed abutments) to meet the design working life requirements, including those set out in Works Requirement 5;

(k) design and construct for the Te Puka Stream high velocities at Bridge 3 and the increased risk of scour and abrasion to ensure the security of both the Structure and the stream bed;

(l) where steel box beams are used, provision shall be made for internal access for inspection and maintenance plus walkways for external access to the inner beams; and

(m) not be required to upgrade the existing MacKays Crossing road over rail Bridge in order to improve the live load or seismic capacity of the existing Structure merely as a result of it forming part of the TG Project, but the Contractor must ensure that it does not compromise the Bridge's existing performance.

Part 5 – Environment

24. Environmental management

24.1 Works Requirements

(a) The Contractor shall ensure that the design and construction of the TG Project avoids, remedies or mitigates any environmental effects, in accordance with the Designation and all relevant Consents and otherwise to the extent reasonably practicable in the circumstances.

(b) The Contractor shall ensure that, where necessary or required, stormwater treatment devices/structures are provided and maintained to treat runoff from within the TG Project Site, together with its contributing catchments, following construction of the TG Main Alignment and Kenepuru Link Road to mitigate potential adverse effects on receiving environments.

(c) The Contractor shall ensure that the stormwater treatment devices/structures used to treat runoff from within the TG Project Site and its contributing catchments, following construction of the TG Main Alignment and Kenepuru Link Road, achieve at a minimum removal of at least 75% of total suspended solids (TSS) on a long-term average basis based on the calculation of Water Quality Volume in accordance with section 6.3 of the Transport Agency's Stormwater Treatment Standard for State Highway Infrastructure (2010), taking into account climate change, or a higher percentage removal efficiency where necessary to meet the requirements of Works Requirement 24.1(b).

24.2 Delivery Proposal

The Contractor will comply and will:

(a) take into account a medium level of 2.1 degree climate change in accordance with the Ministry for the Environment *Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand*, 2nd Edition, May 2008;

(b) limit the length of stream modified to less than that impacted in the consented design;

(c) provide additional stream mitigation using the same model used for the Board of Inquiry (**BoI**) on sites where stream ecological values are reduced, including where Bridges have been replaced by other structures;

(d) select plant species that achieve the required ecological mitigation outcomes required by the Consent Conditions, minimise costs for Operational Services and provide ecological successions;

(e) provide not steeper than 1.5 (horizontal):1 (vertical) fully planted embankment slopes in the Te Puka and Horokiri Stream valleys; and

(f) revegetate and/or provide tailored planting treatments on erosion prone slopes above the TG Main Alignment.

25. Sustainability

25.1 Works Requirement

(a) The Contractor shall design and construct the TG Main Alignment and Kenepuru Link Road to achieve, as a minimum, a Silver certification under the Greenroads™ Rating System.

(b) The Contractor shall employ measurable sustainable design principles, including with respect to:

(i) energy and carbon management;

(ii) water management;

(iii) natural and recycled resources; and

(iv) waste management.

25.2 Delivery Proposal

The Contractor will comply and will:

(a) with respect to the Greenroads™ Rating System:

(i) design and construct the TG Project to achieve not less than a Silver certification; and

(ii) demonstrate Greenroads™ criteria through processes, evidence and documentation with Leighton Contractors' "Our Way" Management System;

(b) with respect to energy and carbon management:

(i) review supply chain for embodied energy in products and materials and, where practicable, recycle and reuse product to decrease embodied energy;

(c) with respect to water management:

(i) where available and appropriate, use other sources of water in preference to potable water for construction activities, including concrete mixing and dust control;

(d) with respect to natural and recycled resources:

(i) beneficially reuse clean-fill spoil as fill on site where practicable;

(ii) where possible, stockpile topsoil for later reuse in site rehabilitation; and

(iii) where possible, stockpile bark mulch from forestry harvesting activities for reuse in the permanent landscaping and stabilising programme; and

(e) with respect to waste management:

(i) adopt management and prevention of waste options in light of the construction methodologies chosen;

(ii) review activities generating waste to determine the potential for prevention, avoidance or reduction of waste generation by using alternative construction methods;

(iii) where waste cannot be avoided, adopt the potential for reuse of the waste material on site or off site where practicable;

(iv) segregate waste materials not fit for purpose for reuse for recycling;

(v) consider for energy recovery waste materials not able to be recycled;

(vi) consider suitability for disposal to a licensed clean fill site; and

(vii) ensure disposal to a licensed landfill is the last option in all cases.

26. Drainage

26.1 Works Requirements

(a) The Contractor shall design drainage based on:

(i) the Bridge Manual;

(ii) Austroads: Guide to Road Design, Part 5, Drainage Design;

(iii) Austroads: Waterway Design – A Guide to the Hydraulic Design of Bridges, Culverts and Floodways (1994);

(iv) TM-2502;

(v) Transport Agency's Stormwater Treatment Standard for State Highway Infrastructure (2010); and

(vi) Auckland Regional Council (ARC) Stormwater Treatment Devices: Design Guidelines Manual 2003 (TP10).

(b) The Contractor shall ensure that Culverts, excluding Temporary Culverts, servicing the TG Project:

(i) are capable of conveying the critical duration 10% annual exceedence probability (**AEP**) storm event taking into account climate change without head rising above the Culvert soffit; and

(ii) do not result in stormwater levels either being within 500 mm of any point in the TG Project carriageway level or being above the base of the subbase for the rainfall duration causing the maximum flood level for a 1% AEP storm event taking into account climate change.

(c) The Contractor shall provide for secondary flowpaths in the design.

(d) The Contractor shall ensure that the drainage design minimises erosion and that water does not compromise any structure, and/or surrounding slopes, where it has an impact on strength and stability.

(e) The Contractor shall ensure that the Drainage Systems servicing the TG Project are designed and constructed to ensure upstream and downstream flooding is no higher or of longer duration than that which has been predicted to occur for the design events used in Technical Report #14 (Transmission Gully Project – Assessment of Hydrology and Stormwater Effects).

(f) The Contractor shall ensure that water from batters or verges does not flow across the road surface.

(g) The Contractor shall ensure that, on curved alignments, water from the higher carriageway does not flow across the lower carriageway, except that, on the TG Main Alignment, the Contractor may allow surface water from the higher carriageway to flow across the lower carriageway on curved alignments where superelevation is developed with a single grading point and mitigating measures are taken to prevent concentrated flows across the lower carriageway and limit the risk of aquaplaning.

(h) The Contractor shall ensure that stream diversions meet the following criteria:

(i) the existing channel form, shape, gradient and long term ecological habitat shall be replicated as closely as possible;

(ii) sufficient flood plain shall be made available to allow for flood flows to be conveyed without significant increases in velocities; and

(iii) where any diversion results in a change in length and/or gradient, the stream banks surrounding the diversion shall incorporate measures to reduce any increases in velocities and any risk of erosion.

(i) The Contractor shall provide suitable maintenance access to all Drainage Systems elements.

26.2 Delivery Proposal

The Contractor will comply and will:

(a) design and construct the TG Project in accordance with Appendix 4 (Drawings) to this Schedule 11;

(b) develop the design in accordance with:

(i) the Drainage Design Philosophy Statement set out in Appendix 9 (Drainage Design Philosophy Statement) to this Schedule 11; and

(ii) its Finalised Drainage Design Report;

(c) provide calibrated hydrological/hydraulic models of the entire Drainage System;

(d) design the stormwater drainage system to attenuate storm events such that post development discharge does not exceed the pre-development discharge;

(e) use high density polyethylene (HDPE) pipe for the permanent Drainage System in seismic fault zones utilising welded joints or a seismically resilient mechanical jointing system;

(f) where there is the potential for gravel debris flows from hanging gullies, provide chutes down the face of cuts and minimum sized 1200 x 900 box Culverts;

(g) provide transverse Culverts under the TG Main Alignment to convey the 1% AEP peak flow with 500mm minimum freeboard and convey the critical duration 10% AEP storm event flow without heading up above the Culvert soffit;

(h) provide longitudinal drainage to convey the 10% AEP storm event with no encroachment into traffic Lanes, and a maximum encroachment into traffic Lanes of 1m in the 1% AEP event;

(i) provide scour protection at the toe of embankments where adjacent to streams that protect the strength and stability of the embankment against flooding up to and including the 1% AEP event;

(j) for curved alignments, where super-elevation is developed with a single grading point, allow surface water to flow from the upper carriageway to the lower carriageway where it can be demonstrated by graphical contours, and longitudinal sections of flow paths, together with the calculations compliant with TM-2502 that show the depth of flow in the design rain event does not exceed 4mm at any point within trafficable Lanes;

(k) for the Te Puka and Horokiri Stream diversions, engage an experienced ecologist to ensure it meets or exceeds the requirements of Consent Conditions G.52 to G.57;

(l) provide unlined channels that will retain their cross-sectional profile/shape and meet their design working life;

(m) provide suitable access arrangement to maintain bench and crest drains;

(n) provide measures to prevent rock debris and vegetation blocking the Drainage System; and

(o) provide stream diversion devices/Drainage Systems that achieve the design working life.

Part 6 – General requirements

27. Property agreements

27.1 Works Requirements

(a) The Contractor shall ensure that all works the Transport Agency has agreed to undertake under each of the Third Party Property Agreements are undertaken in accordance with requirements of the relevant Third Party Property Agreement, including as to communication, liaison, timing, scheduling and materials.

(b) The Contractor shall ensure that it protects land value by ensuring Surplus Land is not landlocked and that resale values for the Transport Agency are not otherwise unreasonably reduced as a result of the Contractor's actions. However, notwithstanding the foregoing, the Contractor shall not be required to prevent a property from being landlocked where Schedule 5 (Property) permits such property to remain landlocked on return to the Transport Agency.

(c) The Contractor shall remove all trees, tree fall and foliage from the Ranui Forest to the extent located to the east of the TG Main Alignment as part of its Works Provisioning (noting that the stumps are permitted to remain). The Ranui Forest includes all forest trees, tree fall and related foliage on the following parcels of land:

(i) PRN 100 Lot 2 DP 90736;

(ii) PRN 101 Lot 3 DP 78422;

(iii) PRN 102 Lot 4 DP 78422;

(iv) PRN 103 Lot 5 DP 78422;

(v) PRN 105 Lot 7 DP 78422;

(vi) PRN 106 Lot 7 DP 78422;

(vii) PRN 109 Lot 6 DP 78422; and

(viii) PRN 110 Lot 1 DP 82381 (ID 4039600).

27.2 Delivery Proposal

The Contractor will comply.

Part 7 - Construction

28. Construction

28.1 Works Requirements

(a) The Contractor shall ensure that all specifications used are documented in accordance with the State Highway Asset Management Manual SM020 (August 2000).

(b) Health and safety shall be a key focus for the Contractor, with nil serious harm during construction being the target. The Contractor shall adopt a "zero harm" approach to health and safety management. The Contractor shall maintain all company and Sub-contractor health and safety data for their New Zealand operations on the SafeStat website, and make it available to the Transport Agency.

(c) The Contractor shall comply with the requirements of the Code of Practice for Temporary Traffic Management (COPTTM) and, for the avoidance of doubt, the Contractor does not have the powers referred to in Appendix B (Code of Practice for Temporary Traffic Management) of Schedule 12 (Service Requirements) prior to the Service Commencement Date.

(d) All temporary traffic management plans affecting the existing State Highway and Local Road network shall be consistent with the "Transmission Gully Project - Draft Construction Traffic Management Plan (Draft F)".

(e) The Contractor shall ensure that the Works Provisioning is delivered by a competent and experienced team, which shall include, as a minimum, personnel with specific experience in the following areas:

(i) design (including Resource Management Act 1991 specialists);

(ii) construction; and

(iii) commissioning.

(f) The Contractor shall only be permitted to replace the key staff listed below in circumstances of death, serious injury, change of employment or otherwise as agreed with the Transport Agency (with the Transport Agency's consent not to be unreasonably withheld).

28.2 Delivery Proposal

The Contractor will comply and will utilise the following key staff in the delivery of the Works Provisioning:

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
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[redacted]	[redacted]

Appendix 1: TG RoNS Standards

See document #15950640, entitled "Transport Agency's Roads of National Significance – Design Guidelines Applicable to Transmission Gully".

RoNS Design Guidelines Applicable to Transmission Gully

1. Background and Purpose

1.1 Application

This document defines the Guidelines to be applied to the Transmission Gully RoNS project. It should be noted that the main alignment of Transmission Gully (i.e., from Linden to MacKays Crossing) will be designated 'motorway'.

The existing section of road north of CH690, including the MacKays Crossing interchange, need not be upgraded to comply with these RoNS design guidelines applicable to Transmission Gully, provided that the Contractor implements appropriate mitigation and improvement measures to meet the safety and performance requirements of the MacKays Crossing interchange in its revised configuration and function.

1.2 Design Guidelines for Transmission Gully.

The Design Guidelines contained in the following sections are a subset of the standards and guidelines contained in the various publications, principally AUSTROADS and NZTA, that set the standards and guidelines for all state highway projects. The purpose of this subset is to provide a standard for the Transmission Gully RoNS project that is consistent with all other RoNS projects, but adapted where necessary for the specifics of Transmission Gully through approved Transmission Gully-specific departures.

2. Geometric Guidelines

The design of Transmission Gully shall reflect the requirements of the Austroads *Guide to Road Design (AGRD)*, the RoNS Guidelines and the Safe System approach. It must comply with the following geometric guidelines, but such guidelines do not detract from any requirements to provide safe roads:

(i)	Number of lanes	Four, dual 2two-lane minimum. Evaluation of theThe need for additional auxiliary/crawler lanes is to be assessed in accordance with AGRD Part 3, Section 9.
(ii)	Design Vehicle	25m long High Productivity Motor Vehicle (HPMV), except in the case of horizontal geometry only, where an 18m semi-trailer as described in LTNZ publication 'RTS18 New Zealand on-road tracking curves for heavy motor vehicles, August 2007' shall be used.
(iii)	Design Speed	110 km/hr for the TG Main Alignment, except with respect to the design of the Linden interchange northbound exit Ramp, for which a design speed of 100 km/hr may be used. 70km/hr for the Kenepuru Link Road.
(iv)	Gradient Limits	Maximum 8% for the TG Main Alignment. Maximum gradients for Ramps in accordance with AGRD Part 4C Table 9.2 except that: (A) a downhill gradient of not steeper than -6.6% with respect to the Kenepuru Link Road southbound exit Ramp would be acceptable, provided that a safe stopping distance is provided to the point defined by the back of the maximum expected queue length;

(B) an uphill gradient of not steeper than 6.7% with respect to the Kenepuru Link Road northbound entrance Ramp would be acceptable;

(C) a downhill gradient of not steeper than -8.0% with respect to the SH58 northbound exit Ramp would be acceptable, provided that a safe stopping distance is provided to the point defined by the back of the maximum expected queue length; and

(D) an uphill gradient of not steeper than 8.5% with respect to the SH58 southbound entrance Ramp would be acceptable, provided that the entrance ramp is configured as a lane gain into an auxiliary lane extending to the James Cook southbound exit Ramp.

Maximum 10% for the Kenepuru Link Road.

Long gradients require consideration of crawler lanes for safety and efficiency.

Long down-hill gradients require consideration of truck attenuation devices (arrester beds).

(v) Sight Distance

Based on reaction time of 2.5 seconds and a deceleration rate of 0.26g, except that:

(A) past horizontal sight distance obstructions and on individually assessed crest curves, neither coinciding with sight distance requirements at interchanges, a deceleration rate of 0.36g would be acceptable;

(B) a stopping sight distance of at least 165m to an object height of 0.2m on the northbound carriageway between chainages 5100 and 5900, being the stopping sight distance required for 110 km/h with a 2s reaction time and 0.46g m/s2 deceleration rate on a level gradient, plus incremental gradient corrections as necessary up to 183 m for -7%, would be acceptable;

(C) a stopping sight distance of at least 183m to an object height of 0.2m on the southbound carriageway between chainages 4700 and 6000, with the exception of chainage 4820, where a momentary stopping sight distance of 180m would be acceptable;

(D) at least 183m stopping sight distance to an object height of 0.2m over crest vertical curvature of the road surface between approximate chainages 18300 and 19300, with the exception of approximate chainages 19480 and 19120, where a momentary stopping sight distance of 177m would be acceptable;

(E) a stopping sight distance of at least 110m to an object height of 0.2m over crest vertical curvature of the road surface on the Kenepuru Link Road

(F) on the crest vertical curve over the NIMT crossing on the proposed new northbound entrance ramp at the MacKays Crossing interchange, a stopping sight distance of not less than 114m would be acceptable;

(G) on the SH58 interchange exit and entrance ramps, a reaction time of not less than 2.0s and deceleration rate of 0.36g would be acceptable;

(H) on the James Cook interchange exit and entrance ramps, a reaction time of not less than 2.0s and deceleration rate of 0.36g would be acceptable;

(I) a sight distance of at least 180m past Barriers and other sight line obstructions on the edge of both northbound and southbound TG Main Alignment carriageways in horizontal curves, except:

- (i) between chainages 5100 and 5900 on the northbound carriageway, where 177m sight distance would be acceptable;
- (ii) between chainages 25000 and 26000 on the northbound carriageway, where 167m would be acceptable;
- (iii) on the Linden interchange northbound semi-directional ramp, where 154m sight distance would be acceptable; and
- (iv) between approximate chainages 1500 and 1800, where the existing SH1 alignment is adjusted to allow the Bridge 27 pier to land in the median, where at least 155m would be acceptable;

(J) for the Kenepuru Link where a minimum sight distance of 73m past sight line obstructions on the inside of horizontal curves would be acceptable; and

[redacted]

all provided that the Contractor shall assess, manage, raise driver awareness, increase visibility, and mitigate by means of appropriate physical and operational measures, all safety risks that may be associated with exceptions (A) to (K).

(vi) Horizontal Curves	Radius at 110 km/hr : Desirable 1100m, Minimum 720m, except that 400m would be acceptable between approximate chainages 1500 and 1800 on existing SH1 where the alignment is to be adjusted to allow the Bridge 27 pier to land in the median.
	Superelevation and Warp: Desirable 4%, Maximum 6%, except that a maximum superelevation of 7.2% would be acceptable on the Kenepuru Link Road, and a maximum superelevation of 7.0% would be acceptable on existing SH1 between approximate chainages 1500 and 1800.
	Desirable maximum warp rate of 2%/s subject to consideration of potential for aquaplaning, except that a maximum warp rate of 2.5%/s would be acceptable on

		Ramps and the Kenepuru Link Road and the existing SH1. Curve Length (inclusive of spirals): Desirable 500m, Minimum 300m. 'Case 1 Broken Back' curves ~~should~~ shall not be used and the use of 'Case 2 Broken Back' curves is discouraged. Spirals: Geometric spirals should be considered where the alignment is curvilinear and should be used where there is a change in superelevation between successive elements.
(vii)	Vertical Curves	K Values: Consistent with sight distance. Eye Height 1.1m. Object height of 0.2m on main alignments. Object height of zero at intersections. Sag curves to AGRD Part 3, Figure 8.7.
(viii)	Lane Width	Traffic lanes: 3.5m.
(ix)	Shoulder Width (Road Section)	2.5m minimum ~~adjacent to two lane sections of road.~~ outside shoulder width adjacent to TG Main Alignment and existing SH1 general traffic through lanes (including the southbound weaving Lane on the TG Main Alignment between SH58 and the James Cook interchange), except that this width shall be increased to at least 3m adjacent to roadside protection (Refer 3.2 (i)), and except that [redacted] ~~1m minimum adjacent to three lane sections of road.~~ 1m minimum outside shoulder width adjacent to crawler or climbing lanes (not including the southbound weaving Lane on the TG Main Alignment between SH58 and the James Cook interchange), whether or not a safety barrier is required. 1m minimum inside shoulder width adjacent to medians, except that [redacted] 1m minimum inside shoulder width and 2m minimum outside shoulder width adjacent to Ramps. ~~3m minimum adjacent to roadside protection (Refer 3.2 (i))~~1.5m minimum outside shoulder width on the Kenepuru Link Road.
(x)	Shoulder Width (Bridges)	Shoulder widths carry through structures, except for bridges longer than 30m where a 2.5m shoulder width applies unless there is a constraint proven to apply

3. Clear Zones, Medians and Barriers

3.1 General

The requirements of TM-2503 *Guidelines for Edge Protection and Medians on Dual Carriageway Roads, incorporating a Safe System Philosophy* must be reflected in the design of the roadside, medians and the use of safety barrier systems. All barrier systems must comply with the *United States National Cooperative Highway Research Program (NCHRP) 350* standard. The minimum requirement for all aspects of the Transmission Gully project (i.e. the Motorway and State Highways) is NCHRP350 Test Level 4 (TL4)~~,~~. ~~t~~The choice of barrier system must take into account:

(i) Containment Area: The width of the area must accommodate both the physical dimensions of the barrier system and any deflection of the system on impact.

(ii) Post Impact Performance: The performance of the system following a design level or greater impact prior to repair must be considered

(iii) Ease of Repair: The ability to readily repair a system safely and with minimal disruption to traffic must be considered.

3.2 Road Side Protection

(i) Safety Barrier System: The preferred safety barrier system ~~shall be~~is a wire rope barrier. The~~ minimum~~ distance from the lane edge to the ~~wire rope ~~barrier system must be at least ~~3m~~equal to the shoulder width and at least 1.5m in medians, except that a localised reduction to at least 1.0m in medians would be acceptable where rigid barrier protection is required to gantry supports located in the median. The level of side protection should be increased (from the TL4 minimum) where there is a significant increase in the level of risk to high centre of gravity vehicles or there is a hazard that requires a higher level of protection.

(ii) In accordance with the philosophy described in TM2503, consideration may be given to providing a run-out area rather than a safety barrier where the roadside treatment does not result in an increase in the risk of death or serious injury. The minimum clear zone width must be 9m with a 3m minimum run-out at the foot of a traversable slope. The clear zone desirable slope is 10:1 or flatter with a maximum slope of 6:1 and it must be clear of hazards that could be impacted at such speed as to cause death or serious injury.

3.3 Median Protection

(i) The desirable median width is 6m edge line to edge line (which includes a 1m inside shoulder on each side). The minimum median width is the greater of that defined by the Containment Area requirement (3.1(i)) or 4m~~.~~), except that between approximate chainage 2700 and 7300, a median width of no less than 3m would be acceptable, provided that the Contractor shall assess, manage, raise driver awareness, increase visibility, and mitigate by means of appropriate physical and operational measures, all safety risks that may be associated with this exception; and provided that in particular the Contractor shall ensure that:

(A) there is no central median drainage;
(B) the barrier is located centrally within the median at the crown of the road;
(C) the tested barrier deflection distance is not greater than 1.2m;
(D) the horizontal curvature has a radius of not less than 3000m; and
(E) any width transitions and deviations in the alignment of the median edges are smooth.

Long lengths of minimum width median should be avoided.

(ii) All medians are to contain a barrier. A wire rope barrier is the preferred system.

(iii) Median crossfalls must not compromise the performance of the barrier system. Where the road is ~~super-elevated~~superelevated, the median crossfall shall be no steeper than 1 in 10.

(iv) Where the road is superelevated, the median barrier should be off-set to provide the appropriate level of forward visibility through the curve.

~~(iv) A full width, fully paved, median crossing (for emergency vehicle turning only) must be provided every 3km.~~

4. Intersections

All intersections on the main alignment must be grade separated.

5. Bridges and Other Structures

The design of new Bridges and Other Structures must comply with the current draft of the new NZTA Bridge Manual SP/M/022 (3rd Edition). Specific consideration must be made of:

(i) Live Load Capacity: The minimum requirement is compliance with the current design loads standard, i.e. HN-HO-72.

(ii) Vertical and Horizontal Clearances: The Preferred Minimum Standards for over-dimension loads of 6m vertical and 12m horizontal must be provided for.

(iii) Scour: The risk of scour must be assessed against NZTA *Scour Screening Procedures* and if necessary a detailed scour assessment must be completed.

(iv) Seismic Design: A seismic assessment must be undertaken for all bridges and major structures.

(v) Global Warming: Global warming must be considered on a case by case basis.

6. Walking, Cycling and Public Transport

6.1 Local Strategies

Any local walking, cycling or public transport strategies must be taken into account.

6.2 Walking

(i) On road pedestrians will not be accommodated on the Transmission Gully Motorway.

(ii) Off road pedestrian facilities are to be provided and promoted wherever practicable, including use of old state highway lengths.

(iii) Where there is the potential for TG to create community severance issues, adequate walking facilities must be provided appropriate to the road classification. i.e. by grade separated crossings, for the motorway, or at grade for a local or non-motorway road. The design of these must recognise safety, alignment and multi-modal considerations and must recognise desire lines that minimise the need for the pedestrian to walk further distances. This also applies to cyclists on dual-use paths. Crossings must link into any walking or cycling networks and to any public transport services.

6.3 Cycling

(i) On road cyclists will not be accommodated on the Transmission Gully Motorway.

(ii) Off road cycle facilities are to be provided and promoted wherever practicable, including use of old state highway lengths.

6.4 Public Transport

For Transmission Gully, public transport stops and bus lanes need not be provided on the motorway. ~~However, in relation to the Kenepuru Link Road State Highway, the design must allow for a future retrofit of bus stops, and future safe use by public transport buses.~~

6.5 Pavement Type

The selection of a rigid pavement over a flexible pavement should be considered particularly if the adopted design loading exceeds about $1x10^7$ EDA as experience has shown that early flexible pavement failure may occur in some cases. Staged development, whereby a structural addition is applied after some years of operation should also be considered. Refer to the New Zealand Supplement to the Document, *Pavement Design – a Guide to the Structural Design of Road Pavements (Austroads 2004) 2007*.

7. Highway Furniture and Facilities

7.1 Traffic Signs

(i) All traffic signs must comply with MOTSAM and its replacement, the Traffic Control Devices Manual (TCDM) and Specifications.

(ii) All traffic signs must have either graffiti guard or dew guard sheeting as appropriate to their location.

7.2 Road Markings

As a minimum:

(i) All road markings must be installed and maintained to NZTA P30 Specification for High Performance Roadmarking (updated as at the date of construction) including performance in the Condition of Rain.

(ii) Edge-lines, both left and adjacent to medians, and centre-lines, must be a minimum of 150 mm wide.

(iii) Audio tactile profiled markings must be installed on all edge-lines and yellow no-overtaking lines except where nearby residents could be disturbed by the noise they generate.

(iv) Lane lines on dual carriageways must be audio tactile stripes rather than ceramic studs.

7.3 Highway Lighting

(i) Full highway lighting must be provided at intersections and at interchanges.

(ii) Flag lighting must be installed as a minimum at all minor intersections.

7.4 Stopping Places

(i) Driver fatigue is an issue of increasing concern to road safety interests and therefore the construction of safe, well-designed and positioned highway stopping places is an integral part of RoNS. Guidance for the location and design of these is provided in NZTA's Highway Stopping Places Strategy.

(ii) Police enforcement of driving behaviour will be an on-going priority on state highways, therefore suitably designed places for patrol vehicles to stop are a necessity. Liaison with local highway patrol officers should be undertaken to establish appropriate places to incorporate these.

Appendix 2: Pavement surfacing requirements

Table 1 Skid resistance minimum levels

Site category	Skid site description	Minimum level, units ESC					
		0.25	0.30	0.35	0.40	0.45	0.50
1	Approaches to: • Railway level crossings • Traffic signals • Pedestrian crossings • Stop and give way controlled intersections (where state highway traffic is required to stop or give way) • Roundabouts One Lane Bridges: • Approaches and Bridge deck						
2	Urban curves <250m radius						
	Rural curves <250m radius			L	M	H	
	Rural curves 250-400m radius		L	L	M	H	
	Down gradients >10% On Ramps with ramp metering						
3	State highway approach to a Local Road junction Down gradients 5-10% Motorway junction area including on/off Ramps Roundabouts, circular section only						
4	Undivided carriageways (event-free).						
5	Divided carriageways (event-free).						

Notes to Table 1:

- the curve risk rating on rural curves with radii 0-400m is shown as H, M or L (high, medium or low-risk curves) in the appropriate greyed minimum level band under site categories 2b and 2c. Two options are available for rural low-risk sites with radii between 250m and 400m. Urban curves with a radius less than 250m are site category 2a.

- the units for minimum level in table 1 are equilibrium SCRIM coefficient (ESC), ESC, being the average of the left and right wheelpaths. Where seasonally corrected data is not available, SCRIM coefficient (SC) may be used as an approximation to ESC with further checks undertaken when seasonal corrections are available.

- the threshold level for the skid resistance (TL) is the appropriate value detailed in Table 1 or 0.30, whichever is higher.

Table 2 Minimum macrotexture requirements

Minimum macrotexture - mean profile depth (MPD mm)		
Permanent speed limit	**Chipseal**	**Asphaltic concrete**
	Minimum level	**Minimum level**
50km/h and less	0.7	0.5
Less than or equal to 70km/h but >50km/h	0.7	0.5
Greater than 70km/h	0.7	0.7

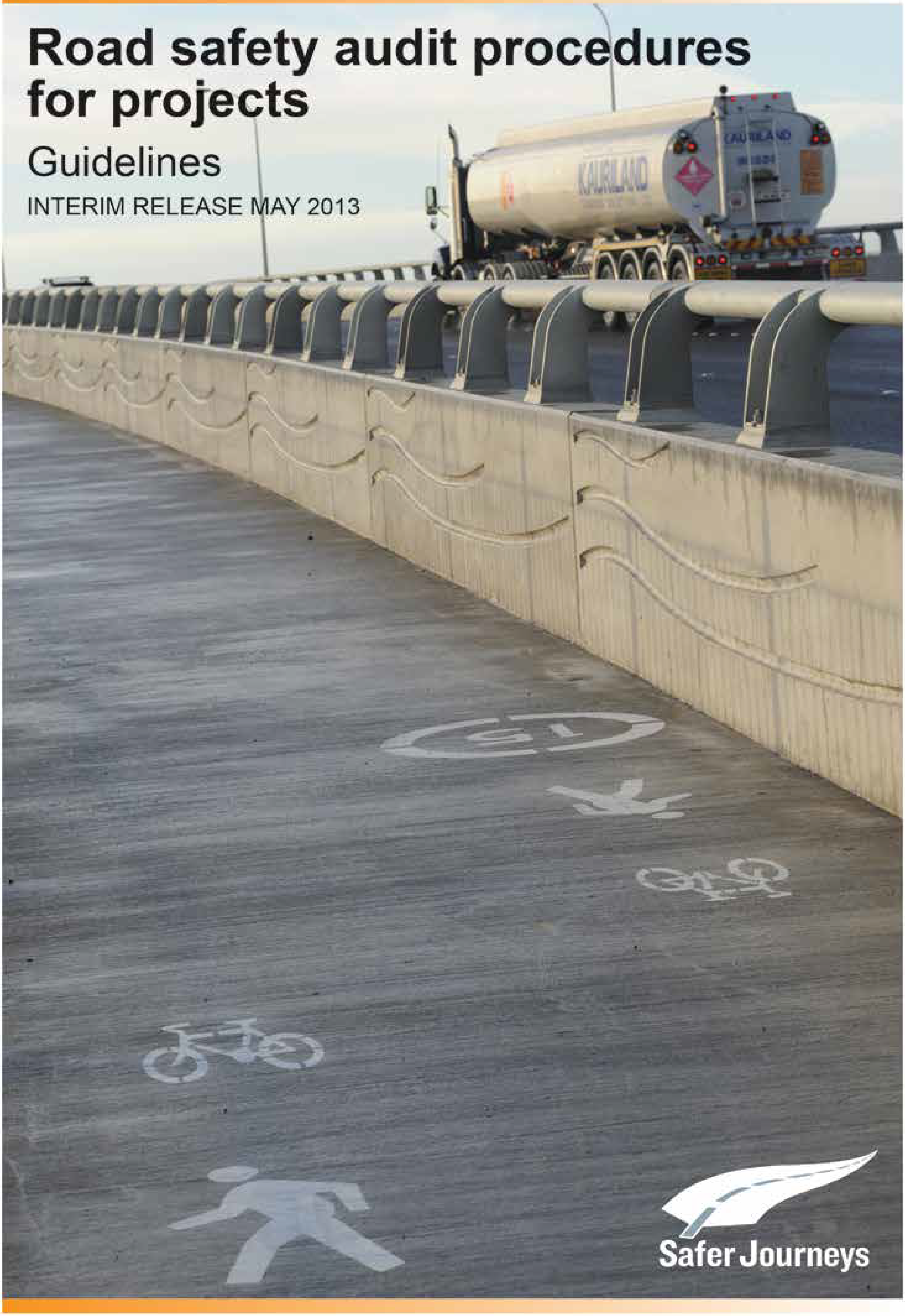
Appendix 3: Road Safety Audit Procedures

See document #15261475, entitled “Road Safety Audit Procedures for Projects - Guidelines (Interim Release May 2013)”.

Road safety audit procedures for projects

Guidelines

INTERIM RELEASE MAY 2013



Safer Journeys

ROAD SAFETY AUDIT PROCEDURES FOR PROJECTS

This document provides guidelines for road safety audit procedures in New Zealand. It updates and replaces *Road safety audit procedures for projects. guideline* (Transfund New Zealand. 2004), Transfund New Zealand manual no. TFM9.

It has been produced by a working group as below convened by NZ Transport Agency (NZTA) that is representative of the roading industry.

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This issue is an interim release to operate for a trial period during which we would be grateful for feedback from all users on the merits and deficiencies of these procedures. Please email any comments to RSAuditTrial@nzta.govt.nz.

Austroads has also published road safety audit procedures and these are currently under review with a revision expected to be complete by late 2014. When the revised Austroads procedures are complete, they will be considered alongside the procedures in this document and the experience gained from using these procedures during this trial period. After this, finalised guidelines will be produced.

Written by TDG for the NZ Transport Agency on behalf of the roading industry

NZ TRANSPORT AGENCY
WAKA KOTAHI

TDG

The NZTA is part of, and contributes to, the Safer Journeys programme. Safer Journeys is the government's strategy to guide improvements in road safety over the period 2010–2020. The strategy's vision is a safe road system increasingly free of death and serious injury.

It is a coordinated effort across partner agencies to improve each aspect of road safety – better behaviours, a safer road environment, safer speeds and higher vehicle standards.

For more information, visit www.saferjourneys.govt.nz.

www.nzta.govt.nz

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CONTENTS

1. INTRODUCTION

Road safety audit definition

A road safety audit is a term used internationally to describe an independent review of a future road project to identify anything that may affect the road's safety. The audit team considers the safety of all road users and qualitatively reports on road safety issues and opportunities to improve safety.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

Objective

The primary objective of a road safety audit is to help ensure a project achieves an outcome consistent with Safer Journeys and the Safe System approach – that is, minimisation of death and serious injury. The road safety audit identifies all areas of a project that are inconsistent with a safe system (refer to section 3) and brings those concerns to the attention of the client, so the client can choose appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

> To deliver completed projects that contribute towards a safe road system that is increasingly free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.

Essential elements

The essential elements of a road safety audit are that the audit:

- focuses on the safety aspects of the project
- is carried out by people who are independent of the client, designer or contractor
- is carried out by people with appropriate experience and training, and who understand the Safe System approach
- is a formal documented process
- considers all potential road users
- requires a formal documented response from the client.

A road safety audit is not intended to be:

- a substitute for a quality control review, a design review or a peer review
- a judgement of the quality of a project (as the project will likely have other components)
- a compliance check with standards, guidelines or drawings and specifications (a separate review is required for this purpose noting that compliance with standards or other documents does not necessarily result in a safe system)
- a redesign of a project

- an informal check, inspection or consultation
- a means of ranking or comparing one project or option over another (although it may form part of the decision process).

Engineering standards and guidelines provide a sound starting point from which a good design can evolve. However, their application alone does not necessarily result in the safest road environment. Road safety audits provide a further means of checking road safety outcomes.

2. Benefits of road safety audits

Road safety audits will:

- help achieve the objectives of a safe system by providing a safer road network with self-explaining roads
- minimise the risk of high-severity crashes that may result from design deficiencies in a proposed road project
- minimise the need for rework and physical remedial works caused by road safety deficiencies at the various stages of project development, including construction
- reduce the whole-of-life costs of the project
- improve the awareness of, and contribute to, improvements in safe design practices.

The cost of a road safety audit and the consequent cost of changing a design are significantly less than the cost of remedial treatments after works have been constructed, or the social cost of road crashes. It is easier to change design plans than to move or alter construction works. However, conducting post-construction road safety audits is still important as the cost of any remedial work may well be less than the cost of crashes that may arise.

3. SAFER JOURNEYS

The road safety strategy Safer Journeys guides road safety initiatives in New Zealand from 2010 to 2020. The long-term goal for road safety is encompassed in the strategic vision as *'a safe road system increasingly free of death and serious injury'.*

Safer Journeys

'A safe road system increasingly free of death and serious injury'

This vision recognises that it is impractical to prevent all road crashes from occurring and focuses efforts on reducing deaths and serious injuries as a consequence of crashes.

In order to achieve this vision Safer Journeys advocates taking a Safe System approach to road safety. The Safe System approach is based on a 'shared responsibility' between system designers and road users, and improving all elements of the road system including roads, speeds, vehicles and road use.

Safe System approach

The Organisation for Economic Co-operation and Development (OECD) has recognised that 'A fundamental policy shift, characterised as the Safe System approach, is required both to consolidate the significant improvements in road safety in recent decades and to generate further gains in the future'. At the heart of the Safe System approach is the recognition that people make mistakes and some crashes are inevitable but that no one should pay for a mistake with their life or limb.

'In a Safe System, a road user who is alert and compliant should not die or be seriously injured while using our roads'

The Safe System approach focuses on creating safe roads, safe speeds, safe vehicles and safe road use.

System designers, system users and the whole community must share responsibility for managing crash forces in order to achieve the Safe System vision. If road users are alert, comply with the road rules and travel at safe speeds, they should be able to rely on the road, roadside features and the vehicle to protect them from death or serious injury.

The key relationships and responsibilities of the Safe System approach are depicted in figure 3.1. Together, they make up the four cornerstones of the Safe System approach.

Figure 3.1 Safe System cornerstones

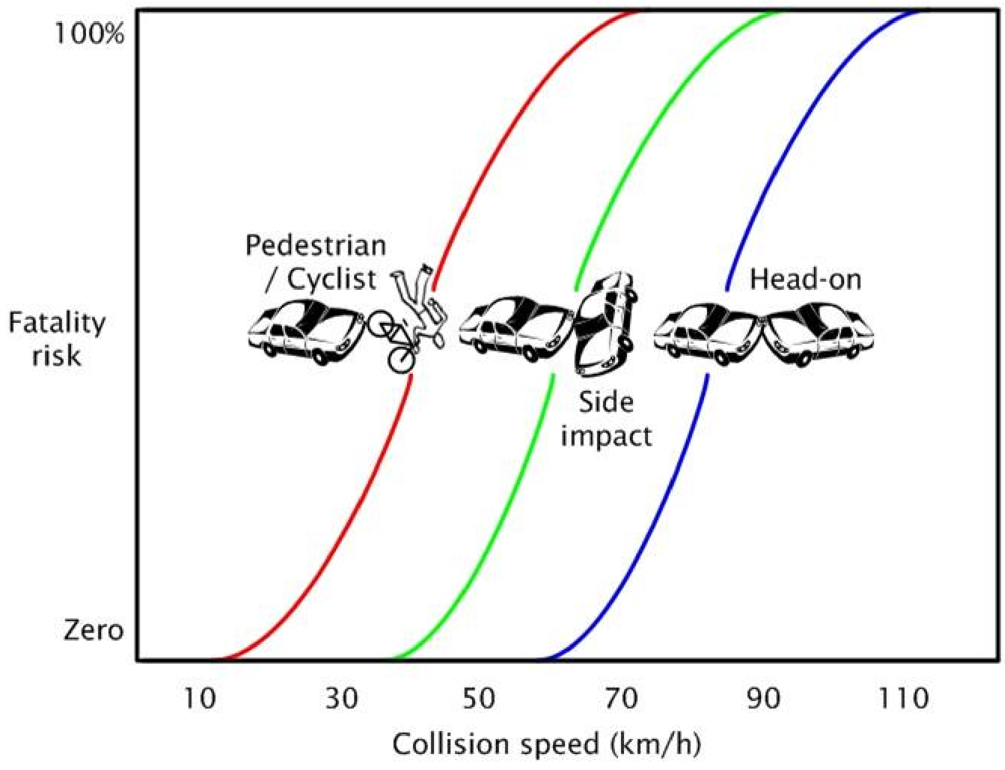
Managing crash forces

The Safe System approach recognises the limitations of the human body's ability to withstand crash forces without death or serious injury and so advocates that crash forces should be managed so they do not exceed those limits. Effectively this means either adequately protecting road users from high crash energies through vehicle and infrastructure design or reducing the impact forces by reducing travel speeds.

Human tolerance to crash forces at different speeds is clearly demonstrated in the probability of survival 'S' curves in figure 3.2 and the appropriate speed thresholds based on those curves given in the bar graph in figure 3.3.

> **Safe System principles**
>
> We need to recognise that people make mistakes and some crashes are inevitable
>
> Our bodies have limited ability to withstand crash forces without being seriously injured or killed
>
> System designers and the people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury
>
> We need to improve the safety of all parts of the system – roads and roadsides, speeds, vehicles, and road users so that if one part fails, other parts will still protect the road user

Figure 3.2 Risk of fatality versus speed



As an example of application, the risk of a pedestrian or cyclist being killed or seriously injured by a car increases significantly when travelling over 30km/h. A safe system would protect pedestrians and cyclists by providing safer road infrastructure, by encouraging the uptake of vehicles that inflict less harm on vulnerable users in a crash, by managing speeds to reduce the risk of serious injury and by both the drivers and the vulnerable user being alert to and aware of the risks associated with their interaction so they can both behave accordingly.

Implications for road safety audit

The role of the safety audit in the current environment is to identify aspects of the project that are inconsistent with both the Safer Journeys vision of a safe road system increasingly free of death and serious injury and with the Safe System approach, ie where deaths and serious injuries may result from road user errors. The decision makers must assess the potential consequences and frequency of these risks and how these could be addressed or eased within a value for money framework. It is recognised that while road safety audits of projects tend to focus on the road and the interrelationship of the driver with the road, all cornerstones of a safe system are important and intertwined.

Safe System focus in safety auditing

Provide forgiving roads and roadsides

Limit crash forces to prevent fatal and serious injuries

Understand road user perception of roads and roadsides

Consider both historic and predictive modelling

Consequently, the ability of the road safety audit procedures to support an ongoing system improvement programme such as the dissemination of current knowledge, feedback from audits and monitoring of performance plays a key role in the delivery of a safe system.

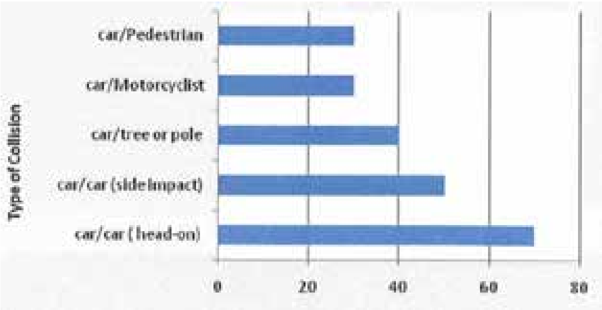
Road safety auditors must be aware of the Safe System guidelines and associated research that are being continually developed with respect to road elements. Asset managers, clients, designers and safety auditors are therefore encouraged to remain current with safety research.

Figure 3.3 contains some examples of the information currently available about how to achieve the Safe System objectives. Note that these examples focus on the provision of forgiving roads and roadsides that are more accommodating of human error, and managing the crash forces to a level that the human body can tolerate without serious injury.

Figure 3.3 Examples of the information currently available about how to achieve the Safe System objectives

Consider safe speeds appropriate to the road environment based on the chance of surviving a particular crash type.

Survivable impact speeds for different scenarios (source: Figure 7 – Australian Road Safety Strategy 2011–2020)



Consider intersection forms that produce safe speeds appropriate to all road users and minimise points of conflict.

Consider appropriate forgiving treatments for motorcyclists, including surfacing, sudden changes in grade and roadside hazards.

Consider using the most forgiving roadside treatments, such as flexible barriers.

Ratio of fatal and serious injuries per injury crash for various roadside hazards and barriers
(source: Austroads ST1427 Final Draft)

Hazard type	Fatal/serious injuries per run-off road injury crash (100km/h)
Poles	0.81
Tree (shrub/scrub)	0.75
Fence/Wall	0.55
Embankment	0.53
Rigid barrier	0.50
Semi-rigid barrier	0.60
Flexible barrier	0.33
No hazard hit	0.43

4. TYPES OF PROJECTS THAT MAY BE SAFETY AUDITED

Road safety audits are applicable to all types of road projects, on all types of roads. Projects can be as small as a pedestrian crossing or set of road humps, or as large as a motorway. The scope of audits ranges from everything within the road corridor to specific facilities such as those for cyclists and pedestrians and may be located within a public road, other public property or private property. All projects can benefit from a road safety audit.

Thus it is not the scale of the project that is important. What is critical to achieving the Safe System goal is the scale of any potential risk that may result from the project. For example, a low-cost traffic management scheme that places pedestrians at risk could have a severe crash potential, because pedestrians are vulnerable to injury, particularly at higher traffic speeds.

The method of procurement should not be a deterrent to ensuring that the principles of road safety audits are followed. An example is Design and Construct: for projects of this nature it is important that the independence of auditors is not compromised by the respective objectives of the client and contracted parties. The authority to make decisions about a road safety audit's recommendations and the responsibility for their implementation should be clearly defined in the contract between the client and the contracted parties.

Road safety audits can be conducted on road projects that include, but are not limited to:

- major divided roads
- expressways and motorways
- reconstruction and realignment
- intersection upgrades or installations
- pedestrian and cycle routes and facilities
- temporary traffic management schemes (from a safe system perspective, not as a compliance review)
- local area traffic management schemes (such as commercial areas and residential streets), and their component parts
- intelligent transport systems
- subdivision roads
- minor safety works
- seal extensions, pavement rehabilitation, seal widening.

Road safety audits can also be conducted for off-road projects (such as commercial developments) where safety concerns are likely to arise from:

- vehicle–pedestrian conflicts in a new carpark
- increased numbers of pedestrians crossing the adjacent road
- a spillover of parking onto an adjacent busy road
- location of access ways
- restricted visibility or delays where vehicles access the development
- changed public transport circulation and access by users
- changed access/egress/unloading for service vehicles.

5. Definitions

Road controlling authority (RCA)
The organisation charged with managing the road asset.

Asset manager
The organisation ultimately responsible for managing the asset. For most road projects this will be the RCA.

Client
The organisation commissioning the project. For many road projects this will be either the RCA or the developer.

Project manager
Person delegated to manage the project on behalf of the client.

Safety engineer
Advisor to the client on safety issues. Where the asset manager differs from the client, a safety engineer may be separately engaged to advise each party.

Designer
The team undertaking the investigation, or the design, or the supervision of the construction of the project. 'Designer' is a generic term and may be part of the RCA, consultant or contractor's organisation.

Contractor
The team engaged by the client to construct the project.

Road safety audit team
The team undertaking the audit (refer to section 7 for team members).

Project
Any work that results in a change in nature or use of an asset that is/will be under the control of an asset manager.

Road
In the context of this guideline, the term 'road' refers to any area that may be frequented by either a motorised or a non-motorised member of the public.

Parties to a road safety audit

The parties typically involved in the road safety audit vary but typically include the client, asset manager (where different from the client), designer and/or contractor and the road safety audit team.

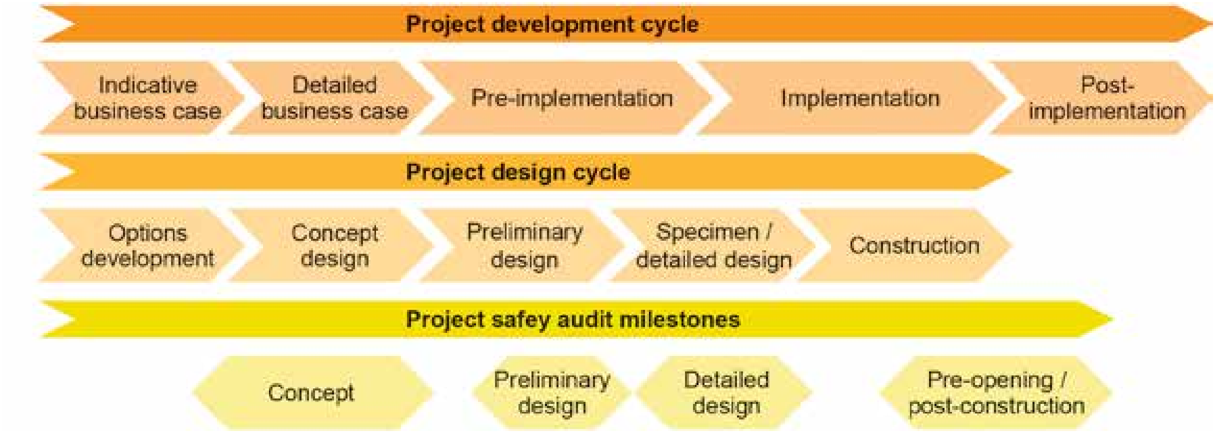
6. WHEN TO UNDERTAKE A ROAD SAFETY AUDIT

A road safety audit should be undertaken at project milestones such as:

- concept stage (part of a business case)
- scheme or preliminary design stage (part of pre-implementation)
- detailed design stage (pre-implementation or implementation)
- pre-opening or post-construction stage (implementation or post-implementation).

These milestones align approximately with the development cycle of a project as depicted in figure 6.1.

Figure 6.1 Road safety audit milestones within project development cycle



These stages should not be seen as rigid, as all projects are not the same and smaller projects will not always follow all the development stages. The stages of a road safety audit should match the project's complexity and actual development stages. However, the earlier an audit is undertaken, the easier and less expensive it is to make changes. A road safety audit only at the post-construction stage should be avoided, as often it is too late to make significant improvements if required.

It is recommended that each road controlling authority embed the requirements for a road safety audit of projects in appropriate policy documents, including but not limited to Asset Plans, Safety Management Systems and Development Codes. As a minimum it is recommended that a road safety audit be undertaken at the design stage for all works within a public space. For requirements specific to a particular road controlling authority, refer to the policy of that authority.

Occasions will arise when a client will consider the need to conduct other types or stages of road safety audit, such as for:

- the design philosophy stage
- intermediate critical milestones – for example, Design and Construct projects may need road safety audits progressively throughout the design process (see 'Requirements for specific procurement models' below)

- traffic management changes in road layout or an environment of a temporary nature such as during physical work (this is not a compliance audit with standards which are separately reviewed and documented in a code of practice, eg COPTTM[1])
- a repeat road safety audit, if major changes result.

Desirably a post-construction road safety audit should be undertaken before opening the project for public use. If in practice this is not possible, the road safety audit should be undertaken as soon after opening as possible. For projects that are constructed in sections, the road safety audit may be conducted at the completion of each section.

Exemption from road safety audit

As noted above, it is not expected that all projects will require all stages to be safety audited. For example, smaller-scale local authority projects may be considered by the asset manager to warrant only a detailed design stage safety audit.

Where an asset manager decides a road safety audit is not required for a particular project or a particular phase of a project then it is recommended that the decision is documented by the asset manager or nominated representatives. An exemption form is provided as appendix C.

When deciding if a road safety audit is warranted, the asset manager will need to refer to the relevant sections of this guideline, including the high-level safety audit checklists provided as appendix E.

Requirements for specific procurement models

Some projects will have specific additional process requirements for reporting, timing and staging such as the Design and Construct, Public–Private Partnerships and/or Alliancing contract models. The specific process to be followed for any particular project will be outlined by the client at the start of the process. The project managers and the safety auditors engaged on such projects should be aware of these procedures, which will be outlined for each project with reference to the NZ Transport Agency's *Project management manual*[2] as appropriate.

The principle of the road safety audit process applies equally to all procurement models. However, for projects where the works are procured (for example, under the Advanced Design and Construction model), additional and more complex road safety audit requirements apply to the specimen design, pre-tender, tender (potentially multiple designs to audit) and post-award stages.

National Land Transport Funding (NLTP) requirements

Further to the recommendations of this guideline, the NZ Transport Agency's policy for projects funded from the National Land Transport Programme (NLTP) current at the time of the request for funding will confirm the mandatory requirements for undertaking road safety audits.

For guidance, the current policy for projects funded under the NLTP is shown in appendix A. It requires road controlling authorities to do one of the following:

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[1] NZ Transport Agency (2012) *Code of practice for temporary traffic management* (COPTTM). NZTA, Wellington.
[2] NZ Transport Agency (2010) *Project management manual*. NZTA, Wellington.

- **Undertake road safety audits at the key stages of a project's development and implementation.** Road safety is a priority for the NZ Transport Agency and road safety audits should be routine and common practice. The audit report and the project manager's responses must be attached to the Transport Investment Online (TIO) funding application.

OR

- **Complete an exemption declaration** that adequately demonstrates the scope of the project and that road safety issues arising from any changes are sufficiently negligible that a road safety audit is not warranted for a particular stage or stages. The exemption declaration must be completed by the road controlling authority's project manager and must be attached to any Transport Investment Online (TIO) funding application. A copy of the exemption form is included as appendix C.

7. ROAD SAFETY AUDIT TEAMS

Selecting the road safety audit team

The most appropriate size of a road safety audit team depends on the complexity of the audit task. There is no optimum number of people suggested, although teams of more than four people can be unmanageable. The benefits of having an audit team, rather than a single person, include:

- the diverse backgrounds, experience, knowledge and approaches of different people
- the cross-fertilisation of ideas through discussion
- simply having more than one pair of eyes.

While skills in road safety engineering are the most crucial attribute, road safety audit teams should possess balanced skills appropriate to the individual projects. In some instances a road safety audit by one person can be appropriate, but that depends on their skills and experience. It is recommended that using a one-person team just to reduce the costs of conducting a road safety audit should be avoided. The cost of undertaking a road safety audit relative to its potential benefits (and client confidence that road safety has been fully considered) is considered small and hence highly cost effective.

For each road safety audit one person in the audit team should be appointed as the road safety audit team leader, to manage the team and process. The client should appoint the audit team following discussion with the team leader. The team leader shall ensure that the audit team (or individual) has the necessary skills and experience appropriate to the complexity and type of project being audited.

While continuity of core members of the road safety audit teams through the stages is desirable, audits at the different stages may require different skills. As well as always having someone familiar with road safety engineering principles and practice, look at including team members with the following skills:

- **Concept and scheme/preliminary design stages**

  The issues to be examined are quite different (broader and often more subtle) than for later stages and these audits should be undertaken only by very experienced safety auditors.

  Include an experienced road design engineer who is familiar with current road design standards and can visualise the layout in three dimensions.

  Include a specialist in any unusual aspect of the project.

  A big picture view is important, taking in the potential for wider implications to all road users and to the adjoining network or interface.

- **Detailed design stage**

  Include person(s) familiar with the types of details required in the project (for example, a person with expertise in motorway design, traffic signals, cycle facilities, etc). They must be able to critically examine the details.

- **Pre-opening or post-construction stage**

  Consider including members such as: a police officer who has experience in traffic and safety, an advocate for pedestrians and/or cyclists, a maintenance engineer, someone familiar with traffic control devices, etc.

Specialist safety auditors may need to be co-opted onto the safety audit team for specific areas of expertise such as for traffic signals, lighting, cycle facilities, temporary traffic management, etc. Those team members who are engaged because of their road safety engineering experience should have specialist knowledge relevant to the project.

Experience in road safety engineering is the key essential ingredient in any road safety audit team. Ideally this should be linked to an understanding of:

- the application of Safe System principles to road design and safety audits, including safe roads, safe speeds and safe road use principles – they should be able to recognise situations where road use errors with the potential for fatal or serious injury outcomes are most likely to occur
- crash reduction studies
- traffic engineering and management of traffic and other road users
- road design and road construction/maintenance techniques.

In applying the Safe System approach, a person who has an understanding of road user behaviour and human perception is also likely to be able to develop road safety audit skills. This understanding is, in fact, a very desirable skill because of the highly interactive nature of the road user with the other elements of the Safe System.

The most successful auditors are able to use their skills to see the road project from the point of view of the different types of 'customer' or road user.

To support the ongoing development of road safety auditors, the inclusion of observers within the audit team is encouraged.

Independence of auditors

Road safety auditors must be independent of the client, designer or contractor, so that the project outcome is viewed with fresh eyes and is unbiased.

The client has the ultimate responsibility for accepting that the level of independence is adequate and credible. To avoid an inappropriate 'culture' of the designer or contractor being incorporated, auditors should be commissioned from other organisations.

The NZ Transport Agency requires road safety auditors to be appointed separately from the Professional Services Contract drawn up for all projects.

Experience and skills: team leader, team members and observers

Team leader

Team leaders should possess:

- a good understanding of the Safe System approach, preferably by attending some form of training course
- demonstrated management and reporting skills
- a wide range of road safety engineering experience
- crash reduction study skills
- a record of participation as a team member in a range of relevant formal road safety audits (at least five formal road safety audits, including at least three for the same stage of audit)
- experience in a relevant road design, road construction or traffic engineering field (typically five years minimum but team leaders for audits of more complicated projects should have significantly more experience)
- up-to-date professional experience and knowledge of current research.

Experience in other regions of New Zealand or other countries can also benefit a client, as the auditor will be more able to challenge inadequate local practices.

Team members

Team members may be more varied in their backgrounds than the team leader and should have experience that achieves the balance required for the audit.

Team members should possess:

- a good understanding of the Safe System approach, preferably by attending some form of training course
- road safety engineering experience
- crash reduction study skills
- experience in a relevant road design, road construction or traffic engineering field (typically three years minimum)
- up-to-date professional experience and knowledge of current research.

Team members should have attended a road safety audit training course and participated in road safety audits as an observer, preferably for different project stages.

Observers

Observers can be included in a road safety audit for a variety of reasons, such as a training exercise in order to be considered as future road safety audit team members, or simply to observe the process. They may come from a variety of backgrounds. However, those aspiring to become team members and ultimately team leaders should note the criteria above.

8. THE SAFETY AUDIT PROCESS

Figure 8.1 shows the steps of the road safety audit process and responsibilities.

Once a decision has been made to undertake a road safety audit and the audit team has been selected and appointed, the audit team will work through the process. If a decision is made not to undertake an audit then this should be documented (see ‘Exemption from road safety audit’ in section 6).

Project information

The client/designer should provide the road safety audit team with all the project information, preferably at least one week before the audit is undertaken. Drawings and documents appropriate to the audit and other supporting information would normally include:

- information on project scope and objectives
- stage and scope of the road safety audit
- previous audits, responses and client decisions
- project assessment reports
- traffic data
- crash data
- design report or statement covering the standards adopted.

Desirably a road safety audit should not proceed until drawings and documents are complete, unless specifically exempt by the client to facilitate progress (eg Design and Construct).

A checklist for information relevant and desirable to each stage of an audit is attached as appendix D.

Individual team members should familiarise themselves with the documentation before the briefing meeting.

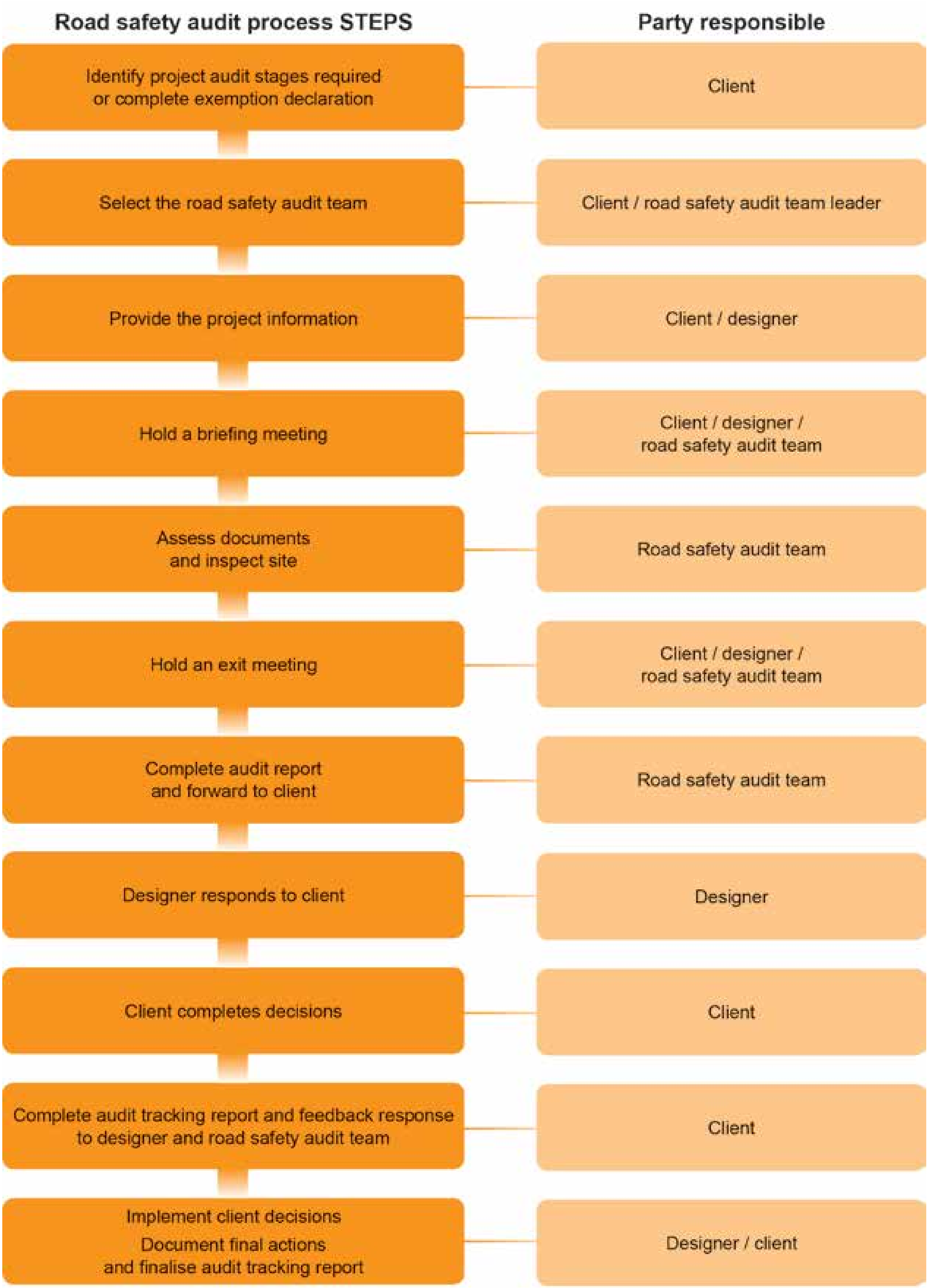
Briefing meeting

Communication between the parties throughout the audit process is very important as it helps foster trust and credibility in the process.

Whether the briefing meeting is necessary often depends on the scale and complexity of the project. However, it is desirable as it provides an opportunity:

- for all parties to meet and establish lines of communication
- for the designer and client to brief the road safety audit team on issues, constraints and specific areas that require comment
- for the road safety audit team to seek additional data and discuss any initial observations from reading the background information
- to discuss the programme for completion of the audit and delivery of the report
- to determine the protocol for delivery of the report.

Figure 8.1 The steps in a road safety audit



Document assessment

This phase takes place in parallel with the site inspections. The road safety audit team discusses their initial observations and reviews the documents in detail. The issues generally considered in the various stages of the audit are outlined in the checklists contained in appendices D and E.

In this phase, specific tasks may be allocated to various team members, eg one team member may review the geometry of the road, while others review the drainage and lighting, delineation, etc.

Site inspection

Inspections of the site are a key component of a road safety audit and are recommended for each stage of an audit.

An inspection provides the opportunity to see how the proposal interacts with its surroundings and to visualise impediments and conflicts for all road users.

The road safety audit team should complete the necessary health and safety requirements, briefing, etc, and be adequately equipped with safety vests, cameras, measuring equipment and whatever else they will need.

The inspection should include adjacent sections of road, so that interface and consistency with the project are considered. Inspections should be undertaken in the range of traffic and environmental conditions likely to be expected, where possible. Both night-time and daytime inspections are desirable, with night-time inspections being essential in the post-construction stage.

During the inspection, the high-level checklists (appendix E) can be referenced, to ensure that no concerns are overlooked. Observed practice is that experienced auditors use the checklists as a backup at the end of inspections, while less experienced auditors will use the checklists throughout the inspection.

Exit meeting

As with the briefing meeting, the need for an exit meeting depends on the project, but it is desirable. It provides the opportunity to:

- seek clarification on concerns
- give preliminary feedback to the designer and client about the safety concerns identified (particularly those that require urgent attention)
- discuss the reasons behind concerns
- informally discuss possible solutions to the problems
- resolve misunderstandings or errors of fact.

Report writing

The primary task of the road safety audit report is to succinctly report on aspects of the project which involve road safety concerns, and to make recommendations about corrective actions.

Recommendations may indicate the nature or direction of a solution but they do *not* specify the details of how to solve the concern. Responsibility for the solution rests with the designer.

The road safety concerns should be listed in a logical order with a numbering system that makes them easy to refer to in follow-up reports. One way of doing this is to list the items in the order given in the appropriate checklist (see appendix E of this guideline). However, this system may not always provide the greatest clarity. For example, where a number of distinct intersections or interchanges occur, they may be best discussed in turn.

All road safety concerns identified in the report should be of sufficient importance to require action. Issues from previous road safety audit reports that have been responded to, and a decision made by the client, do not need to be repeated in subsequent audits. The report should not be cluttered with trivial matters. Aspects like amenity or aesthetics, which are unrelated to road safety, should not be mentioned. Likewise traffic capacity issues should not be discussed unless they have a bearing on road safety. To help the designers and client gauge the importance of the road safety concerns raised, a simple ranking system is desirable.

By their nature, road safety audit reports appear to be negative documents as they typically raise only concerns. Positive design elements are not necessarily mentioned, as the assumption is that all designs contain good elements. However, a notable or excellent element which improves safety can be mentioned, if appropriate.

Issues to be considered in a safety audit

Safety aspects to be considered during an audit are listed in the high-level checklists supplied in appendix D. Each stage of the audit has its own checklist. The checklists are not exhaustive. Other aspects may also be considered.

Checklists are only an aid. They should not replace thorough and complete consideration of road safety issues.

More detailed checklists are available in other publications, including the Austroads *Guide to road safety, part 6: Road safety audit*. For more specialised checklists, eg for pedestrians and cyclists, useful information is contained in the Federal Highway Administration (FHWA) publications *Pedestrian road safety audit guidelines and prompt lists* and *Bicycle road safety audit guidelines and prompt lists* respectively.

Contents of a report

Road safety audit reports could contain the following information.

- Introduction
  - Title
  - Brief description of the road safety audit process undertaken
  - Clear statement of what is being audited
  - Road safety audit team: names and affiliations
  - Dates that the road safety audit was carried out
  - Brief description of the project and its objectives
- Project information
  - A list of drawings and documents made available for the audit
  - Other supporting information used
  - Plans which identify the extent of work
- Findings and recommendations
  - Sequential listing of safety concerns and recommendations, including photos (use of which is to be encouraged), annotating findings on a suitable set of plans, where emphasis is desirable
  - Ranking of concerns to aid designers and project managers
  - Referencing system so that the findings are easily identified, eg by using the checklist topics in appendix E of this guideline
- Formal statement
  - A draft report should be circulated to team members for comment, review and agreement. As the road safety audit team has a position of independence, a draft of the report does not have to be provided to the client or designer for comment
  - A signed and dated statement by the auditors
- Response and decision reporting
  - Record of the designer response, safety engineer response, client decision and action taken for each item in the road safety audit report (it is expected that the report will remain a live document until all items have been decided and the final report signed by the project manager)
  - Final report with responses and decisions forwarded to the client to record designer's response and client's decision

Even if an audit does not identify any safety concerns, a short report should still be documented.

An example of the format of a report is attached as appendix B.

A suggested ranking system

The ranking system used should be defined in the report, and should take into account the likely frequency of a crash occurring, and the likely outcome. With the adoption of the Safe System, the emphasis is on avoiding the more severe casualty outcomes. The recommended ranking of safety concerns is outlined below. The safety concerns may be ranked based on documented or perceived risk. Risk may be documented in available crash research. Perceived risk may be based on the expected crash frequency (all severities) and the expected severity of the outcomes.

The expected crash frequency is qualitatively assessed on the basis of expected exposure and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole, can help with understanding the likely crash types, frequency and severity that may result from a particular concern.

While the frequency of crashes in the assessment is necessarily qualitative, some quantitative assessment will help put things into perspective and assist with some relativity and consistency across audits and New Zealand. An example may be that an issue that could result in the likelihood of more than one crash per year may be deemed as 'frequent' while one crash in 10 years may be considered as 'infrequent'. The frequency and severity ratings are used together to develop a combined qualitative ranking for each safety concern using the Assessment Matrix in Table 8.1 below. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

Table 8.1 Concern Assessment Rating Matrix

Severity (likelihood of death or serious injury)	**Frequency** (probability of a crash)			
	Frequent	Common	Occasional	Infrequent
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

It is recommended that, in addition to the overall rating, the severity and frequency ratings be individually noted for each issue in the road safety audit report to assist the project manager with their decision (see the report template in appendix B).

While all safety concerns should be considered for action, the client or nominated project manager will decide what course of action will be adopted based on the guidance given in this ranking process, and also by considering factors other than safety. As a guide, a suggested action for each concern category is given in table 8.2.

Table 8.2 Concern categories

Concern	Suggested action
Serious	Major safety concern that must be addressed and requires changes to avoid serious safety consequences
Significant	Significant concern that should be addressed and requires changes to avoid serious safety consequences
Moderate	Moderate concern that should be addressed to improve safety
Minor	Minor concern that should be addressed where practical to improve safety

In addition to the ranked safety issues it is appropriate for the road safety audit team to provide additional comments about items that may have a safety implication but lie outside the scope of the road safety audit. A comment may include: items where the safety implications are not yet clear due to insufficient detail for the stage of project; items outside the scope of the audit such as existing issues not impacted by the project; an opportunity for improved safety that is not necessarily linked to the project itself, or drawing/signage issues that should be addressed but are not necessarily safety related. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the auditors.

9. RESPONSES TO REPORTS

Road safety audit team report to the client

For each audit, the road safety audit team will deliver the written report in electronic format directly to the client, incorporating fields for the tracking of responses. The team will provide hard copies if requested. The report shall be delivered in both a secure signed format as well as an editable format to assist with subsequent responses.

The client refers the audit report to the designer (and/or contractor) and seeks a response to the report's recommendations.

Designer reports to the client

The designer's response to the client will:

- clarify whether they agree or otherwise with each safety audit issue raised in the report and recommend whether each audit recommendation should be adopted
- document the reason for the designer's views (addressing the safety issue raised and not relying on compliance with standards)
- identify the cost and implications of implementing each audit recommendation.

The reasons for suggesting that a road safety audit recommendation is to be rejected should be more detailed than the reasons for accepting it.

Client advises the designer and road safety audit team

It is the client who makes the final decision about whether recommendations are to be adopted. The client may seek independent safety advice. Where a recommendation is not adopted, the reasons should be documented by the client.

In many instances the client and the asset manager will either be the same entity or directly linked. In cases where the client is a third party, such as for a development, then the designer's response should be provided to the asset manager for their comment before the client makes the final decision.

For each audit team recommendation that is accepted, the client shall brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may ask their safety engineer to comment to aid with this decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations to be completed by the designer, safety engineer and client (see an example in appendix B). The decision tracking table documents:

- the designer's response
- the client's decision (and in some cases as noted above, the asset manager's comment)
- the action taken.

A copy of the report, including the designer's response to the client and the client's decision on each recommendation, shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members. **The feedback loop is an essential part of the process so that safety auditors can judge whether their recommendations are considered appropriate.**

If major changes result, the client may consider the need for a further road safety audit.

10. POST-AUDIT FEEDBACK

A key part of maintaining a safe system requires a self-improvement process. Integral to this is the dissemination of knowledge gained either from the road safety audit process or following project construction.

The following actions should be considered to promote the healthy sharing of knowledge within the industry either formally or informally:

- Regularly review previous audit reports to identify recurring issues or issues for industry-wide dissemination.
- Disseminate information relating to road safety audits or road safety generally to the industry by either direct communication with interested parties or a website.
- From the review process identify issues that should be considered for a review of standards or guidelines.

It is also recommended that the safety performance of project sites is monitored following the post-construction audit to verify the effectiveness of decisions made.

Appendix A: NZTA requirements

The NZTA requirements for receiving funding from the NLTP are specified in the planning and investment knowledge base – www.pikb.co.nz. The requirements for road safety audits are specified in the section 'Preparing a transport programme for input to the RLTP and developing activities for funding approval – general guidance'.

As at May 2013 this guidance states:

> **Safety audits**
>
> The NZTA requires that a safety audit procedure must be applied to the development of any improvement or renewal activity that involves vehicular traffic, and/or walking and/or cycling, proposed for funding assistance from the NLTP (National Land Transport Programme adopted by the NZTA under section 19 of the LTMA, as from time to time amended or varied). It does not apply to auditing of the existing network or specialist applications, such as traffic control at roadwork sites.
>
> Safety audits must be undertaken at key stages of a project's development. The latest audit report and the project manager's response to issues are to be attached to any Transport Investment Online funding application.
>
> If the project manager considers there is justification for not conducting a safety audit at a particular stage, then they must complete an exemption declaration for that stage, keep it on file for audit purposes and attach it to any Transport Investment Online funding application.

Please note this guidance is subject to change so for the latest requirements always check the knowledge base.

Appendix B: Example safety audit report

The following pages show an example of a road safety audit report.

A Word template is available on the NZTA's website at www.nzta.govt.nz/resources/road-safety-audit-procedures/

NZTA

STATE HIGHWAY EXPRESSWAY PROJECT

PRELIMINARY DESIGN STAGE Road Safety Audit

Safety Audit Report

Date: December 2012

Table of Contents

1. Background

1.1 Safety Audit Procedure

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, that is, minimisation of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a safe system and bring those concerns to the attention of the client in order that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

> *To deliver completed projects that contribute towards a safe road system that is increasingly free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.*

A road safety audit should desirably be undertaken at project milestones such as:

- ☐ Concept Stage (part of Business Case);
- ☐ Scheme or Preliminary Design Stage (part of Pre-Implementation);
- ☐ Detailed Design Stage (Pre-implementation / Implementation); and
- ☐ Pre-Opening / Post-Construction Stage (Implementation / Post-Implementation).

A road safety audit is not intended as a technical or financial audit and does not substitute for a design check on standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the "*NZTA Road Safety Audit Procedures for Projects Guideline",* (dated…..)", the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client shall make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations to be completed by the designer, safety engineer and client for each issue documenting the designer response, client decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The Safety Audit Team

The road safety audit was carried out in accordance with the "*NZTA Road Safety Audit Procedure for Projects Guideline",* (dated……….), by

☐ Name, Position, Company;

☐ Name, Position, Company; and

☐ Name, Position, Company.

The Safety Audit Team (SAT) met at the client offices, sometown to review the drawings on some date. The designer's representative A Designer briefed the safety audit team on the project and clarified the scope of the audit. A site inspection was subsequently undertaken on a date.

An exit meeting was held with A designer and P Manager on a date.

1.3 Report Format

The potential road safety problems identified have been ranked as follows:-

The expected crash frequency is qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole, have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative ranking for each safety issue using the Concern Assessment Rating Matrix in Table 1 below. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

Severity (Likelihood of Death or Serious Injury Consequence)	Frequency (Probability of a Crash)			
	Frequent	Common	Occasional	Infrequent
Very Likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very Unlikely	Moderate	Minor	Minor	Minor

Table 1: Concern Assessment Rating Matrix

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each concern category is given in Table 2 below.

CONCERN	Suggested Action
Serious	A major safety concern that must be addressed and requires changes to avoid serious safety consequence.
Significant	Significant concern that should be addressed and requires changes to avoid serious safety consequences
Moderate	Moderate concern that should be addressed to improve safety
Minor	Minor concern that should be addressed where practical to improve safety.

Table 2: Risk Categories

In addition to the ranked safety issues it is appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the auditors.

1.4 Scope of Audit

This audit is a Preliminary Design Stage Safety Audit of SH 1001 Expressway drawings produced by ABC Consultants on behalf of NZTA.

A previous Road Safety Audit was carried out on earlier scheme stage drawings for the project.

1.5 Documents Provided

The SAT has been provided with the following documents for this audit:

- ☐ Preliminary Design Drawings, ABC Consultants, numbered 123 to 456 and dated DATE as appended.
- ☐ Copy of previous audit report incorporating responses and client decision.

Also provided for background information only:

- ☐ Expressway Section Preliminary Design Report
- ☐ Traffic Modelling Report

1.6 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the SAT. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review nor an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

1.7 Project Description

The SH 1001 Expressway is a 10km length of expressway which links existing sections of expressway from nowhere to somewhere.

A 110km/h design speed has been provided throughout and the steepest grade is 5.0% with horizontal curves of 900m minimum radius.

Two grade-separated interchanges are proposed, one at each end of the project and all local road crossings are grade-separated.

The changes to the design since the previous scheme stage audit were described to the audit team at the briefing as:

- ☐ Incorporation of a safe system approach including safety barriers on each shoulder and the median.

No departures from the RONS standards were noted.

2. Safety Audit Findings

2.1 Main Alignment

2.1.1 Adjacent Local Road – Headlights **Moderate**

Adjacent Road is proposed to be re-aligned and follow the mainline over a distance of approximately 600m which has the potential for headlights from any vehicles on the side road at night to confuse or blind oncoming traffic. Even in daylight hours some form of physical separation of these facilities is recommended to avoid driver confusion in the form of a raised berm to provide backdrop to the main alignment.

The designers have advised that it is intended to include a barrier and screening with landscaping in the detailed design yet to be completed.

Recommendation:

Provide a physical separation between Adjacent Road and the mainline, such as a raised berm, and if headlights are a potential conflict with the mainline then provide screening.

Frequency Rating:	**Infrequent**	*Severity Rating*:	**Likely**

Designer Response: *Agree with audit recommendation that a visual barrier is required to provide a backdrop to the main alignment and provide screening of vehicles on Adjacent Road. As long as the vegetation or other screen is effective then we propose that these be acceptable solutions. The expressway left hand edge safe system barrier provides physical separation and curve backdrop.*

Safety Engineer: *Agree with designer*

Client Decision: *Agree with designer*

Action Taken: *Changes implemented as per Client Decision and has been included as a requirement in the detailed design.*

2.1.2 Long "Steep" Grades **Minor**

A long grade of 5.2% over a length of 1500m is proposed. This long grade will slow heavy vehicles and result in a speed differential between the slowest heavy vehicles and a faster car. It is recognised that newer heavy vehicles and unladen heavy vehicles are capable of maintaining higher speeds which means that frequently the heavy vehicles will themselves be overtaking the slower vehicles. These slower vehicles will reduce the level of service on the uphill road section with a corresponding increase in frustration of following drivers and potentially leading to erratic driver behaviour i.e. potential for fast lane changing due to high speed differential.

Recommendation:

Assess the effect the long grade on the level of service and associated safety ramifications based on the expected volume of heavy vehicles and consider the need for a crawler lane.

Frequency Rating:	**Occasional**	*Severity Rating*:	**Unlikely**

Designer Response: *Proposed uphill gradients and lengths are longer than desirable and will affect truck speeds. However, due to traffic volumes being relatively modest, there are no capacity issues. No crawler lanes are proposed.*

Safety Engineer: *Agree with designer*

Client Decision: *Agree with designer*

Action Taken: *No changes to design required.*

2.1.3 Accesses off Mainline **Moderate**

A potential access and/or maintenance vehicle pull off has been identified directly off the mainline, namely at xxxm to the Random Scenic Reserve. Drivers will not be anticipating any vehicles pulling out from the shoulder in this high speed expressway environment and no direct access is recommended to the mainline at any point along the alignment. It also requires a break in the otherwise nearly continuous roadside barrier which is a safety concern as it exposes traffic to potential roadside hazards.

Recommendation:

If access to the Random Reserve is required then provide access from the local road network as opposed to the expressway.

Frequency Rating:	**Occasional**	*Severity Rating*:	**Likely**

Designer Response: *A commitment to provide access to the reserve for the purposes of pest control has been made in correspondence. Use of this access by the public will not be permitted. Alternative access is not practical. The access will be used very infrequently and operational restrictions could be applied to ensure safe use. We recommend that safe use of the access be addressed in the Asset Owners Manual.*

Safety Engineer: *Agree with designer*

Client Decision: *Agree with designer*

Action Taken: *Recommended forwarded to asset owner.*

2.2 Cross-Section

2.2.1 Cyclist Provisions **Moderate**

Cyclists are noted to be specifically provided for on adjacent sections of highway and it is understood they may also be permitted to use this section. However, this will be a high speed expressway and ideally cyclists would not be permitted on the expressway where they are at risk from the traffic and in particular fast moving heavy vehicles. Cyclists are vulnerable users in this environment.

For this particular section of the expressway, the old alignment will provide a suitable lower volume alternative to the expressway and it is recommended that consideration be given to discouraging general use of the expressway as a cyclist route which could be achieved by appropriate signage at each end of the section, directing cyclists to use the off-expressway routes. While this would not completely remove the potential for cyclist movement along the main line, it may minimise the use of the main line to those unfamiliar with the area.

Recommendation:

Consider provision of cycle routes separate from the expressway for the full length of the section with safe and appropriately designed and signed entry and exit points.

Frequency Rating:	**Infrequent**	*Severity Rating*:	**Very Likely**

Designer Response: *Cyclists may use this section of the expressway as with any other. Banning them would require a change in NZTA policy and in this case the off-expressway route is obvious and easy to find using the interchange guide signs without the need for additional signs specifically for cyclists.*

Standard provisions for crossing interchange ramps will be included for those cyclists who choose to use the expressway.

Safety Engineer: *Additional signage would reinforce the desired route for cyclists and should be considered.*

Client Decision: *Include additional direction signage.*

Action Taken: *Additional signage has been included in contract requirements.*

2.2.2 Wire Rope/Rigid Barrier Transition **Comment**

Where wire rope barrier is transitioned to rigid barrier the wire rope barrier passes in front of the rigid barrier nose and no details were available for this stage of safety audit. The wire rope barrier system adopted will need to be designed to ensure its deflection is within the available space in front of the rigid barrier.

Frequency Rating:	**NA**	*Severity Rating*:	**NA**

Designer Response: *Agree*

Safety Engineer: *Agree*

Client Decision: *Agree*

Action Taken: *Transition design is included as a requirement of detailed design.*

2.3 Interchanges

2.3.1 Eastern Interchange - Interchange Spacing **Significant**

The proposed eastern interchange is less than 2.0km from the Other interchange to the north making the distance between ramp tapers estimated at around 1 km. Ideally interchange spacing in a rural setting should be significantly greater to ensure that driver decisions, lane changes and associated signage can be safely accommodated.

While ideally the spacing should be increased, it may be possible to demonstrate the safety of the proposed layout by way of a study of the relative traffic volumes and likely weaving movements between these two interchanges to understand whether there are any safety issues with the proposed spacing.

Recommendation:

Consider increasing the spacing between interchanges.

Frequency Rating:	**Common**	*Severity Rating*:	**Likely**

Designer Response: *Traffic weaving behaviour has been studied using modelling and the outcomes deemed acceptable by NZTA without requiring changes to the project.*

Safety Engineer: *Need to record evidence of modelling.*

Client Decision: *Agree with designer. Documentation of modelling to be provided.*

Action Taken: *Modelling documentation forwarded to NZTA on xx date.*

2.3.2 Northern Interchange – Southbound On-Ramp **Minor**

The suitability of the northbound on-ramp length is interdependent on the final ramp gradients yet to be designed. The preliminary design indicates the on-ramp length may be barely sufficient for a vehicle and particularly a heavy vehicle to comfortably reach the speed of the adjacent through traffic. There is a need to check the length of ramp is suitable for the final ramp grades adopted, the design vehicle and the expected speeds of traffic.

Recommendation:

Consider lengthening the northern interchange southbound on-ramp to provide adequate space for heavy vehicles to accelerate to the speed of adjacent through traffic and use standard merge taper layouts.

Frequency Rating:	**Occasional**	*Severity Rating*:	**Unlikely**

Designer Response: *The on-ramp length illustrated in the design is about 250m measured from roundabout to entry ramp nose. Given the relatively low traffic volumes on the ramp and given that an increase in ramp length will impact on the width of the bridge, the ramp length could be considered by NZTA to be adequate*

Safety Engineer: *Consider the safety benefits of lengthening the ramp.*

Client Decision: *Designer to provide cost/benefit analysis for extension of the ramp.*

Action Taken: *yet to be completed.*

2.3.3 Local Road Noise Wall **Moderate**

A noise wall is proposed on Local Road RHS over distance 100 – 200m which appears to be very close to the traffic lane although difficult to ascertain with the given information. The location of the noise wall may adversely affect the forward sight distance on Local Road and the property accesses at xxm. The detailed design of the noise wall will need to consider an offset to the traffic lane to ensure that both forward sight distance and access sight distance is appropriate to the prevailing speeds of vehicles.

Recommendation:

Consider offsetting the noise wall to provide adequate forward sight distance and sight distance for the accesses.

Frequency Rating:	**Occasional**	*Severity Rating*:	**Likely**

Designer Response: *Agree*

Safety Engineer: *Agree with designer*

Client Decision: *Agree with designer*

Action Taken: *Changes implemented as per Client Decision.*

2.3.4 Pedestrians on Structures **Significant**

None of the local road structures over the expressway include provision for pedestrians. While the SAT are not aware of any significant numbers of pedestrians on these routes, there is the potential for pedestrian demand at Local Road overbridge where there are a number of property accesses on each side of the bridge which may generate a demand.

With no facilities, the pedestrians would be forced to share the carriageway with vehicular traffic in the vicinity of limited sight lines due to the vertical crest curves making these road users particularly vulnerable.

Recommendation:

Consider provision of pedestrian facilities on all bridge structures.

Frequency Rating:	**Occasional**	*Severity Rating*:	**Very Likely**

Designer Response: *Given the low pedestrian demand we do not agree that this is a significant safety issue. Standards meet district requirements agreed for this project. Visibility to pedestrians will be excellent.*

Safety Engineer: *Need verification as to actual pedestrian demands.*

Client Decision: *Agree with designer subject to documentation of pedestrian demands*

Action Taken: *No changes required (pedestrian data has been supplied)*

3. Audit Statement

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed or modified in order to improve safety. The problems identified have been noted in this report.

Signed:……………………………………………………………….. Date:

Name, Qualification
Position, Company

Signed:…………………………………………………………………… Date:

Name, Qualification
Position, Company

Signed:……………………………………………………………… Date:

Name, Qualification
Position, Company

Designer:	*Name……………………………………*	*Position………………………..*
	Signature………………………………..	*Date…………………………….*
Safety Engineer:	*Name……………………………………*	*Position………………………..*
	Signature………………………………..	*Date…………………………….*
Project Manager:	*Name……………………………………*	*Position………………………..*
	Signature………………………………..	*Date…………………………….*
Action Completed:	*Name……………………………………*	*Position………………………..*
	Signature………………………………..	*Date…………………………….*

Project Manager to distribute audit report incorporating decision to designer, Safety Audit Team Leader, Safety Engineer and project file. ***Date:……………………..***

Appendix A

Audit Drawings

Appendix C: Exemption form

Road Safety Audit Exemption Form

NZ TRANSPORT AGENCY
WAKA KOTAHI

File reference	Example
Project name	Road Rehabilitation
Project stage	Design
RCA	Auditville Council

Brief project description and location:

Pavement reconstruction of 2km of Valley Road (from SH 72 intersection to Coopers Lane) in Auditville.

Exemption rationale:

Pavement works only, with no change in road geometrics, width, traffic facilities, streetscape or traffic movements.

Declaration:

Having checked the above project with reference to the relevant procedures as laid down in Road Safety Audit Procedures for Projects - Guidelines, 2013. I consider that the proposals will not have an adverse effect on the safety of road users over a significant period. Therefore I consider that an independent road safety audit is not required for this stage.

Recommended by (project manager):

Name	Jimmy Tarmac
Position	Asset Manager Auditville Council
Signature	
Date	xx/xx/xxxx

Endorsed by (safety engineer):

Name	Fergus Brodie
Position	Senior Safety Engineer, Auditville Council
Signature	
Date	xx/xx/xxxx

Appendix D: Road safety audit brief – checklist

INFORMATION DESIRABLE FOR EACH STAGE OF ROAD SAFETY AUDIT

Stages 1 and 2: Concept/scheme/preliminary design

- Scheme assessment report covering purpose of the project, problem description, scope of the work, preliminary design philosophy, project description, and any anticipated departures from standards.
- Location plan.
- General arrangement drawings.
- Crash and traffic flow data (current and projected).

Stage 3: Detailed design

- Design report covering purpose of the project, scope of the work, design philosophy, design description, background information, and any departures from standards.
- Copies of stages 1 and/or stage 2 road safety audit reports and completed decision tracking forms.
- Detailed drawings showing (as applicable):
  - Layout
  - Long sections
  - Typical and detailed cross sections
  - Pavements and kerbs
  - Signs and markings
  - Traffic signals
  - Lighting
  - Barriers
  - Drainage
  - Structures
  - Landscaping.
- Crash and traffic flow data (current and projected).

Stage 4: Pre-opening/post-construction

- Design report covering purpose of the project, scope of the work, design philosophy, design description, background information, and any departures from standards.
- Copies of stage 3 road safety audit report and completed decision tracking form.
- Location plan and key layout drawings including signs, markings, signals, lighting, barriers, landscaping.

Appendix E: High-level road safety audit – checklists

Stage 1: Feasibility/concept

General

- Consistency of standards with the adjacent road network, especially at tie-ins
- Secondary effects on surrounding road network
- Major generators of traffic
- Type and degree of access to property and developments
- Potential for serious crashes (side impact, head-on, hit hazards)
- Safe accommodation for vulnerable road users (pedestrians and cyclists)
- Relative safety performance between options being considered
- Staging requirements

Design issues

- Design standards
- Design speed
- Design volume and traffic characteristics
- Impact of standard of route on safety (ref design flows and speed)
- Overtaking opportunities
- Consistency of intersection arrangements and access control
- Number of intersections (public and private) re safe access
- Location of intersections and accesses in relation of horizontal and vertical alignments
- Horizontal and vertical alignments consistent with visibility requirements along the route and at intersections/accesses
- Facilities for pedestrians and cyclists

Environmental

- Sunrise/sunset glare, fog, ice, wind conditions

Stage 2: Scheme/preliminary design

General

- Review changes since stage 1 road safety audit
- Departures from standards
- Adjacent developments and major generators of traffic

- Type and degree of access to property and developments
- Potential for serious crashes (side impact, head-on, hit hazards)
- Safe accommodation of vulnerable road users (pedestrians and cyclists)
- Hazard protection/management
- Drainage requirements
- Lighting provision
- Services
- Landscaping
- Emergency vehicles
- Staging of the works
- Ongoing maintenance
- Future widening and/or realignment issues

Design – general

- Design standards
- Roadway layout
- Typical cross sections and issues of cross-section variations
- Traversability of side slopes
- Shoulders and edge treatment
- Concept of road marking and signage for road user perception and guidance
- Facilities for pedestrians and cyclists
- Overtaking facilities and merges
- Property accesses
- Rest areas

Alignment

- Geometry of horizontal and vertical alignments re sight lines, especially where combined
- Readability of the alignment
- Tie in with existing road(s)
- Sight lines obstructed by physical features (including landscaping)
- Location and type of pedestrian crossing facilities

Intersections

- Appropriateness of type of intersection
- Layout

- Minimising conflict points (including private accesses) re crash risk
- Conspicuousness and perception of intersections on all approaches
- Control of approach speed
- Sight lines from side roads and accesses
- Provisions for turning traffic
- Provisions for pedestrians and cyclists to safely cross roads

Special requirements

- Facilities for mobility and visually impaired
- Passenger transport facilities
- Truck tracking and manoeuvring
- Motorcyclists
- Farm equipment and stock movements

Environmental

- Sunrise/sunset glare, fog, ice, wind conditions

Stage 3: Detailed design

(Note: the scope for altering alignment or intersection designs is less extensive at this stage)

General

- Review stage 2 road safety audit and decisions
- Review changes since stage 2 road safety audit
- Adjacent developments and major generators of traffic
- Type and degree of access to property and developments
- Potential for serious crashes (side impact, head-on, hit hazards)
- Safe accommodation of vulnerable road users (pedestrians and cyclists)
- Hazard protection/management
- Surface treatment/skid resistance
- Drainage design
- Lighting design
- Services
- Landscaping
- Emergency management and breakdowns
- Emergency vehicles access

- Staging of the works
- Ongoing maintenance
- Future widening and/or realignment issues

Design – general

- Design standards
- Roadway layout
- Typical cross sections and issues of cross-section variations
- Traversability of side slopes
- Shoulders and edge treatment
- Pavement type (including approaches to intersections and thresholds)
- Kerb types
- Facilities for pedestrians and cyclists
- Overtaking facilities and merges
- Rest areas
- Property accesses

Alignment

- Detail of geometry of horizontal and vertical alignments
- Readability of the alignment
- Tie in with existing road(s)
- Treatment of bridges and culverts
- Sight lines obstructed by physical features (including landscaping)
- Location and type of pedestrian crossing facilities

Intersections

- Layout
- Detailed geometric design
- Minimising conflict points (including private accesses) re crash risk
- Conspicuousness and perception of intersections on all approaches
- Traffic signals design
- Roundabout design
- Control of approach speed
- Sight lines from side roads and accesses
- Provisions for turning traffic

- Provisions for pedestrians and cyclists to safely cross roads

Signs and markings

- Regulatory and warning signage
- Direction/guidance signage
- Locations of signs without obscuring visibility
- Pavement marking and delineation
- Consistency of signing and marking information
- Threshold signage/marking

Physical objects

- Placement of all poles
- Median and roadside barriers

Landscaping

- Location of trees re potential collisions
- Choice of plant species
- Ability to maintain planted areas safely

Special requirements

- Facilities for mobility and visually impaired
- Passenger transport facilities
- Truck tracking and manoeuvring
- Motorcyclists
- Farm equipment and stock movements

Environmental

- Sunrise/sunset glare, fog, ice, wind conditions

Stage 4: Post-construction

General

- Review stage 3 road safety audit and decisions in order to allow for any design changes
- Inspect from the viewpoint of the different road users:
  - Private vehicle drivers
  - Truck drivers
  - Passenger transport operators
  - Pedestrians

  - Cyclists
  - Mobility and visually impaired
- Inspect in both daylight and darkness
- Checklist for stage 3 provides an appropriate reminder

Additional matters

- Visibility of markings including contrast with surface treatment
- Visibility of signs and signals re vegetation and other objects
- Readability of alignment and intersections
- Conspicuousness of intersections
- Visibility at all potential points of conflict
- Protection of hazards

Appendix 4: Drawings

Section of Schedule 11	Drawing Number	Plan	Title	Rev
6, 10	TG-DRG-S11-AL-4401	Roadway	Typical Cross Sections – Sheet 1	B
6, 10	TG-DRG-S11-AL-4402	Roadway	Typical Cross Sections – Sheet 2	B
6, 10	TG-DRG-S11-AL-4403	Roadway	Typical Cross Sections – Sheet 3	B
6, 10	TG-DRG-S11-AL-4404	Roadway	Typical Cross Sections – Sheet 4	B
6	TG-DRG-S11-AL-4441	Roadway	Median Barrier Detail for Gantry Leg	B
8	TG-DRG-S11-AL-1611	Road alignment	Overweight/Overdimension Route – Sheet 1	B
8	TG-DRG-S11-AL-1612	Road alignment	Overweight/Overdimension Route – Sheet 2	B
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10, 20	TG-DRG-S11-AL-4421	Roadway	Typical Cut Sections – Sheet 1	C
10, 20	TG-DRG-S11-AL-4422	Roadway	Typical Cut Sections – Sheet 2	C
10	TG-DRG-S11-AL-4431	Roadway	Barrier Transition Details - Sheet 1	B
10	TG-DRG-S11-AL-4432	Roadway	Barrier Transition Details - Sheet 2	B
10	TG-DRG-S11-AL-4433	Roadway	Barrier Transition Details - Sheet 3	B
10	TG-DRG-S11-AL-4434	Roadway	Barrier Transition Details - Sheet 4	B
10	TG-DRG-S11-AL-4435	Roadway	Barrier Transition Details - Sheet 5	B
10	TG-DRG-S11-AL-4439	Roadway	Barrier Transition Details - Sheet 9	B
10	TG-DRG-S11-AL-4440	Roadway	Barrier Transition Details - Sheet 10	B
15	TG-DRG-S11-LD-2021	Landscaping	Access Track – Sheet 1	B
15	TG-DRG-S11-LD-2022	Landscaping	Access Track – Sheet 2	B
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	TG-DRG-S11-AL-4436	Roadway	Barrier Transition Details - Sheet 6	B
17	TG-DRG-S11-AL-4437	Roadway	Barrier Transition Details - Sheet 7	B
17	TG-DRG-S11-AL-4438	Roadway	Barrier Transition Details - Sheet 8	B

Section of Schedule 11	Drawing Number	Plan	Title	Rev
19	TG-DRG-S11-AL-4461	Roadway	SH58 Weigh Facility	C
20	TG-DRG-S11-GT-2401	Geotechnical	Geogrid Arrangement	B
21	TG-DRG-S11-PV-2401	Pavement	Pavement Profiles	C
21	TG-DRG-S11-PV-2402	Pavement	Pavement Edge Details	C
21	TG-DRG-S11-PV-1401	Pavement	Plan Sheet 1	A
21	TG-DRG-S11-PV-1402	Pavement	Plan Sheet 2	A
21	TG-DRG-S11-PV-1403	Pavement	Plan Sheet 3	A
21	TG-DRG-S11-PV-1404	Pavement	Plan Sheet 4	A
21	TG-DRG-S11-PV-1406	Pavement	Plan Sheet 6	A
21	TG-DRG-S11-PV-1407	Pavement	Plan Sheet 7	A
21	TG-DRG-S11-PV-1408	Pavement	Plan Sheet 8	A
21	TG-DRG-S11-PV-1409	Pavement	Plan Sheet 9	A
21	TG-DRG-S11-PV-1413	Pavement	Plan Sheet 13	A
21	TG-DRG-S11-PV-1414	Pavement	Plan Sheet 14	A
21	TG-DRG-S11-PV-1419	Pavement	Plan Sheet 19	A
21	TG-DRG-S11-PV-1429	Pavement	Plan Sheet 29	A
21	TG-DRG-S11-PV-1430	Pavement	Plan Sheet 30	A
21	TG-DRG-S11-PV-1431	Pavement	Plan Sheet 31	A
21	TG-DRG-S11-PV-1435	Pavement	Plan Sheet 35	A
21	TG-DRG-S11-PV-1436	Pavement	Plan Sheet 36	A
21	TG-DRG-S11-PV-1437	Pavement	Plan Sheet 37	A
21	TG-DRG-S11-PV-1438	Pavement	Plan Sheet 38	B
21	TG-DRG-S11-PV-1439	Pavement	Plan Sheet 39	A
21	TG-DRG-S11-PV-1441	Pavement	Plan Sheet 41	A
21	TG-DRG-S11-PV-1443	Pavement	Plan Sheet 43	B
21	TG-DRG-S11-PV-1444	Pavement	Plan Sheet 44	A

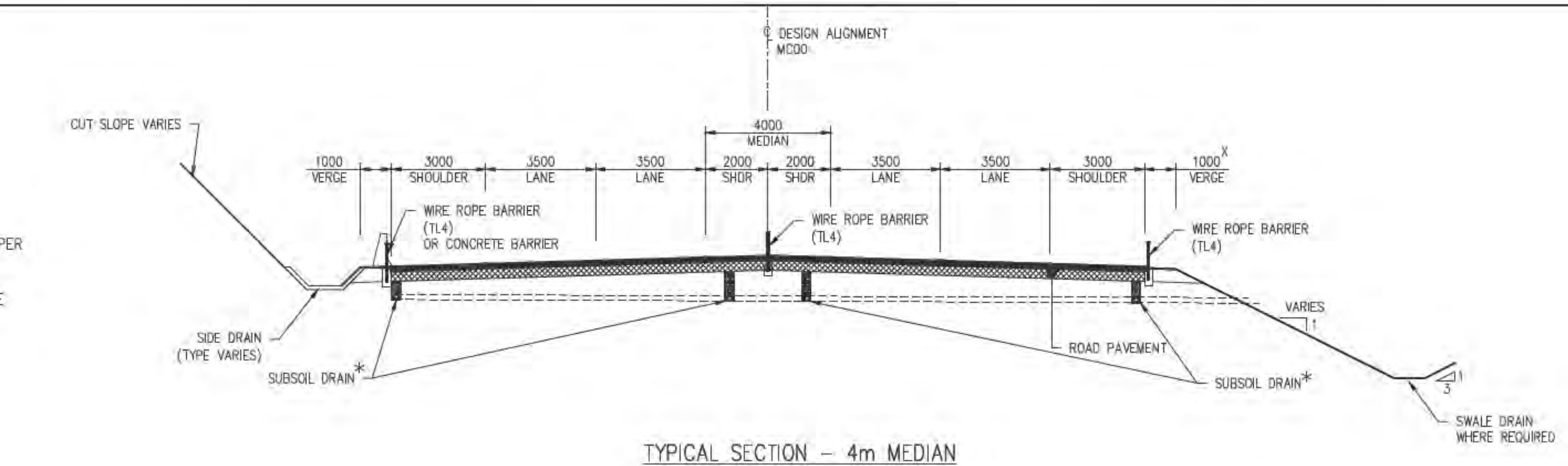
Section of Schedule 11	Drawing Number	Plan	Title	Rev
21	TG-DRG-S11-PV-1454	Pavement	Plan Sheet 54	A
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
21	TG-DRG-S11-PV-1459	Pavement	Plan Sheet 59	A
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
23	TG-DRG-S11-BR3011	Bridge 1A	Bridge 1A Perspective View	B
23	TG-DRG-S11-BR3012	Bridge 1B	Bridge 1B Perspective View	B
23	TG-DRG-S11-BR3013	Bridge 2	Bridge 2 Perspective View	B
23	TG-DRG-S11-BR3014	Bridge 3	Bridge 3 Perspective View	B
23	TG-DRG-S11-BR3015	Bridge 4	Bridge 4 Perspective View	B
23	TG-DRG-S11-BR3016	Bridge 5	Bridge 5 Perspective View	B
23	TG-DRG-S11-BR3017	Bridge 6	Bridge 6 Perspective View	B
23	TG-DRG-S11-BR3018	Bridge 7	Bridge 7 Perspective View	B
23	TG-DRG-S11-BR3019	Bridge 8	Bridge 8 Perspective View	B
23	TG-DRG-S11-BR3020	Bridge 10	Bridge 10 Perspective View	B
23	TG-DRG-S11-BR3021	Bridge 11	Bridge 11 Perspective View	B
23	TG-DRG-S11-BR3022	Bridge 12	Bridge 12 Perspective View	B
23	TG-DRG-S11-BR3023	Bridge 13	Bridge 13 Perspective View	B
23	TG-DRG-S11-BR3025	Bridge 14	Bridge 14 Perspective View	B
23	TG-DRG-S11-BR3026	Bridge 14A	Bridge 14A Perspective View	B
23	TG-DRG-S11-BR3027	Bridge 15	Bridge 15 Perspective View	B
23	TG-DRG-S11-BR3028	Bridge 16	Bridge 16 Perspective View	B
23	TG-DRG-S11-BR3029	Bridge 17	Bridge 17 Perspective View	B
23	TG-DRG-S11-BR3031	Bridge 18	Bridge 18 Perspective View	B

Section of Schedule 11	Drawing Number	Plan	Title	Rev
23	TG-DRG-S11-BR3032	Bridge 18A	Bridge 18A Perspective View	B
23	TG-DRG-S11-BR3033	Bridge 19	Bridge 19 Perspective View	B
23	TG-DRG-S11-BR3034	Bridge 20	Bridge 20 Perspective View	B
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
23	TG-DRG-S11-BR3037	Bridge 26	Bridge 26 Perspective View	B
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
26	TG-DRG-S11-DR-3101	Drainage	Te Puka Stream Diversion Staging Plan	A

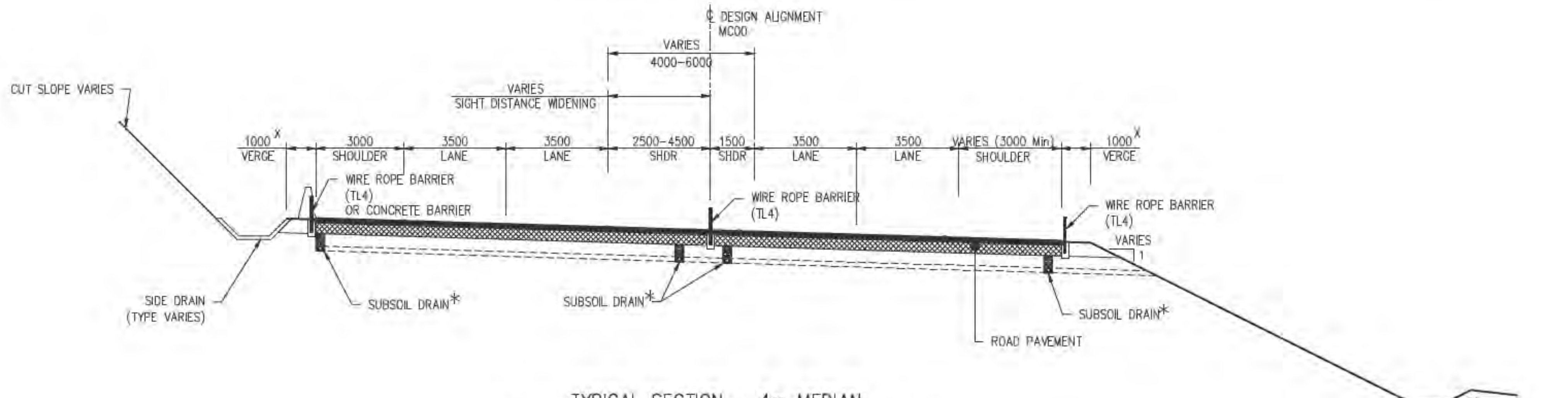
The relevant drawings are enclosed following this page.

LEGEND

X	VERGE WIDTH 1.5m WHEN FILL SLOPE STEEPER THAN 1V : 1.75H.
*	THE SUBSOIL DRAIN LOCATIONS SHOWN ARE INDICATIVE ONLY.

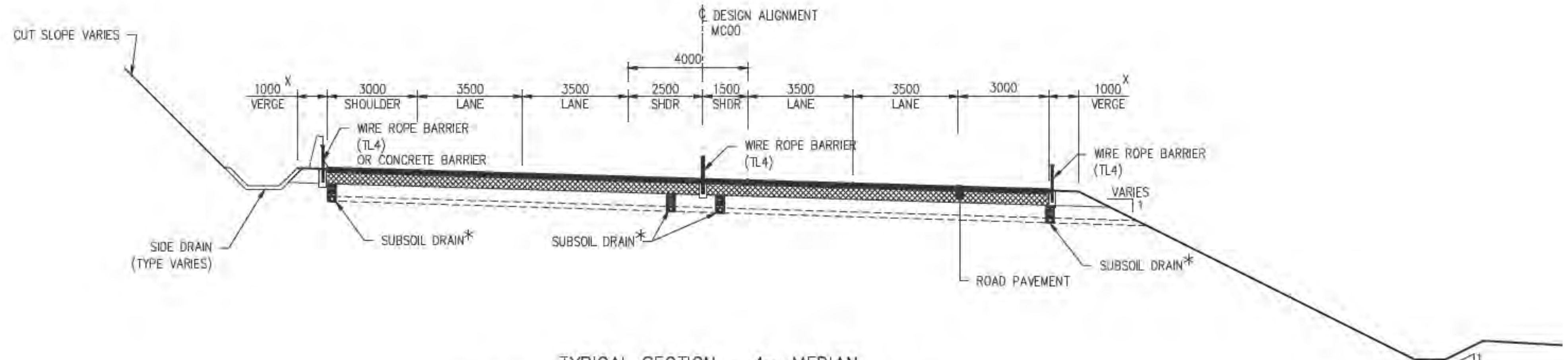


TYPICAL SECTION – 4m MEDIAN
SCALE E



TYPICAL SECTION – 4m MEDIAN
(WITH SIGHT DISTANCE WIDENING & LEVEL MEDIAN)
SCALE E

SWALE DRAIN WHERE REQUIRED



TYPICAL SECTION – 4m MEDIAN
(SUPER-ELEVATED NO ADDITIONAL SIGHT WIDENING)
SCALE E

SWALE DRAIN WHERE REQUIRED

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 06 JUNE 2014

SCALE 0 1 2 3 4 5m 1:200 (A3) 1:100 (A1)

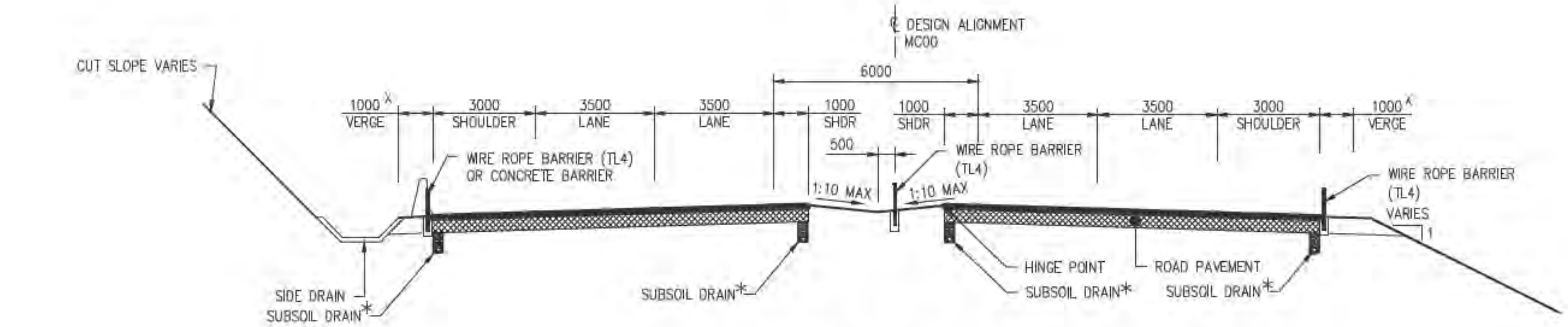
WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
TYPICAL CROSS SECTIONS - SHEET 1
TG-DRG-S11-AL-4401

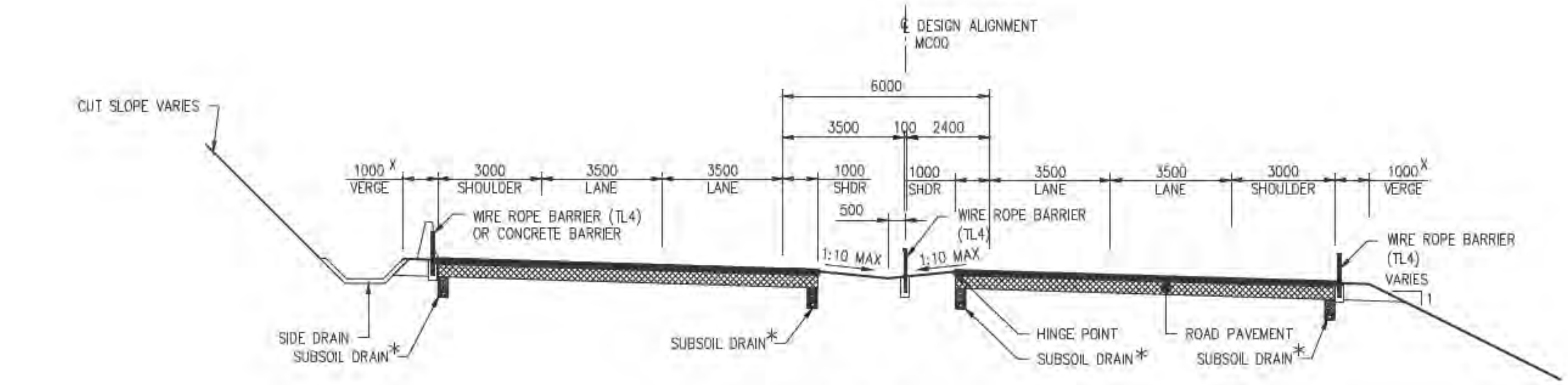
LEGEND

X VERGE WIDTH 1.5m WHEN FILL SLOPE STEEPER THAN 1V : 1.75H.

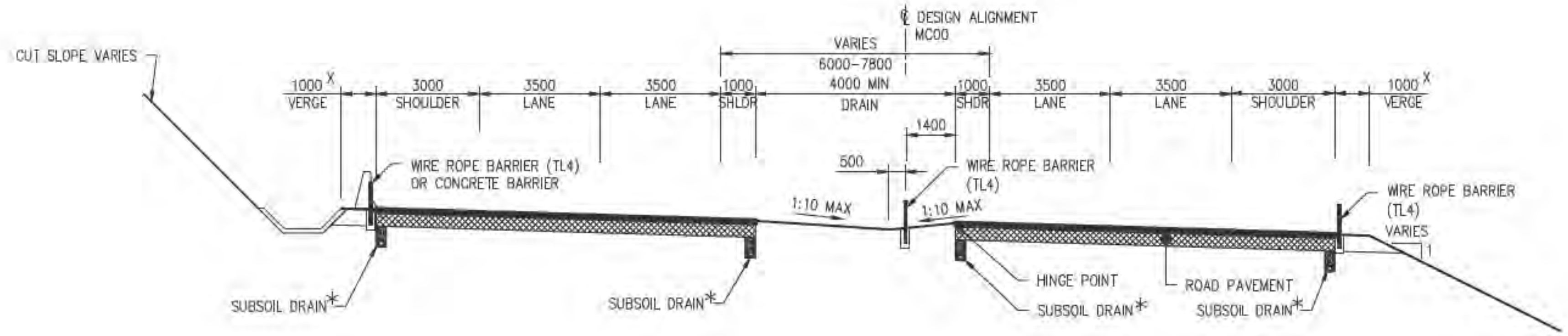
* THE SUBSOIL DRAIN LOCATIONS SHOWN ARE INDICATIVE ONLY.



TYPICAL SECTION
(6m DEPRESSED MEDIAN WIDTH)
SCALE E



TYPICAL SECTION
(6m DEPRESSED MEDIAN WIDTH)
SCALE E



TYPICAL SECTION
(SIGHT DISTANCE WIDENING & DEPRESSED MEDIAN
FOR USE WHERE 6m MEDIAN SIGHT DISTANCE INSUFFICIENT)
SCALE E

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 06 JUNE 2014

SCALE E 1:200 (A3) 1:100 (A1)

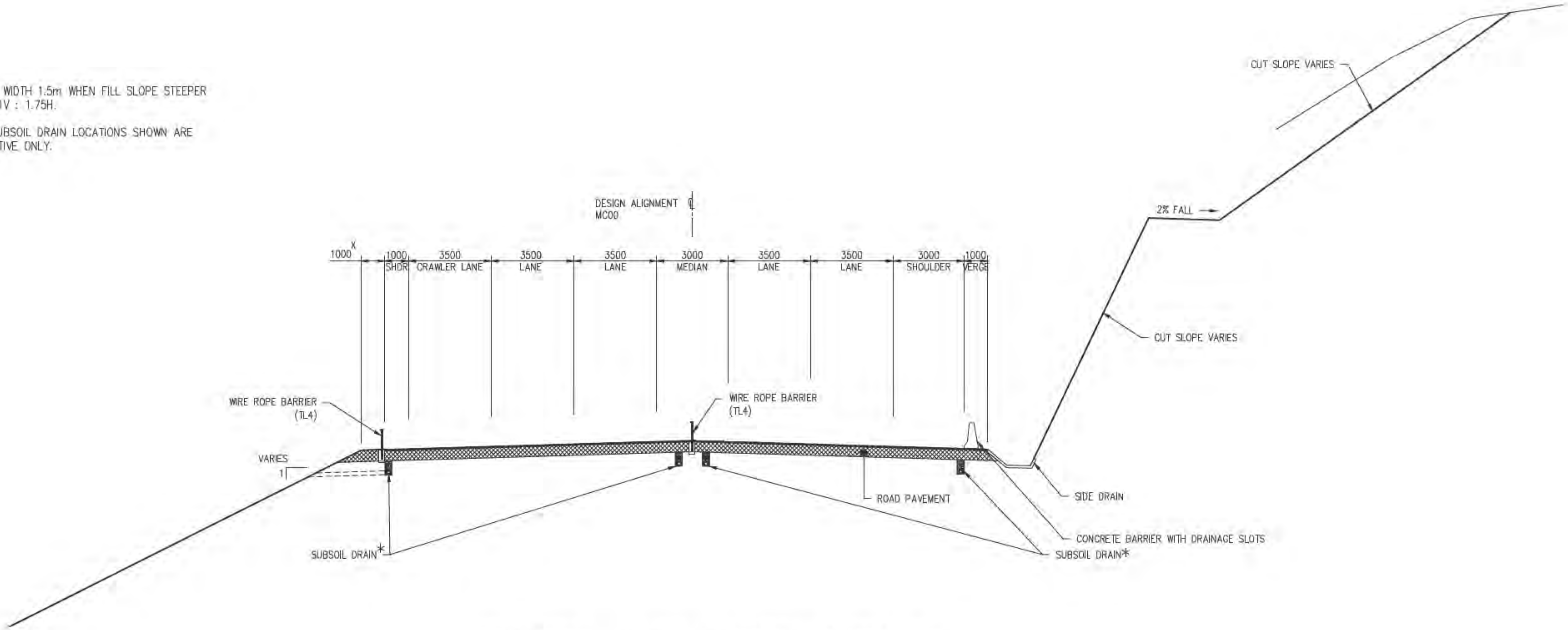
WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
TYPICAL CROSS SECTIONS - SHEET 2
TG-DRG-S11-AL-4402

LEGEND

X VERGE WIDTH 1.5m WHEN FILL SLOPE STEEPER THAN 1V : 1.75H.

∗ THE SUBSOIL DRAIN LOCATIONS SHOWN ARE INDICATIVE ONLY.



TYPICAL SECTION – CRAWLER LANE SECTION AND STEEP CUTS
SCALE E

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 06 JUNE 2014

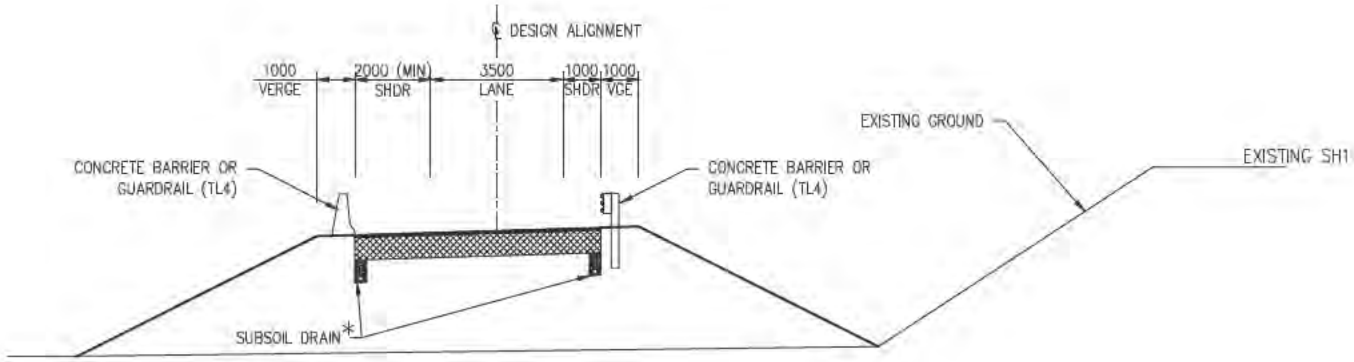
SCALE E 1:200 (A3) 1:100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

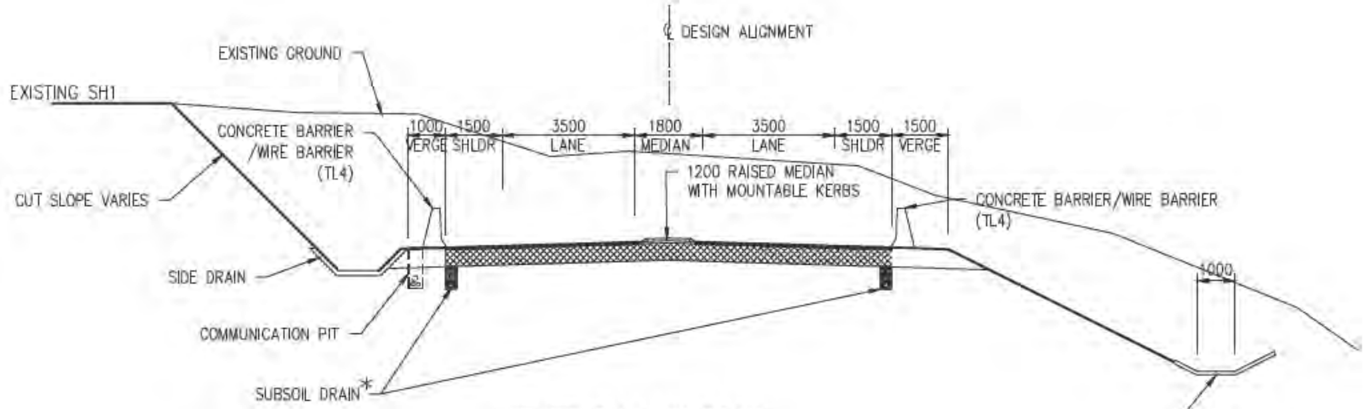
ROADWAY
TYPICAL CROSS SECTIONS - SHEET 3
TG-DRG-S11-AL-4403

LEGEND

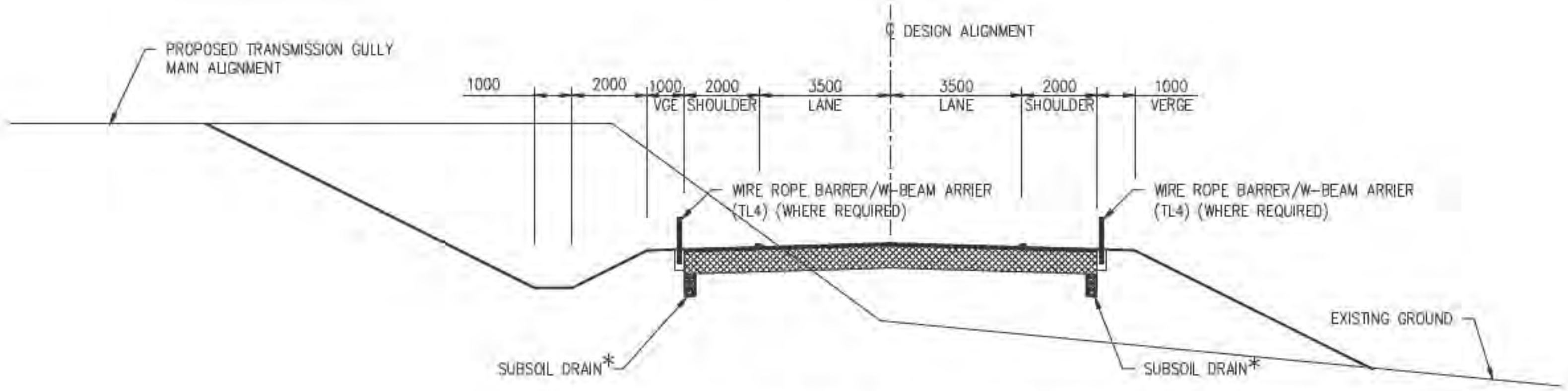
* THE SUBSOIL DRAIN LOCATIONS SHOWN ARE INDICATIVE ONLY.



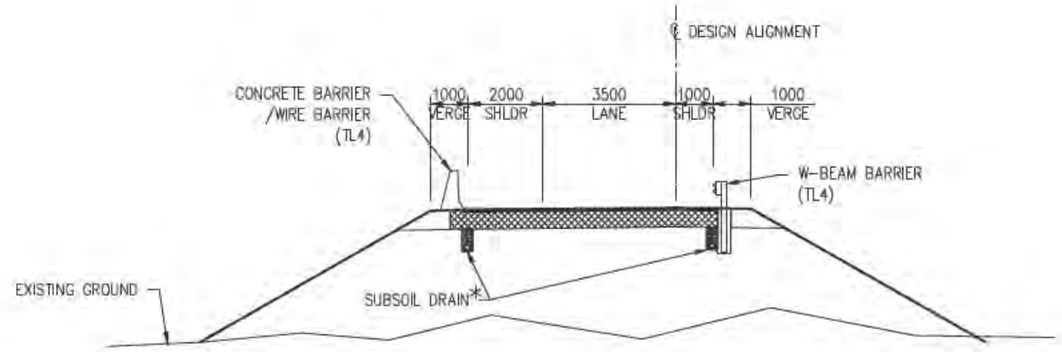
NORTHBOUND ON–RAMP
AT MACKAYS CROSSING
SCALE E



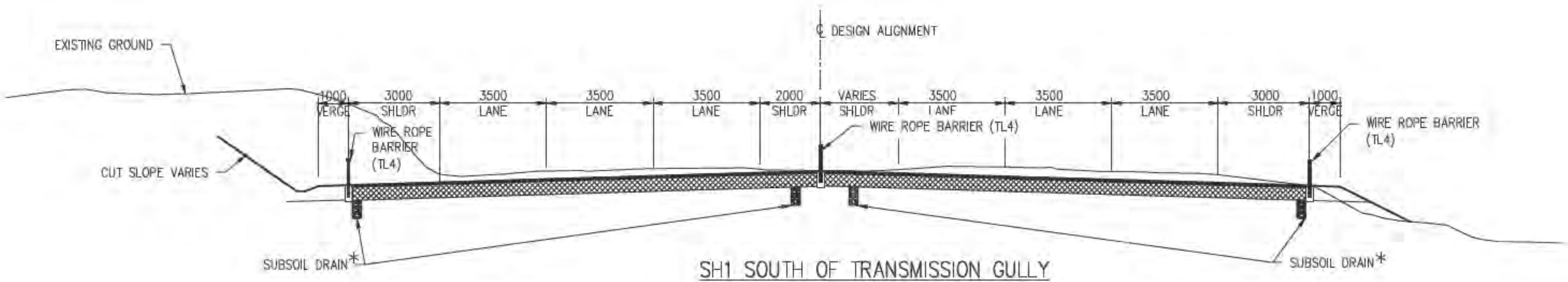
KENEPURU LINK ROAD
SCALE E



COASTAL HIGHWAY AT MACKAYS CROSSING
SCALE E



KENEPURU RAMP DETAIL
SCALE E



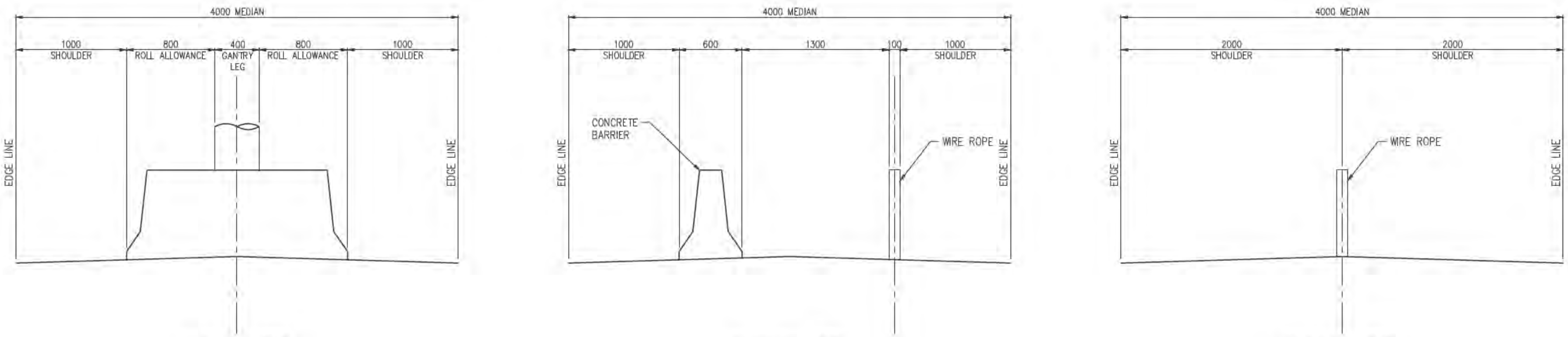
SH1 SOUTH OF TRANSMISSION GULLY
SCALE E

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 06 JUNE 2014

SCALE E: 1:200 (A3) 1:100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

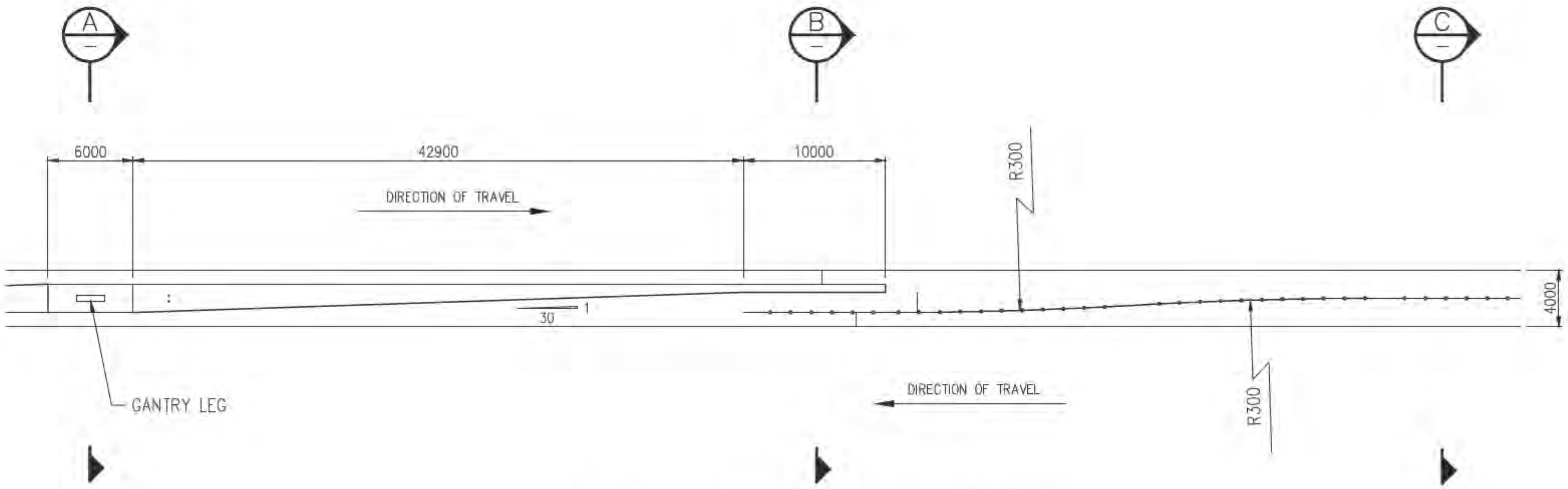
ROADWAY
TYPICAL CROSS SECTIONS - SHEET 4
TG-DRG-S11-AL-4404



SECTION A – SCALE G

SECTION B – SCALE G

SECTION C – SCALE G



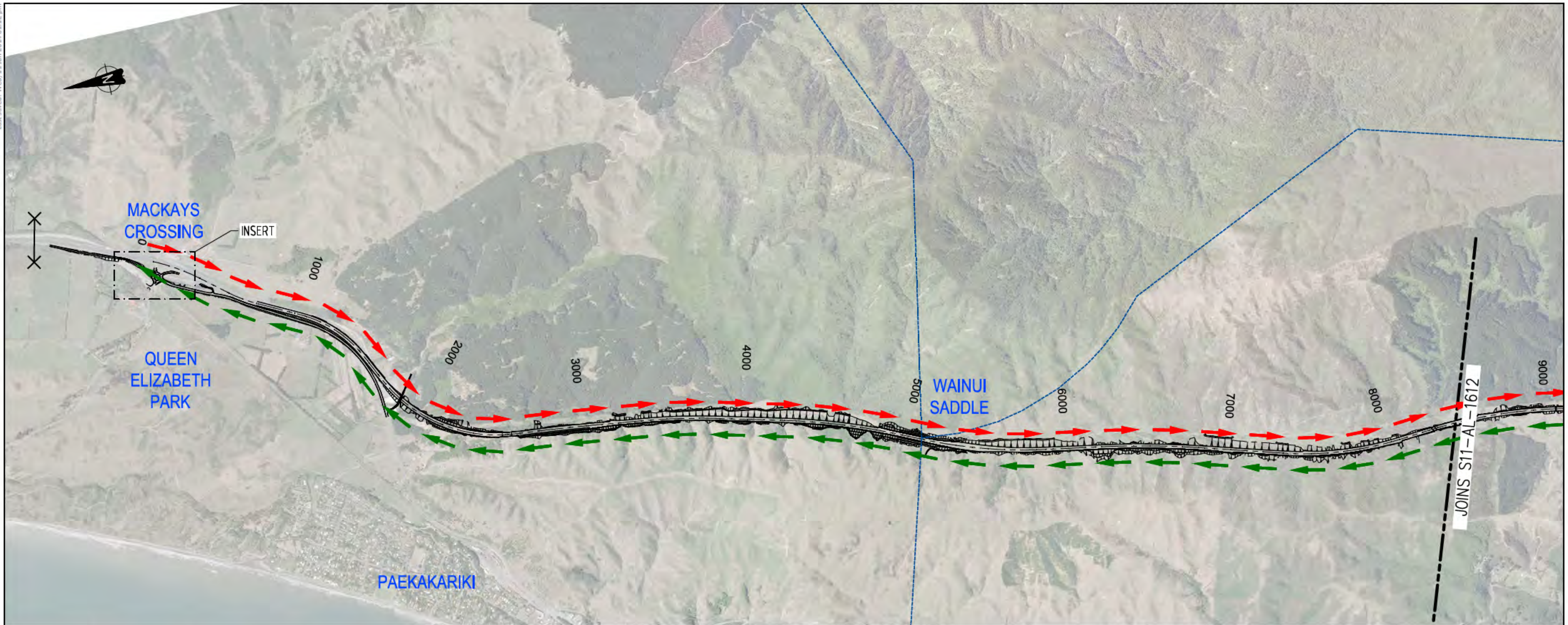
PLAN – 4m MEDIAN WITH GANTRY
SCALE C

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 06 JUNE 2014

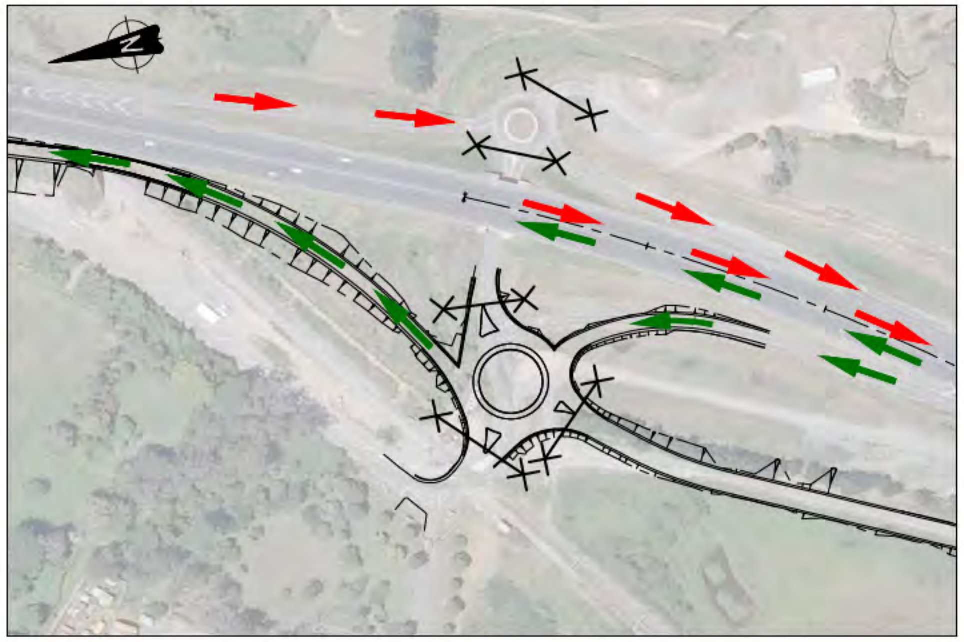
SCALE G 0 500 1000 1250mm 1 : 50 (A3) 1 : 25 (A1)
SCALE C 0 5 10 12.5m 1 : 500 (A3) 1 : 250 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
MEDIAN BARRIER DETAIL FOR GANTRY LEG
TG-DRG-S11-AL-4441



PLAN
SCALE A



INSERT
MACKAYS CROSSING INTERCHANGE
SCALE 1:2000 (A1)

LEGEND

Red arrow	OVER DIMENSIONED ROUTE – TG ALIGNMENT SOUTHBOUND
Green arrow	OVER DIMENSIONED ROUTE – TG ALIGNMENT NORTHBOUND
Blue arrow	OVER DIMENSIONED ROUTE – OTHER ROADS
X—X	TG LIMIT OF OVERWEIGHT/OVERDIMENSIONED ROUTE

NOTE

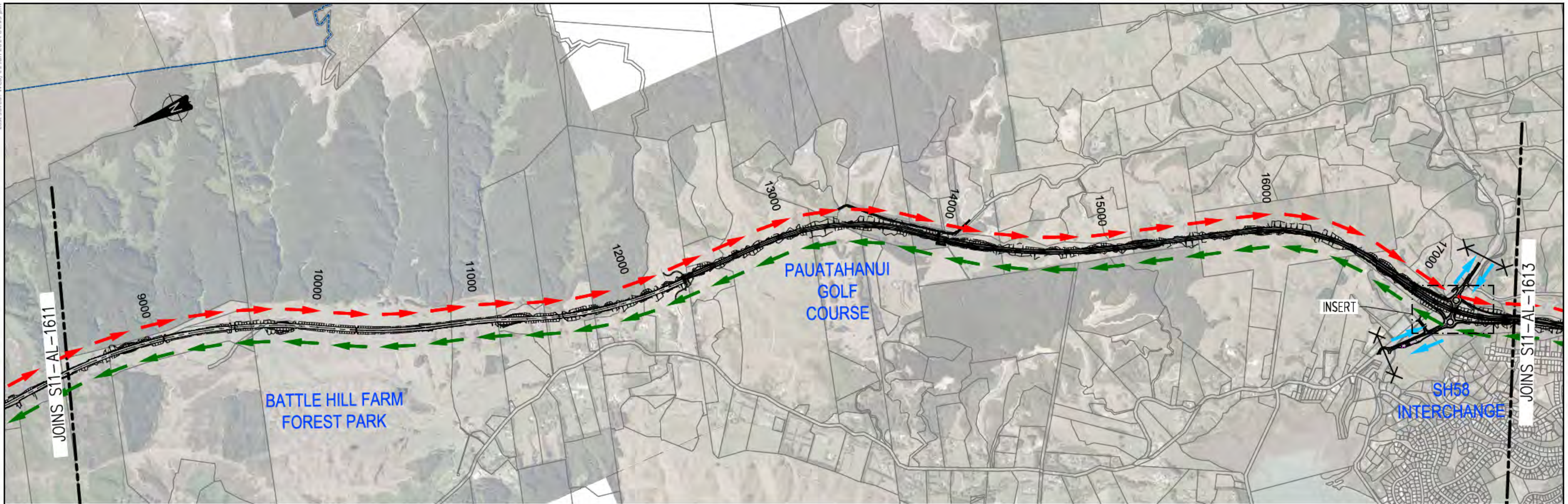
1. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE SPATIAL EXTENT OF THE OVER–WEIGHT AND OVER–DIMENSION ROUTES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

NOT TO SCALE

WELLINGTON GATEWAY PARTNERSHIP

OVERWEIGHT/OVERDIMENSIONED ROUTE
SHEET 1
TG-DRG-S11-AL-1611



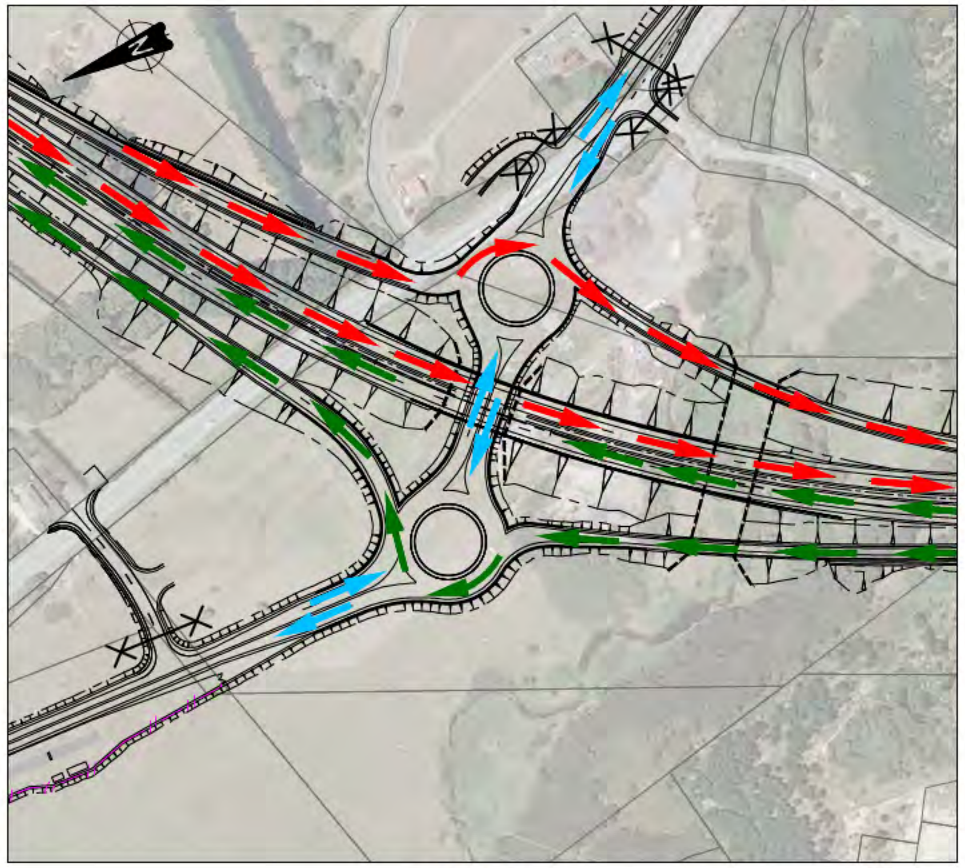
LEGEND

Red arrow	OVER DIMENSIONED ROUTE – TG ALIGNMENT SOUTHBOUND
Green arrow	OVER DIMENSIONED ROUTE – TG ALIGNMENT NORTHBOUND
Blue arrow	OVER DIMENSIONED ROUTE – OTHER ROADS
X——X	TG LIMIT OF OVERWEIGHT/OVERDIMENSIONED ROUTE

PLAN
SCALE A

NOTE

1. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE SPATIAL EXTENT OF THE OVER-WEIGHT AND OVER-DIMENSION ROUTES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.



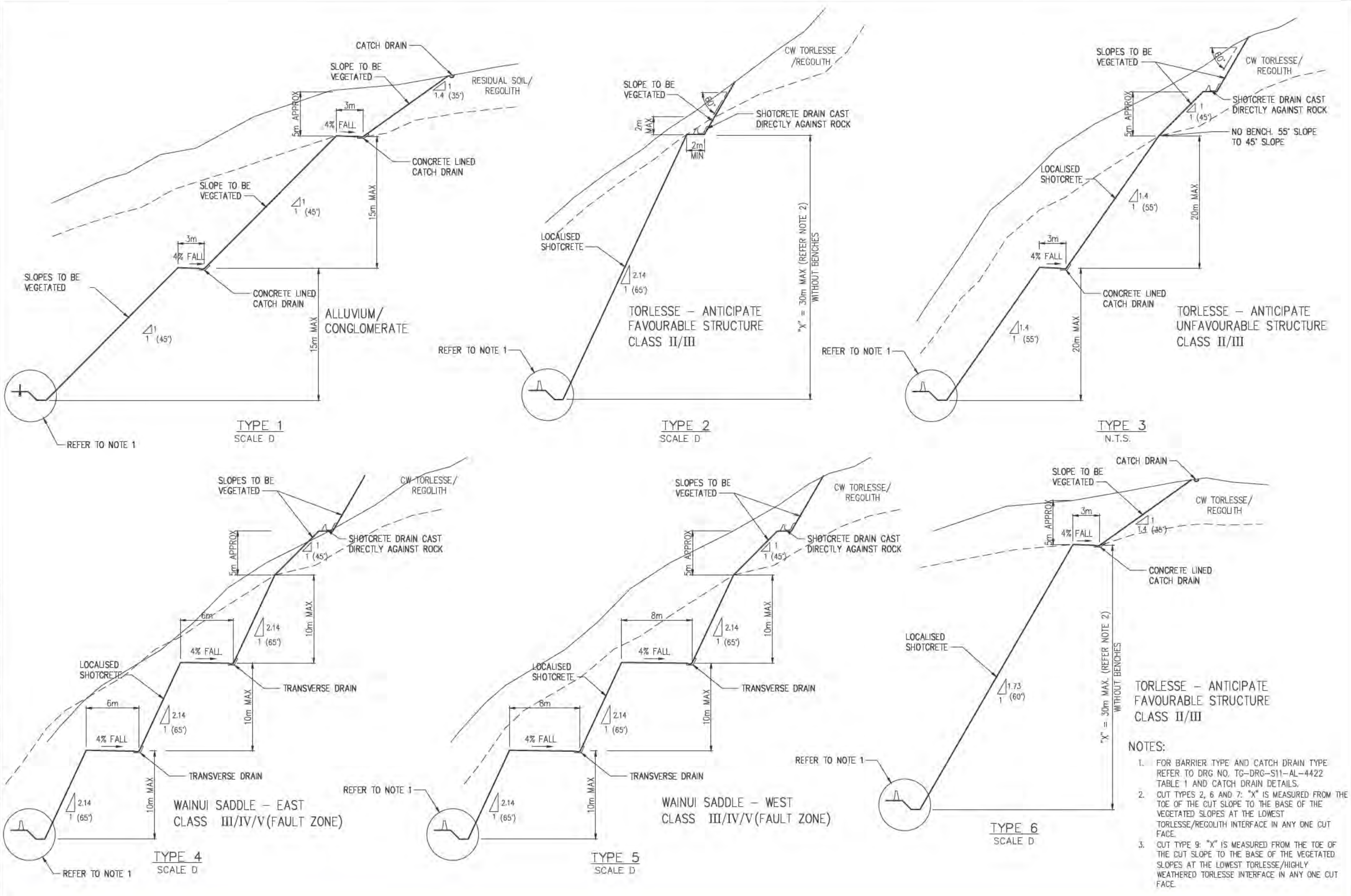
INSERT
SH58 INTERCHANGE
SCALE 1:2000 (A1)

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

NOT TO SCALE

WELLINGTON GATEWAY PARTNERSHIP

OVERWEIGHT/OVERDIMENSIONED ROUTE
SHEET 2
TG-DRG-S11-AL-1612



NOTES:

1. FOR BARRIER TYPE AND CATCH DRAIN TYPE REFER TO DRG NO. TG-DRG-S11-AL-4422 TABLE 1 AND CATCH DRAIN DETAILS.
2. CUT TYPES 2, 6 AND 7: "X" IS MEASURED FROM THE TOE OF THE CUT SLOPE TO THE BASE OF THE VEGETATED SLOPES AT THE LOWEST TORLESSE/REGOLITH INTERFACE IN ANY ONE CUT FACE.
3. CUT TYPE 9: "X" IS MEASURED FROM THE TOE OF THE CUT SLOPE TO THE BASE OF THE VEGETATED SLOPES AT THE LOWEST TORLESSE/HIGHLY WEATHERED TORLESSE INTERFACE IN ANY ONE CUT FACE.

TRANSMISSION GULLY PPP PROJECT

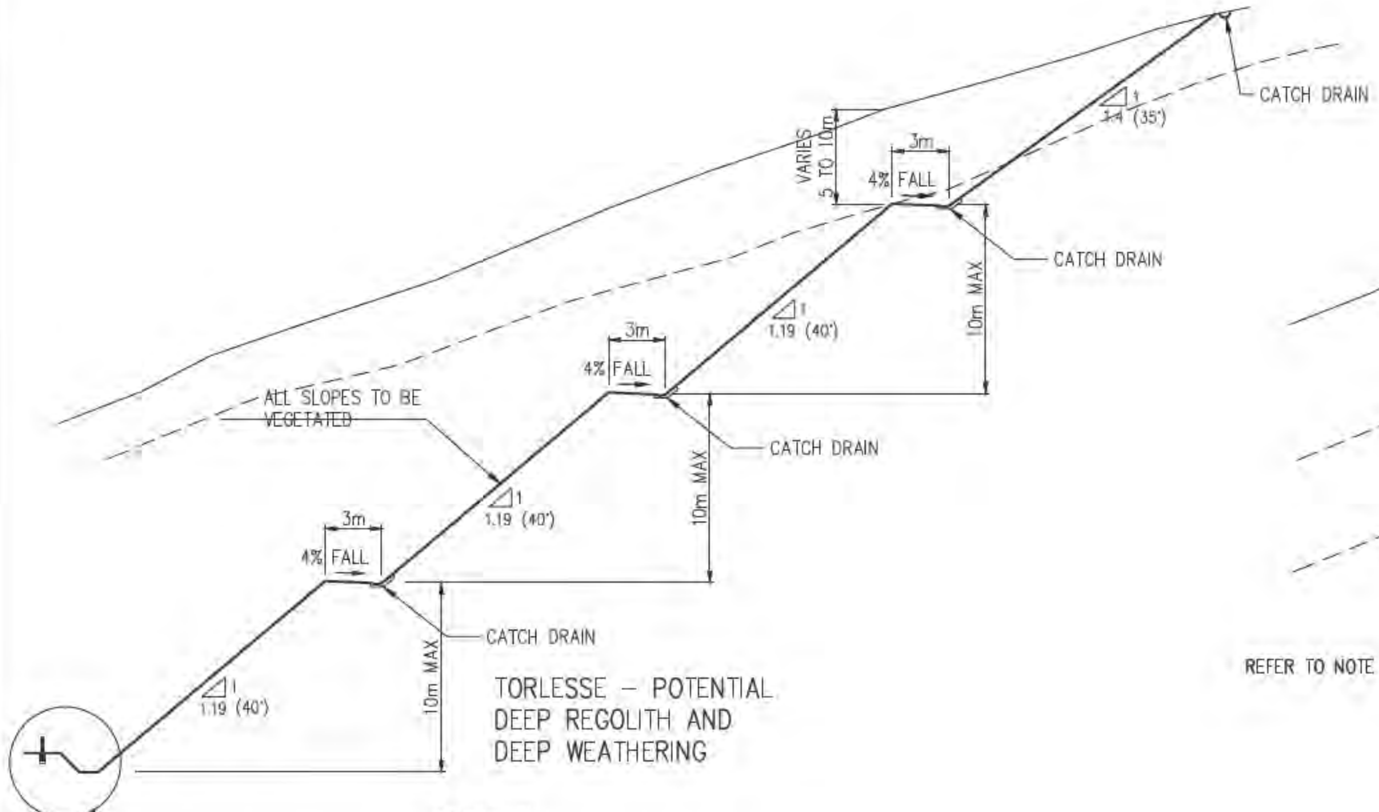
STATUS SCHEDULE 11
REV C
DATE 16 JUNE 2014

SCALE D 0 2 4 6 8 10m
1 : 400 (A3) 1 : 200 (A1)

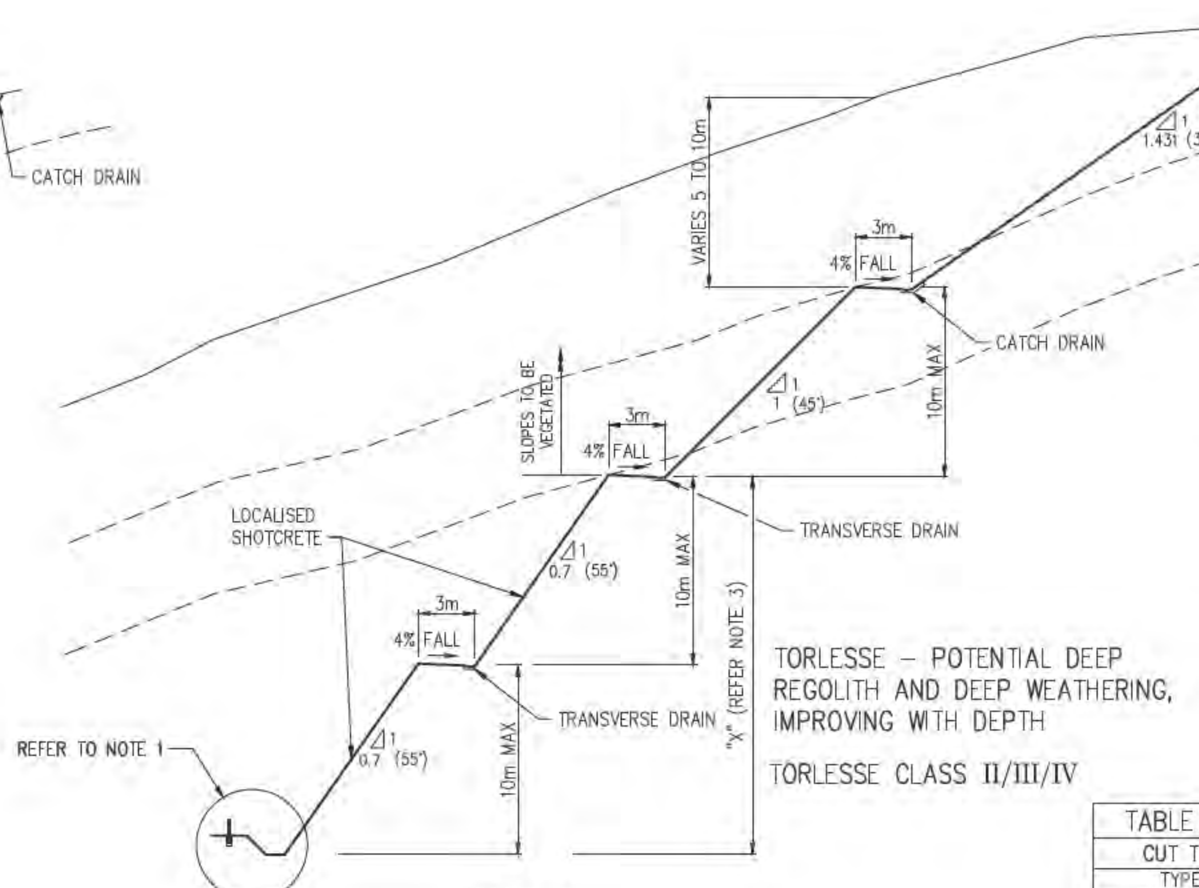
WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
TYPICAL CUT SECTIONS - SHEET 1

TG-DRG-S11-AL-4421



TYPE 8
SCALE D



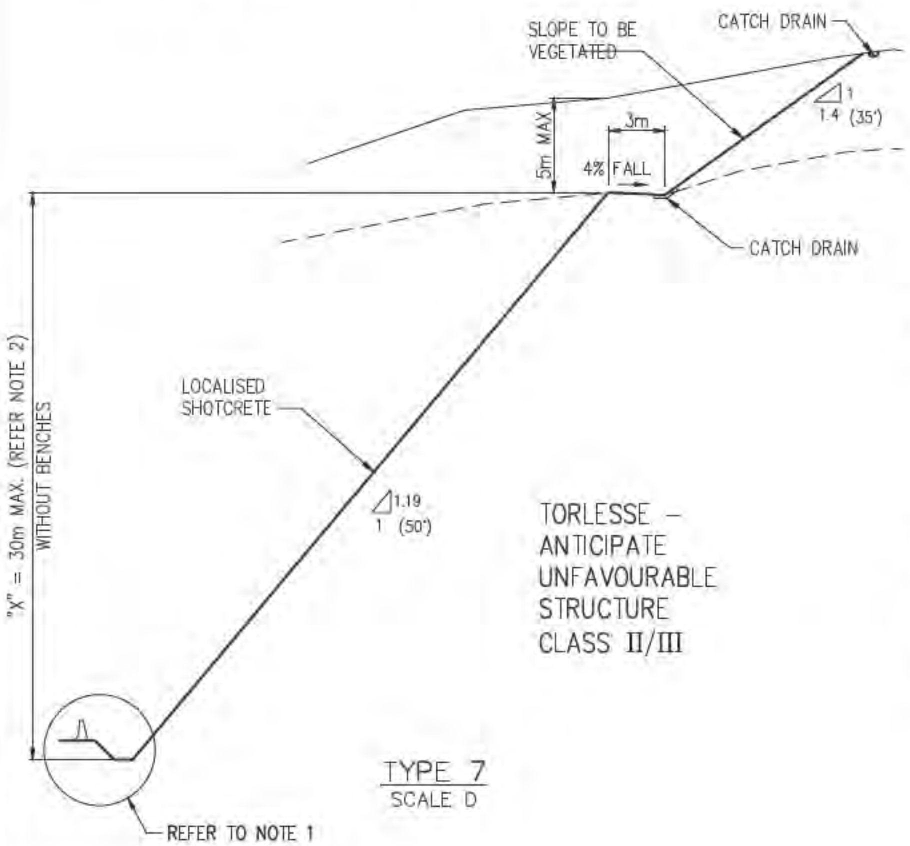
TYPE 9
SCALE D

NOTES:

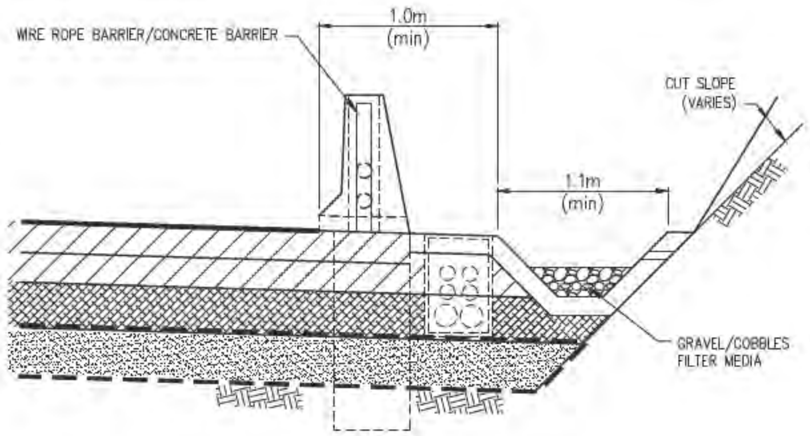
1. FOR BARRIER TYPE REFER TO TABLE 1, FOR CATCH DRAIN TYPE REFER TO CATCH DRAIN DETAILS.
2. CUT TYPES 2, 6 AND 7: "X" IS MEASURED FROM THE TOE OF THE CUT SLOPE TO THE BASE OF THE VEGETATED SLOPES AT THE LOWEST TORLESSE/REGOLITH INTERFACE IN ANY ONE CUT FACE.
3. CUT TYPE 9: "X" IS MEASURED FROM THE TOE OF THE CUT SLOPE TO THE BASE OF THE VEGETATED SLOPES AT THE LOWEST TORLESSE/HIGHLY WEATHERED TORLESSE INTERFACE IN ANY ONE CUT FACE.

TABLE 1: BARRIER TYPE AND DRAIN WIDTH

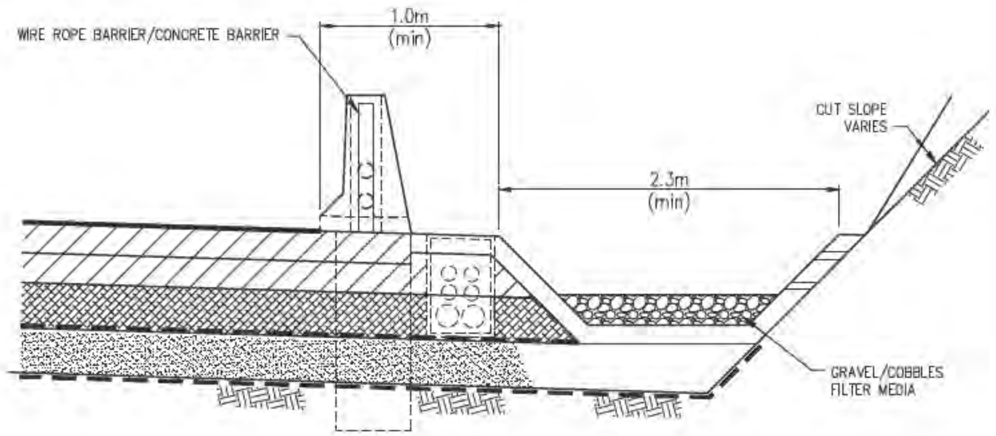
CUT TYPE	PROPOSED BARRIER	DRAIN WIDTH
TYPE 1	WIRE ROPE	NARROW (1.1m)
TYPE 2 ("X" < 10m)	WIRE ROPE	WIDE (2.3m)
TYPE 2 ("X" > 10m)	CONCRETE	WIDE (2.3m)
TYPE 3	CONCRETE	WIDE (2.3m)
TYPE 4	CONCRETE	NARROW (1.1m)
TYPE 5	CONCRETE	NARROW (1.1m)
TYPE 6 ("X" < 10m)	WIRE ROPE	WIDE (2.3m)
TYPE 6 ("X" > 10m)	CONCRETE	WIDE (2.3m)
TYPE 7 ("X" < 10m)	WIRE ROPE	WIDE (2.3m)
TYPE 7 ("X" > 10m)	CONCRETE	WIDE (2.3m)
TYPE 8	WIRE ROPE	NARROW (1.1m)
TYPE 9 ("X" < 10m)	WIRE ROPE	NARROW (1.1m)
TYPE 9 ("X" > 10m)	CONCRETE	WIDE (2.3m)



TYPE 7
SCALE D



CATCH DRAIN DETAIL
(CUT TYPES 1, 4, 5, 8, 9)
(REFER TO TABLE 1)
SCALE G



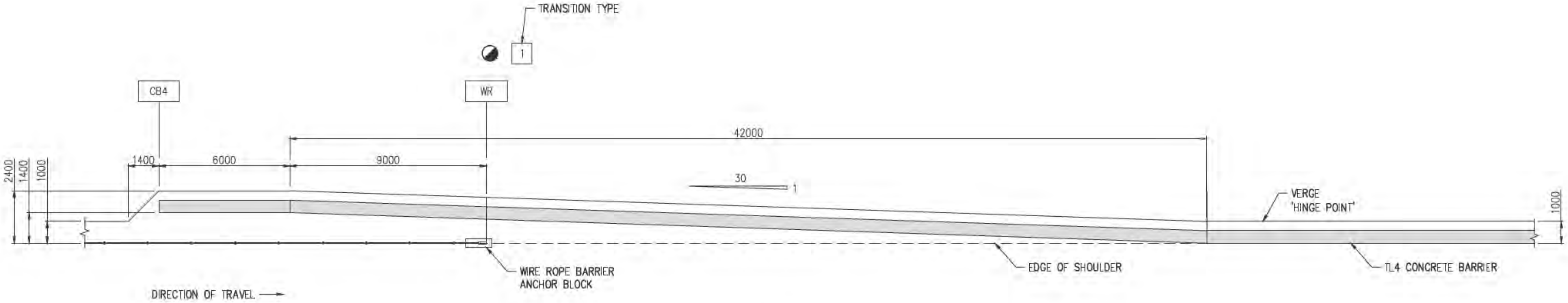
CATCH DRAIN DETAIL
(CUT TYPES 2, 3, 6, 7, 9)
(REFER TO TABLE 1)
SCALE G

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV C
DATE 16 JUNE 2014

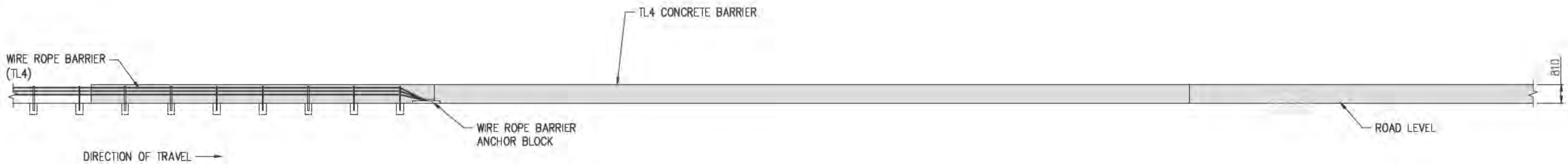
SCALE G 0 500 1000 1250mm 1 : 50 (A3) 1 : 25 (A1)
SCALE D 0 2 4 6 8 10m 1 : 400 (A3) 1 : 200 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
TYPICAL CUT SECTIONS - SHEET 2
TG-DRG-S11-AL-4422



PLAN
SCALE E



ELEVATION
SCALE E

WIRE ROPE BARRIER TO CONCRETE BARRIER APPROACH TRANSITION (TRANSITION TYPE 1)

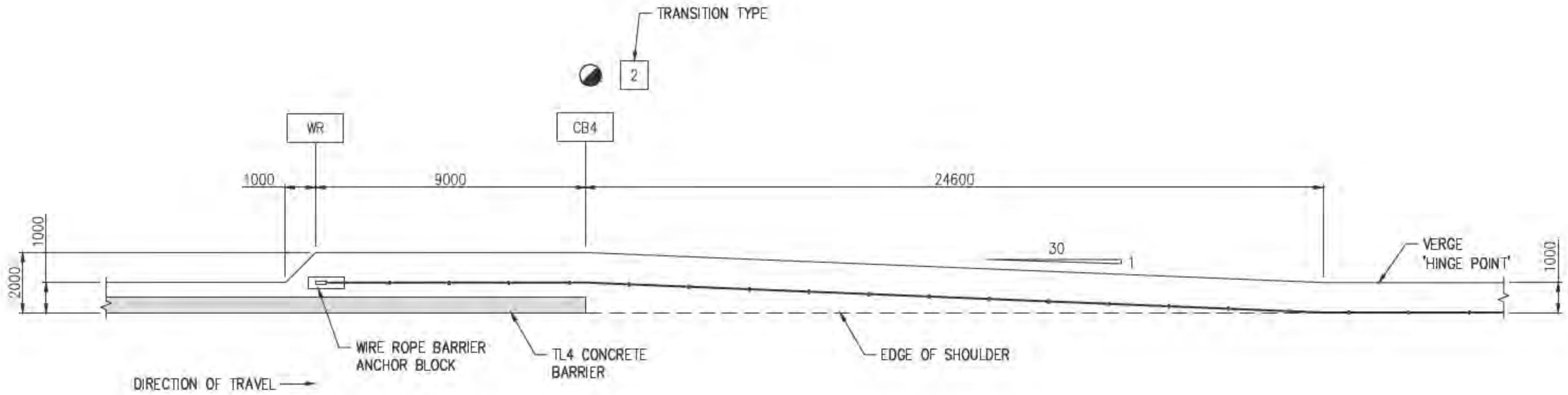
X DENOTES TRANSITION TYPE
WR DENOTES WIRE ROPE BARRIER
CB DENOTES CONCRETE BARRIER

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

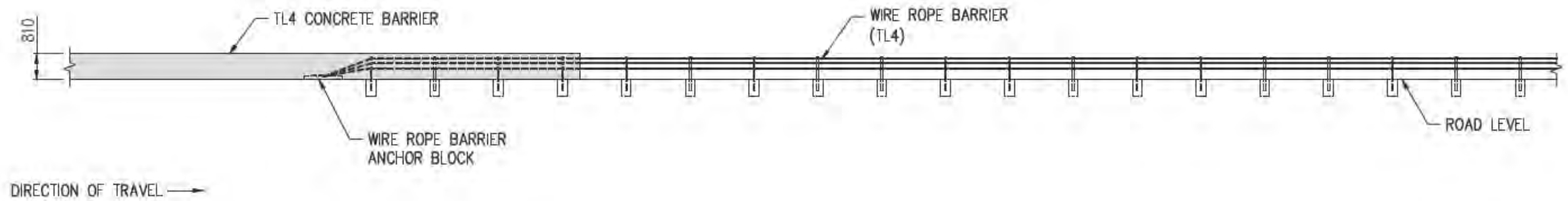
SCALE E 0 1 2 3 4 5m
1 : 200 (A3) 1 : 100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 1
TG-DRG-S11-AL-4431



PLAN
SCALE E



ELEVATION
SCALE E

CONCRETE BARRIER TO WIRE ROPE BARRIER DEPARTURE TRANSITION (TRANSITION TYPE 2)

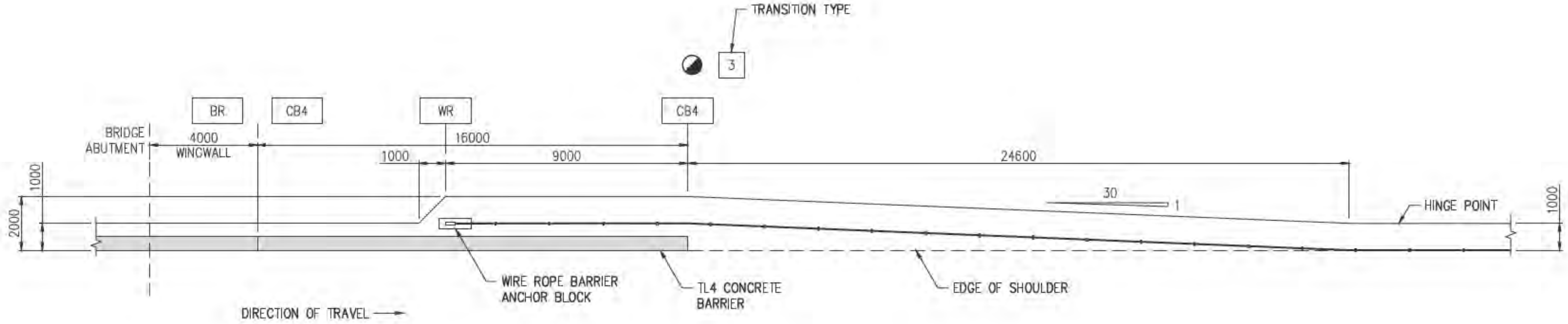
X DENOTES TRANSITION TYPE
WR DENOTES WIRE ROPE BARRIER
CB DENOTES CONCRETE BARRIER

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

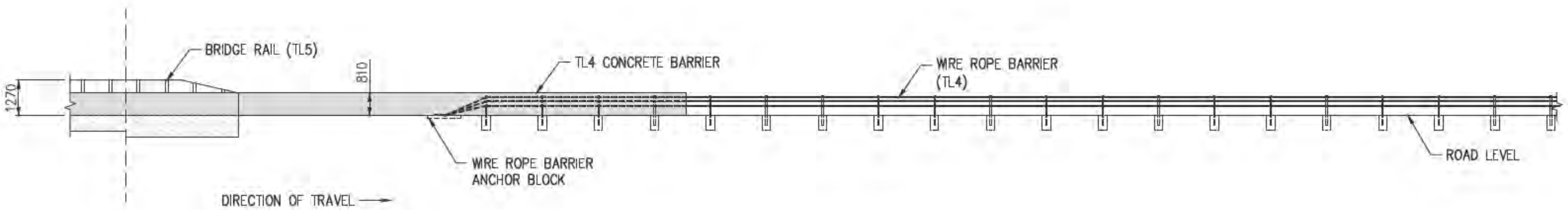
SCALE E 0 1 2 3 4 5m
1 : 200 (A3) 1 : 100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 2
TG-DRG-S11-AL-4432



PLAN
SCALE E



ELEVATION
SCALE E

CONCRETE BARRIER TO WIRE ROPE BARRIER DEPARTURE TRANSITION
(TRANSITION TYPE 3)

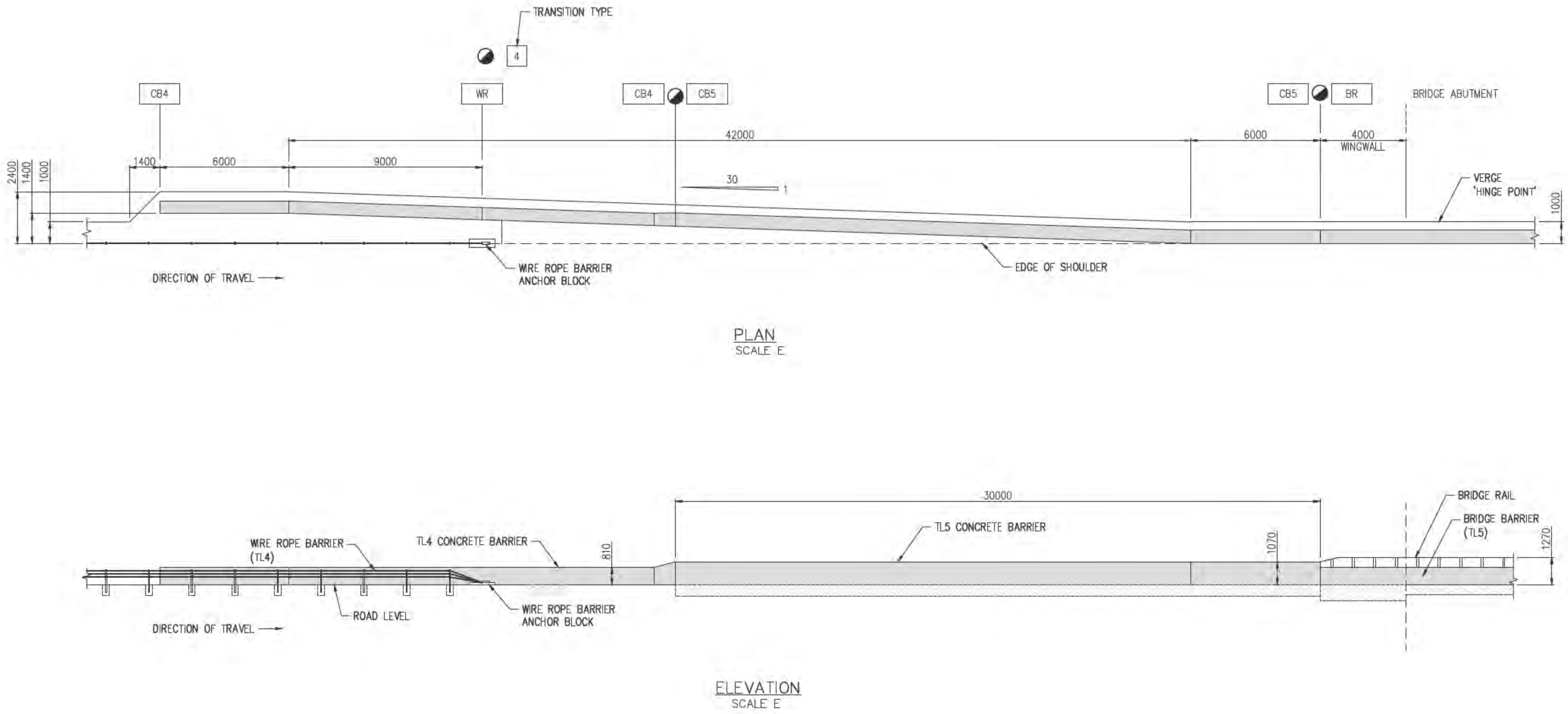
X DENOTES TRANSITION TYPE
WR DENOTES WIRE ROPE BARRIER
CB DENOTES CONCRETE BARRIER
BR DENOTES BRIDGE RAILING

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

SCALE E 0 1 2 3 4 5m
1 : 200 (A3) 1 : 100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 3
TG-DRG-S11-AL-4433



WIRE ROPE BARRIER TO BRIDGE BARRIER APPROACH TRANSITION (TRANSITION TYPE 4)

X DENOTES TRANSITION TYPE

WR DENOTES WIRE ROPE BARRIER

CB DENOTES CONCRETE BARRIER

BR DENOTES BRIDGE RAILING

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV B

DATE 09 JUNE 2014

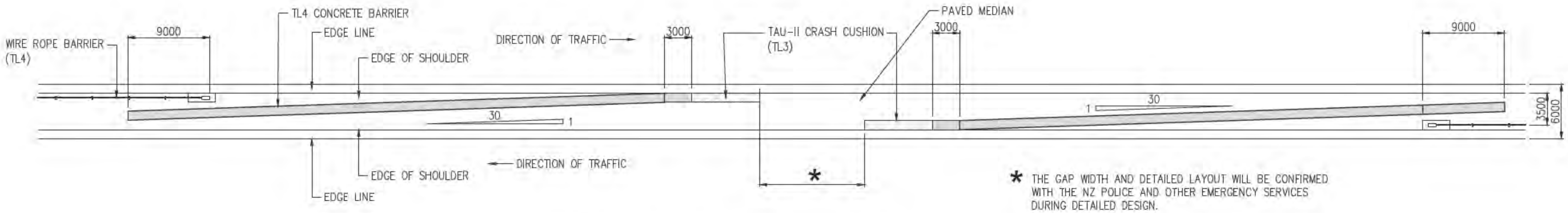
SCALE E. 0 1 2 3 4 5m 1 : 200 (A3) 1 : 100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY

BARRIER TRANSITION DETAILS - SHEET 4

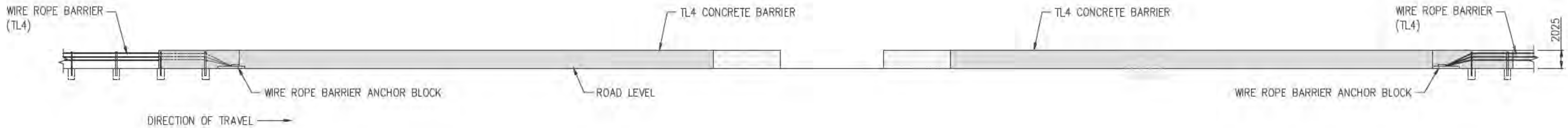
TG-DRG-S11-AL-4434



* THE GAP WIDTH AND DETAILED LAYOUT WILL BE CONFIRMED WITH THE NZ POLICE AND OTHER EMERGENCY SERVICES DURING DETAILED DESIGN.

EMERGENCY VEHICLE MEDIAN OPENING PLAN (CH10665)

SCALE C



ELEVATION

SCALE C

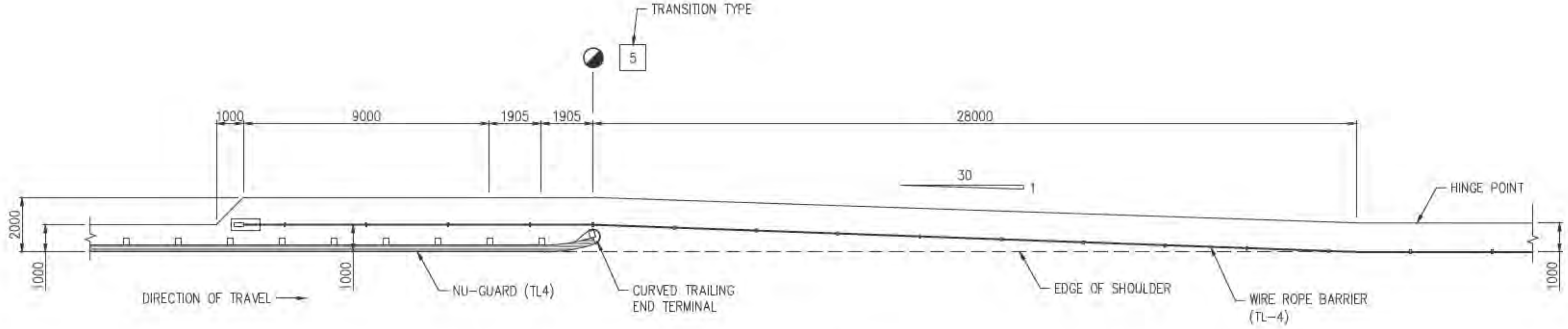
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 16 JUNE 2014

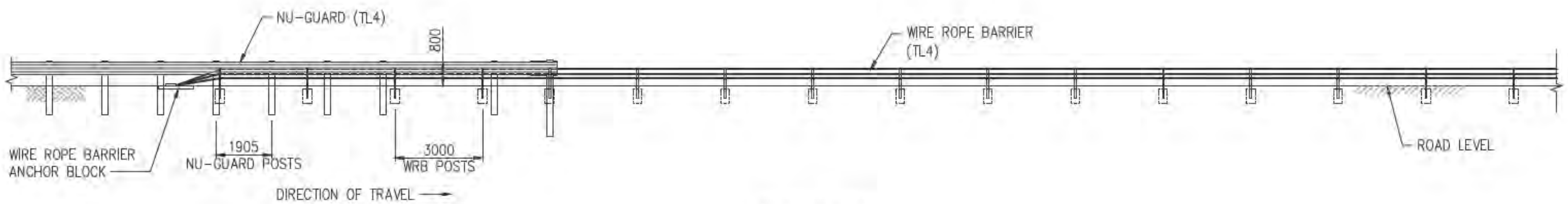
SCALE C 0 5 10 12.5m 1 : 500 (A3) 1 : 250 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 5
TG-DRG-S11-AL-4435



PLAN
SCALE E



ELEVATION
SCALE E

NU-GUARD TO WIRE ROPE BARRIER DEPARTURE TRANSITION (TRANSITION TYPE 5)

X DENOTES TRANSITION TYPE

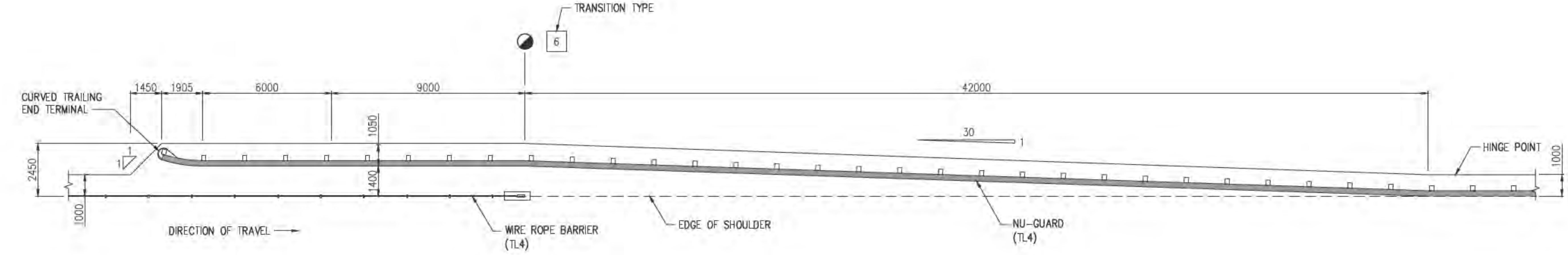
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

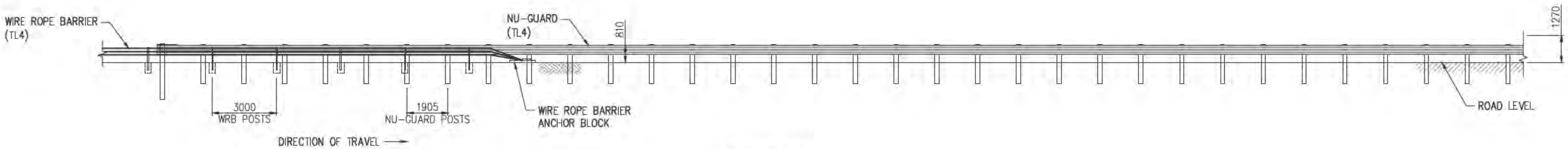
SCALE E. 0 1 2 3 4 5m
1 : 200 (A3) 1 : 100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 9
TG-DRG-S11-AL-4439



PLAN
SCALE E



ELEVATION
SCALE E

WIRE ROPE BARRIER TO NU-GUARD APPROACH TRANSITION (TRANSITION TYPE 6)

X DENOTES TRANSITION TYPE

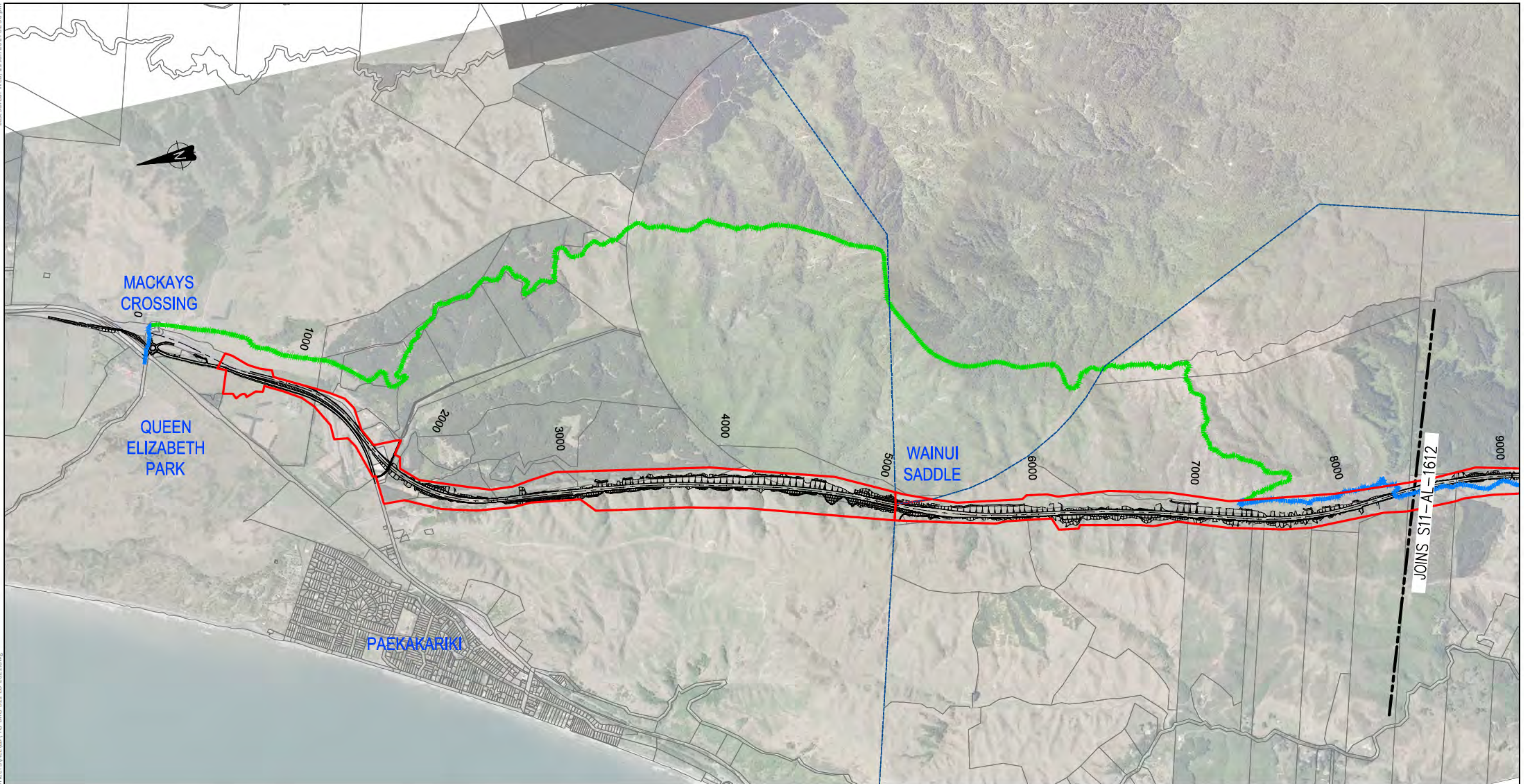
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

SCALE E. 0 1 2 3 4 5m
1 : 200 (A3) 1 : 100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 10
TG-DRG-S11-AL-4440



LEGEND

TG DESIGNATION BOUNDARY

WGP PUBLIC ACCESS TRACK

EXISTING ACCESS TRACK

NOTE

1. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE SPATIAL EXTENT OF THE ACCESS TRACKS. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV B

DATE 09 JUNE 2014

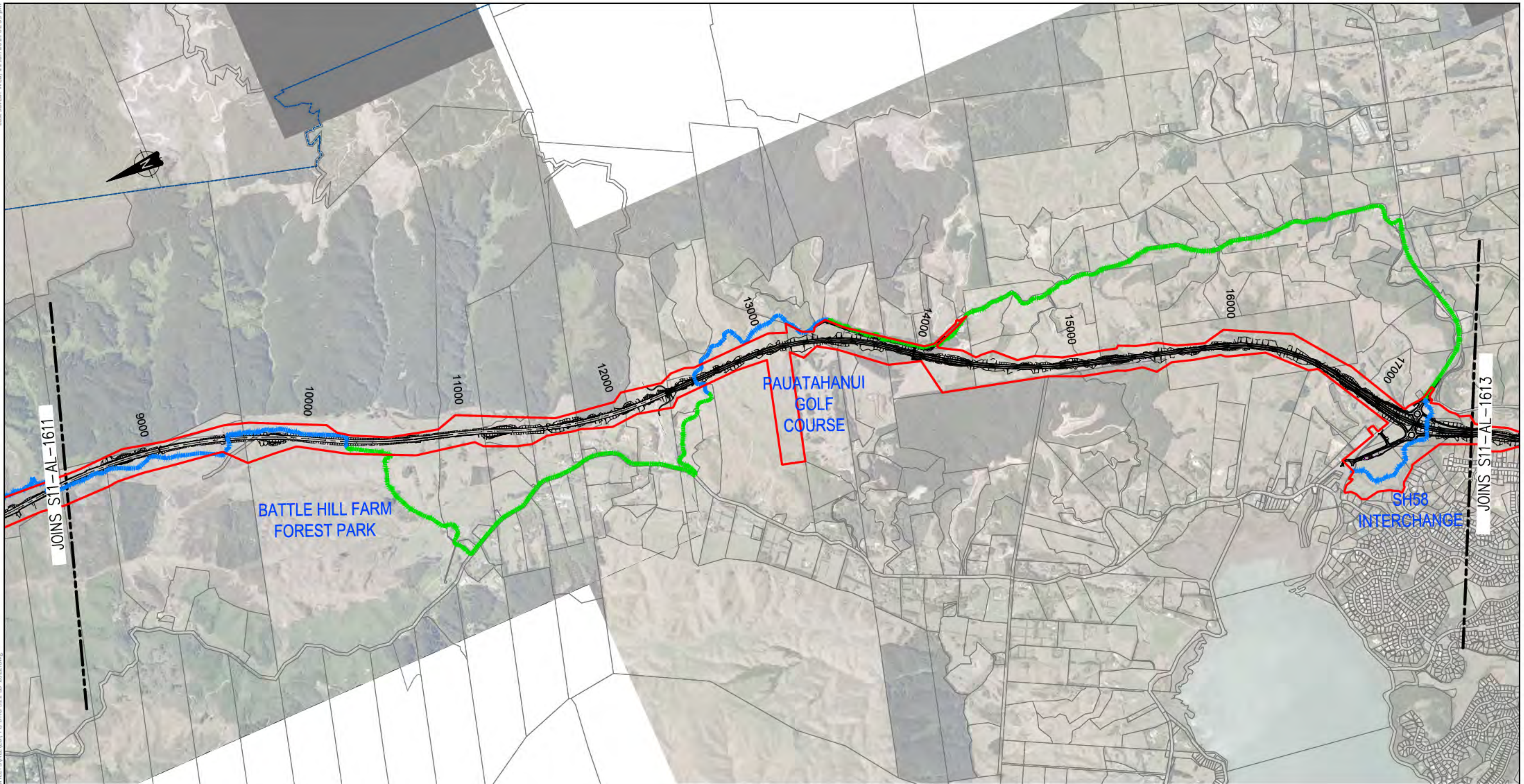
NOT TO SCALE

WELLINGTON GATEWAY PARTNERSHIP

ACCESS TRACK

SHEET 1

TG-DRG-S11-LD-2021



LEGEND

- TG DESIGNATION BOUNDARY
- WGP PUBLIC ACCESS TRACK
- EXISTING ACCESS TRACK

NOTE

1. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE SPATIAL EXTENT OF THE ACCESS TRACKS. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.

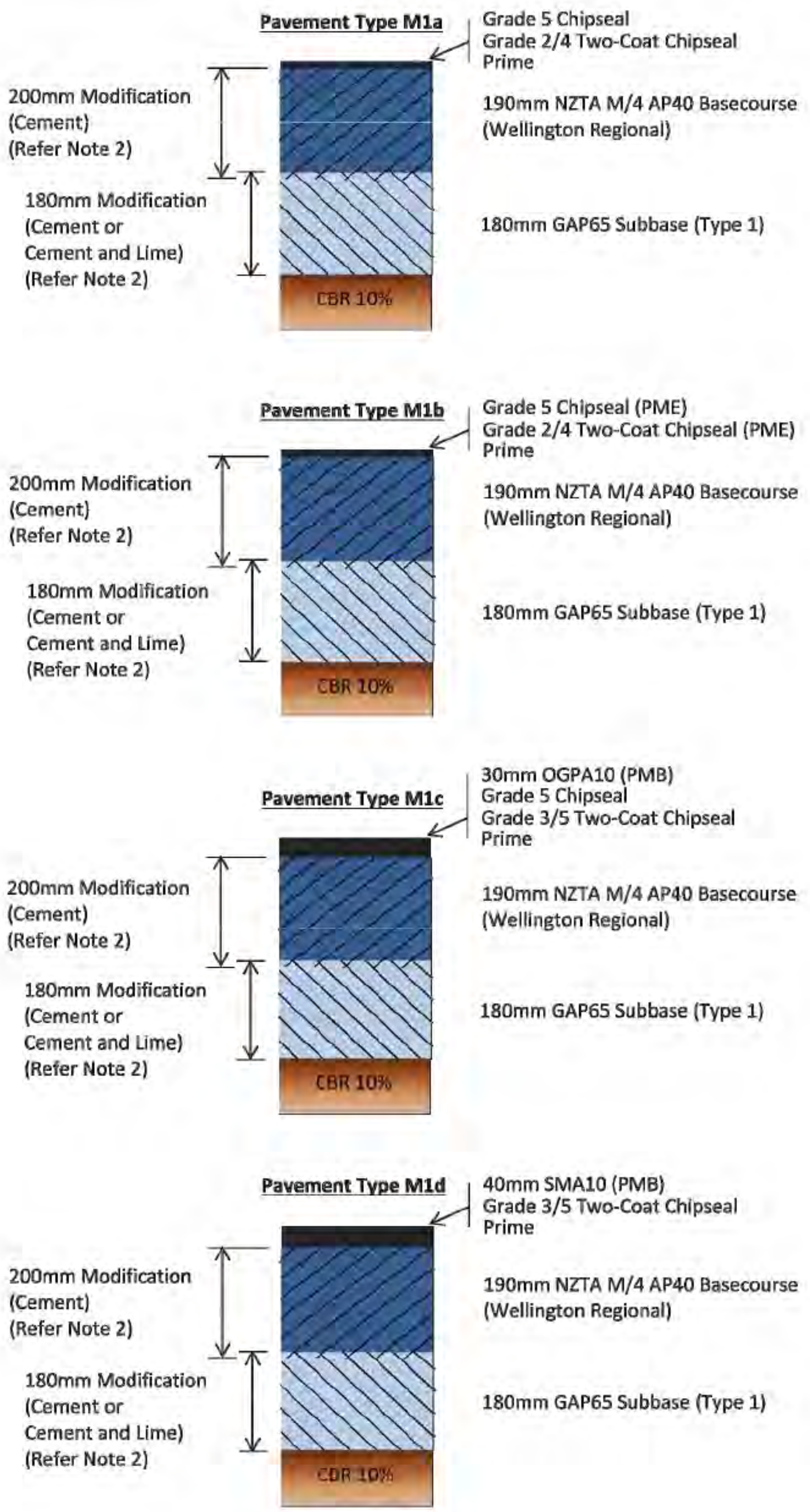
TRANSMISSION GULLY PPP PROJECT

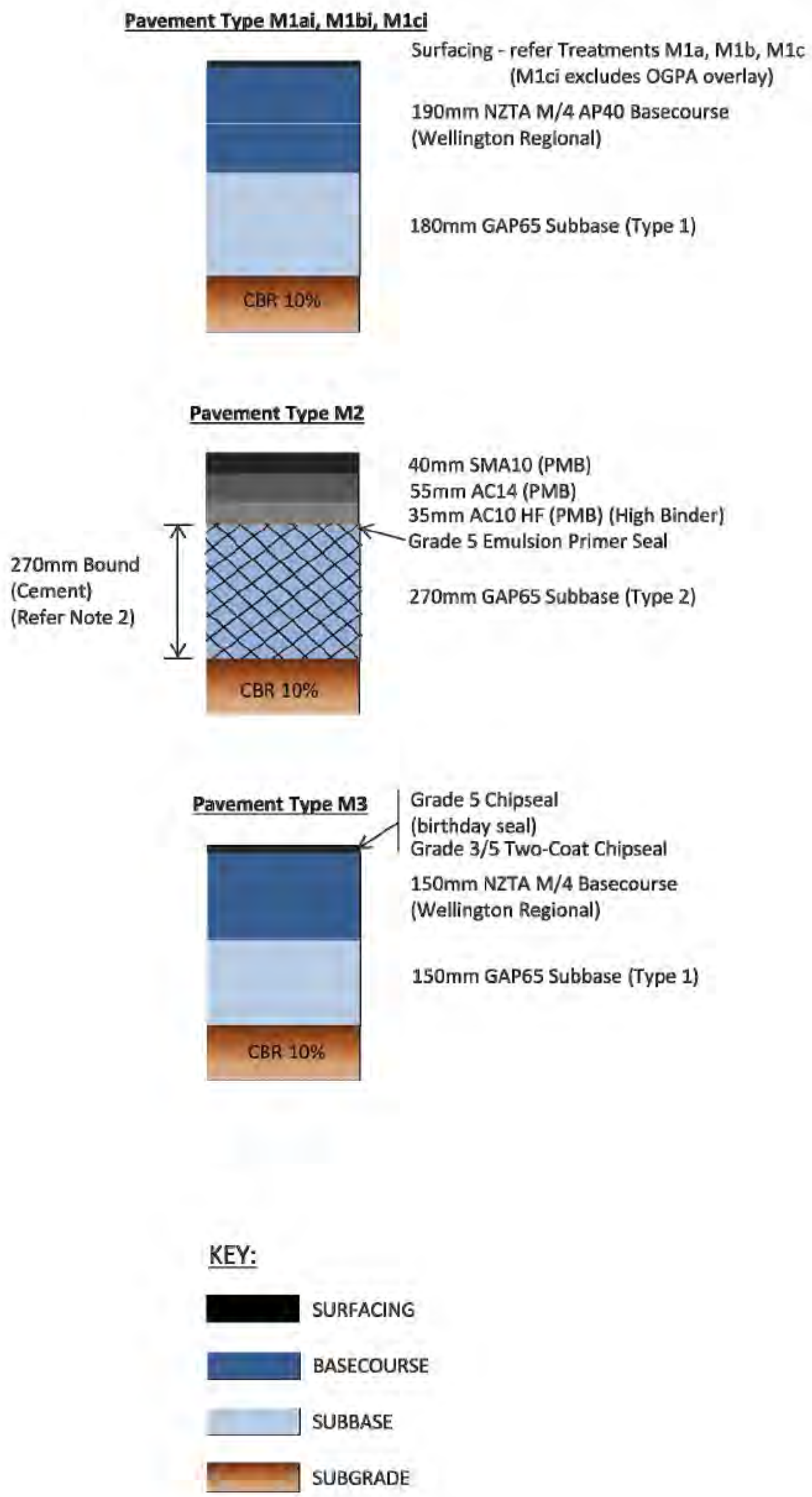
STATUS SCHEDULE 11
REV B
DATE 09 JUNE 2014

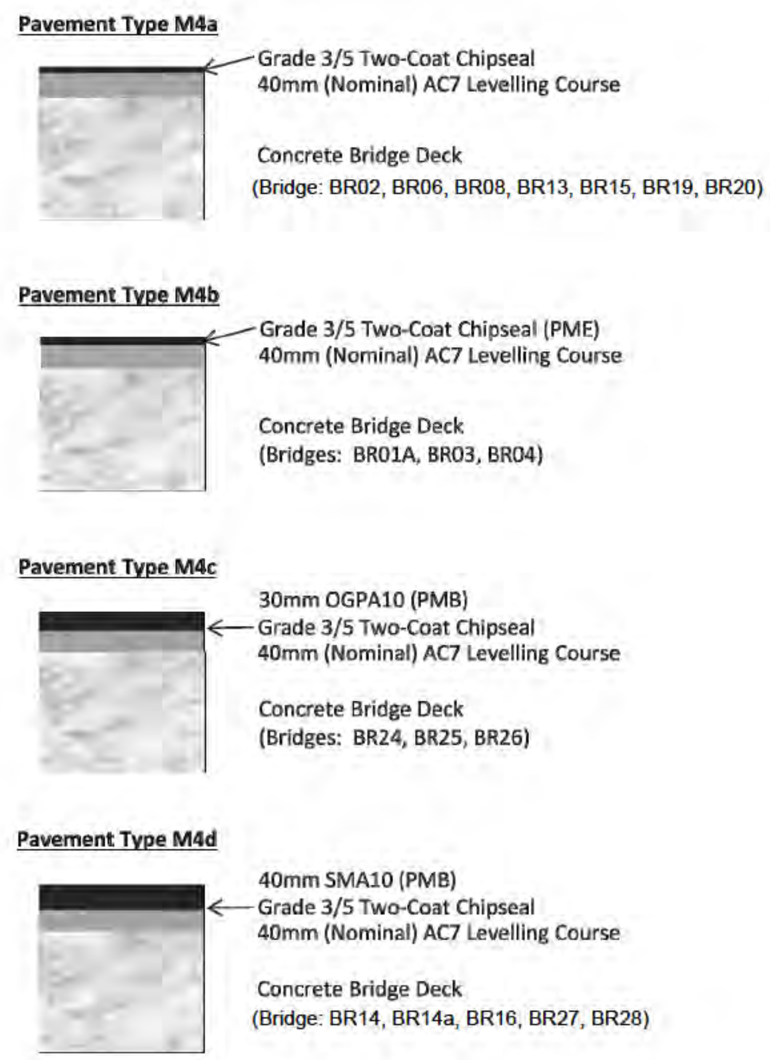
NOT TO SCALE

WELLINGTON GATEWAY PARTNERSHIP

ACCESS TRACK
SHEET 2
TG-DRG-S11-LD-2022







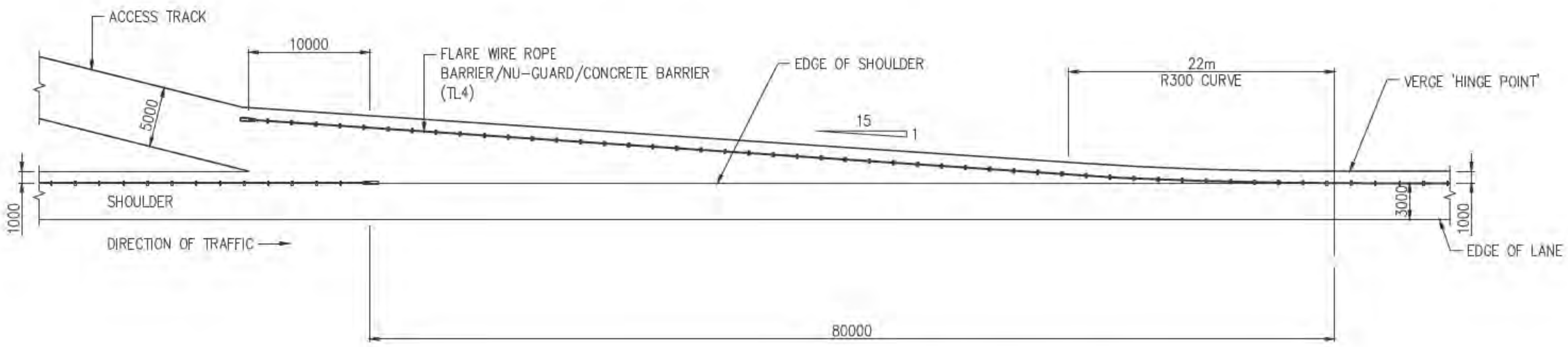
NOTES:

1. NO CONSTRUCTION TOLERANCE IS INCLUDED IN THE PAVEMENT TREATMENTS.
2. ADDITIVE DOSAGES FOR MODIFIED AND BOUND LAYERS TO BE FINALISED AT DETAILED DESIGN STAGE. INITIAL DOSAGES ARE AS TENDERED:
   - MODIFIED BASECOURSE: 2.0% CEMENT
   - MODIFIED SUBBASE: 1.5% CEMENT + 1.5% LIME
   - BOUND SUBBASE: 5.0% CEMENT
3. REFER TO DRG No. TG-DRG-S11-PV-1401 TO 1461 FOR SPACIAL EXTENTS OF PAVEMENT TREATMENTS.
4. REFER TO DRG No. TG-DRG-S11-PV-2402 FOR PAVEMENT EDGE DETAILS.

TRANSMISSION GULLY PPP PROJECT
STATUS: SCHEDULE 11
REV: C
DATE: 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

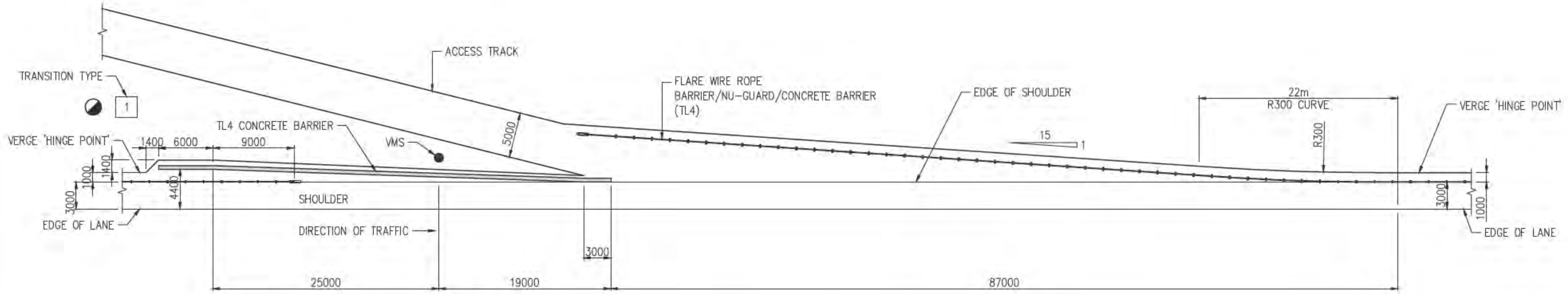
PAVEMENT
PAVEMENT PROFILES
TG-DRG-S11-PV-2401



TYPE A — MAINTENANCE ACCESS

SCALE C

TYPE A - MAINTENANCE ACCESS		
NO.	DIRECTION	APPROX. CH
1	SB	2400
2	SB	4800
3	SB	7450
4	NB	8430
5	SB	8550
6	SB	9750
7	SB	11870
8	SB	13070
9	NB	13070
10	SB	16030
11	NB	16100
12	SB	18160
13	SB	19020
14	SB EXIT RAMP (KENEPURU)	250 (CONTROL LINE MCF0)



TYPE B — MAINTENANCE ACCESS WITH VMS

SCALE C

TYPE B - MAINTENANCE ACCESS WITH VMS		
NO.	DIRECTION	APPROX. CH
1	SB	3150
2	NB	8050

X DENOTES TRANSITION TYPE

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV B

DATE 10 JUNE 2014

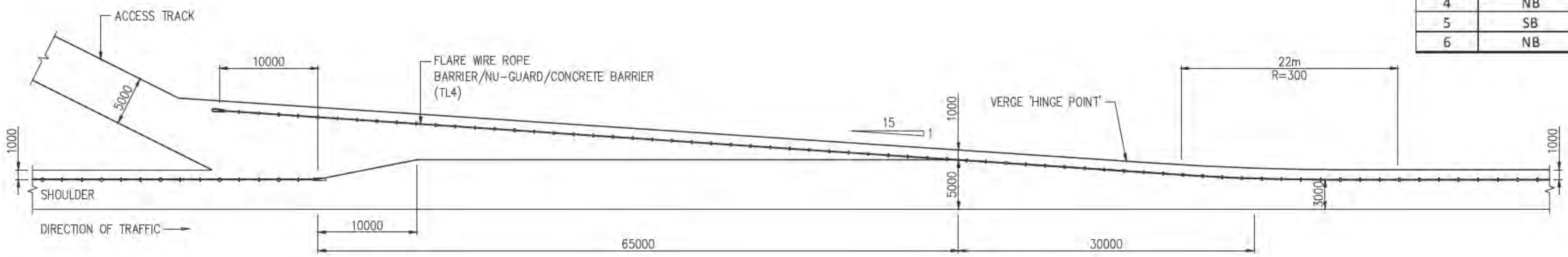
SCALE C 0 5 10 12.5m 1 : 500 (A3) 1 : 250 (A1)

WELLINGTON GATEWAY PARTNERSHIP

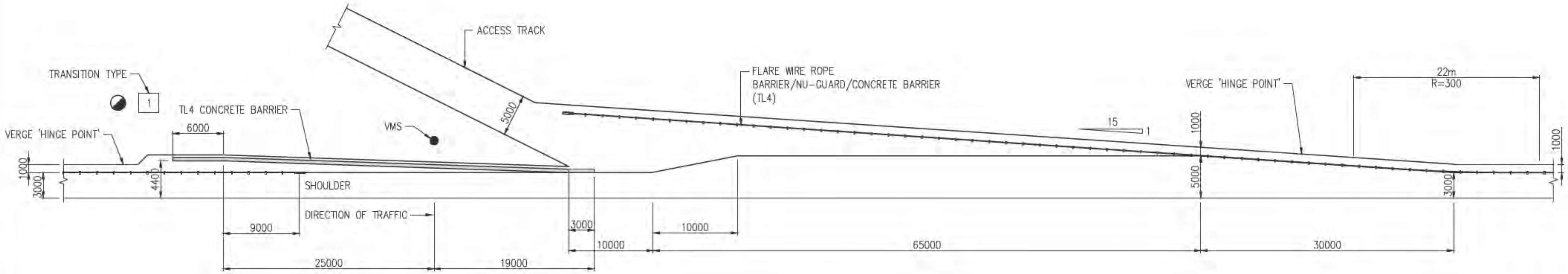
ROADWAY
BARRIER TRANSITION DETAILS - SHEET 6

TG-DRG-S11-AL-4436

TYPE C - ENFORCEMENT BAY WITH MAINTENANCE ACCESS		
NO.	DIRECTION	APPROX. CH
1	SB	6400
2	SB	10650
3	NB	10650
4	NB	15100
5	SB	21500
6	NB	23650



TYPE C – ENFORCEMENT BAY
WITH MAINTENANCE ACCESS
SCALE C



TYPE D – ENFORCEMENT BAY
WITH MAINTENANCE ACCESS & VMS
SCALE C

TYPE D - ENFORCEMENT BAY WITH MAINTENANCE ACCESS & VMS		
NO.	DIRECTION	APPROX. CH
1	SB	15430
2	SB	24620

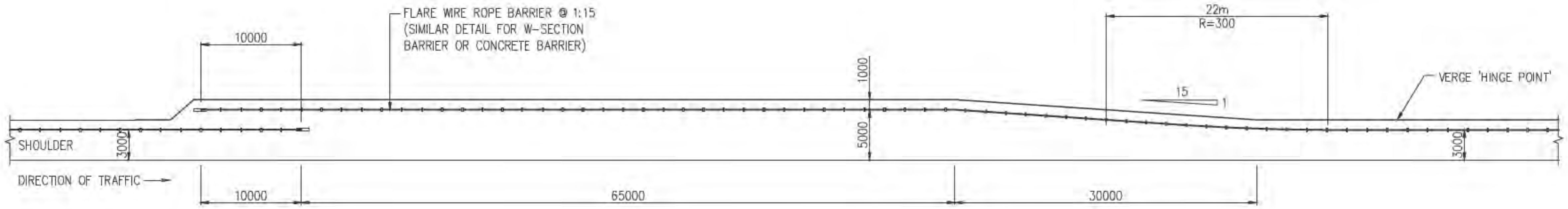
X DENOTES TRANSITION TYPE

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 10 JUNE 2014

SCALE C 0 5 10 12.5m 1 : 500 (A3) 1 : 250 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 7
TG-DRG-S11-AL-4437



TYPE E – ENFORCEMENT BAY
SCALE C

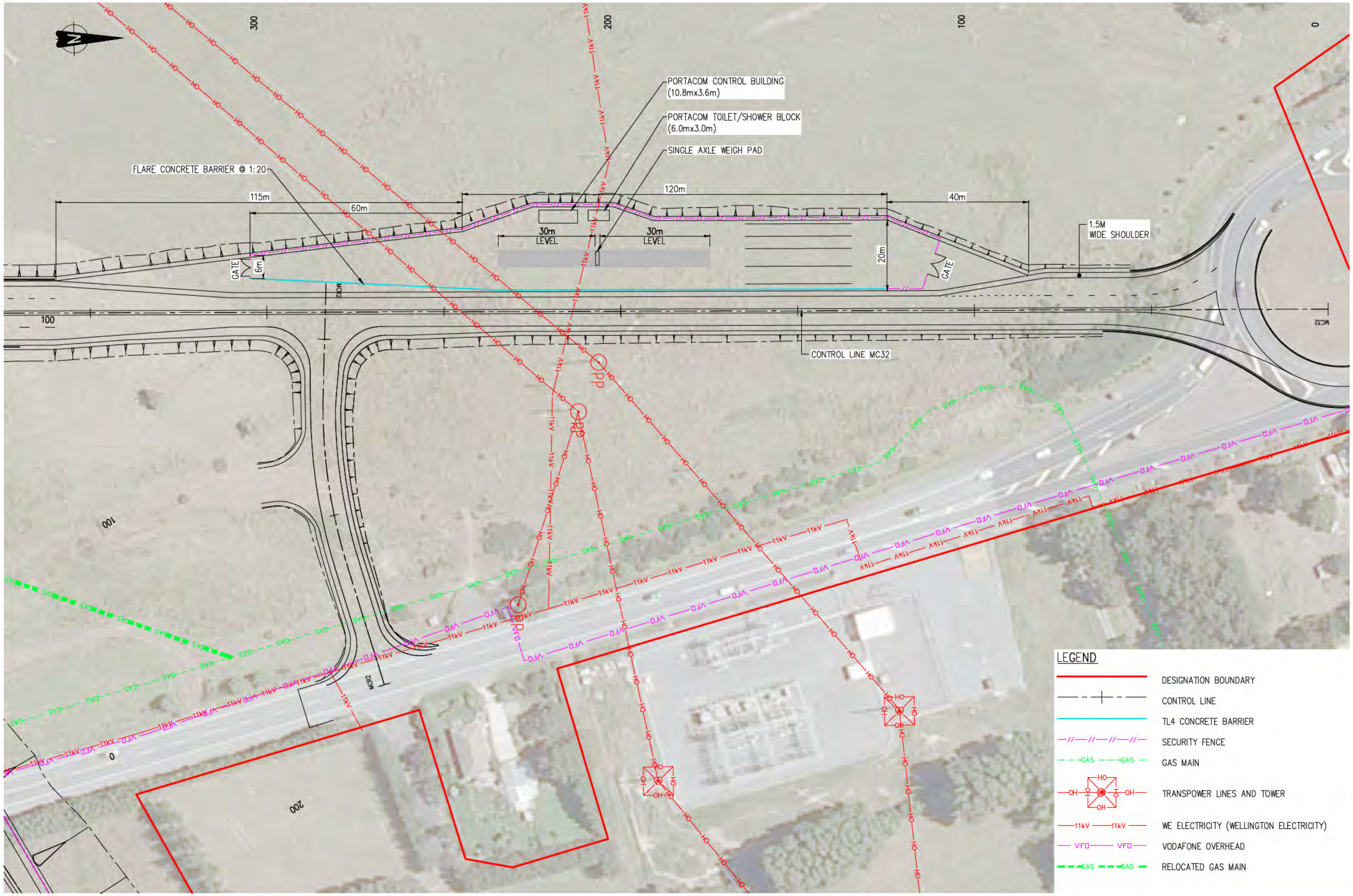
TYPE E - ENFORCEMENT BAY		
NO.	DIRECTION	APPROX. CH
1	NB	7000
2	NB	21600

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 10 JUNE 2014

SCALE C 0 5 10 12.5m
1 : 500 (A3) 1 : 250 (A1)

WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
BARRIER TRANSITION DETAILS - SHEET 8
TG-DRG-S11-AL-4438



TRANSMISSION GULLY PPP PROJECT

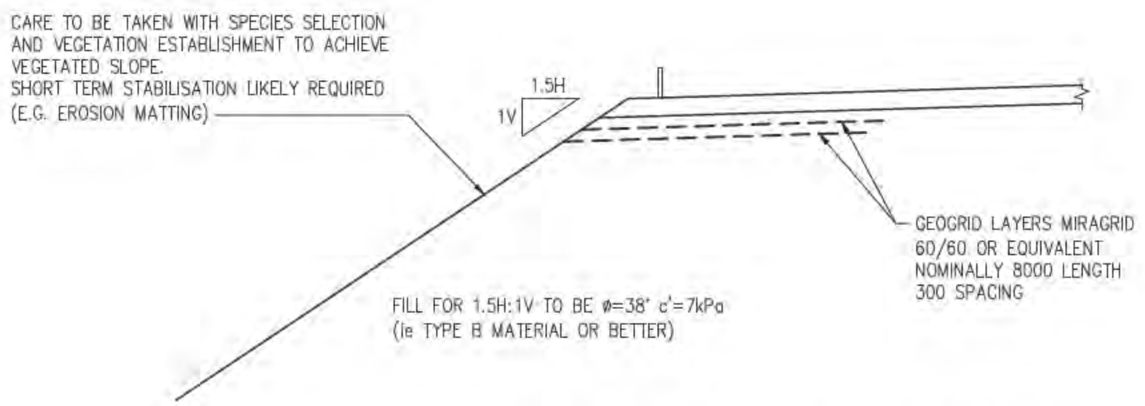
STATUS SCHEDULE 11
REV C
DATE 06 JUNE 2014

SCALE B 0 10 20 25m
1 : 1000 (A3) 1 : 500 (A1)

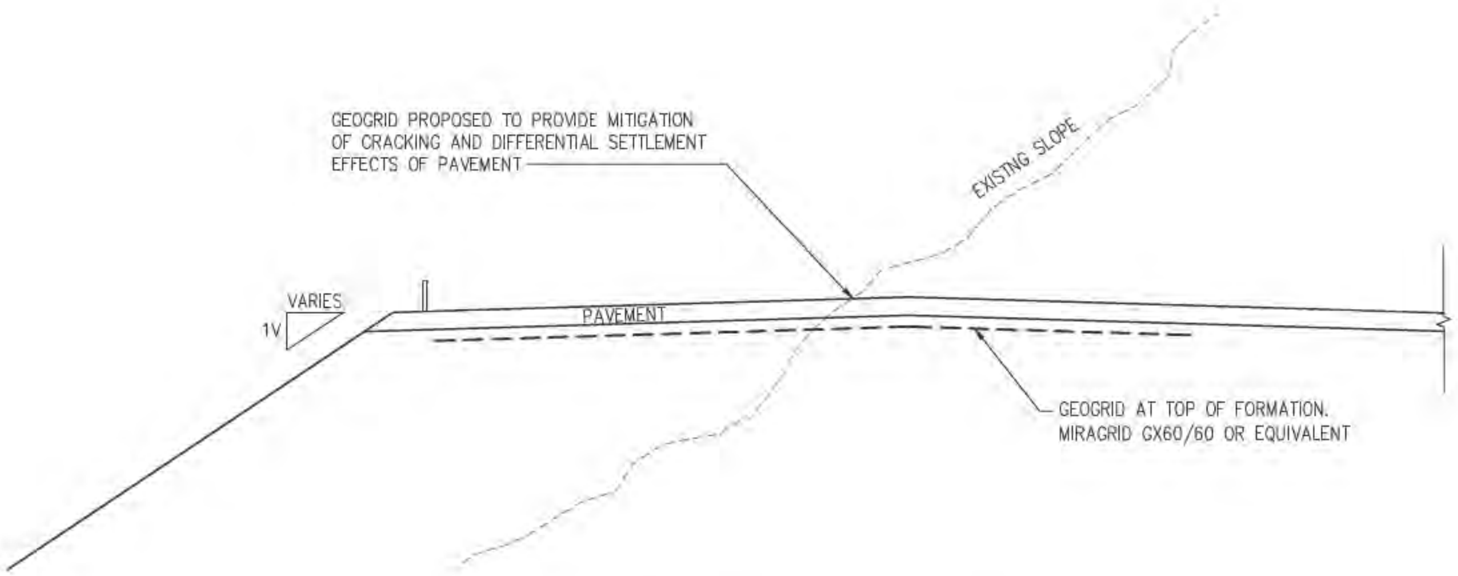
WELLINGTON GATEWAY PARTNERSHIP

ROADWAY
SH58 WEIGH FACILITY

TG-DRG-S11-AL-4461



CREST PROTECTION OF 1.5H:1V SLOPES
SCALE E



CUT/FILL TRANSITION AT
EXISTING NATURAL SLOPES >30 DEGREES
SCALE E

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV B
DATE 06 JUNE 2014

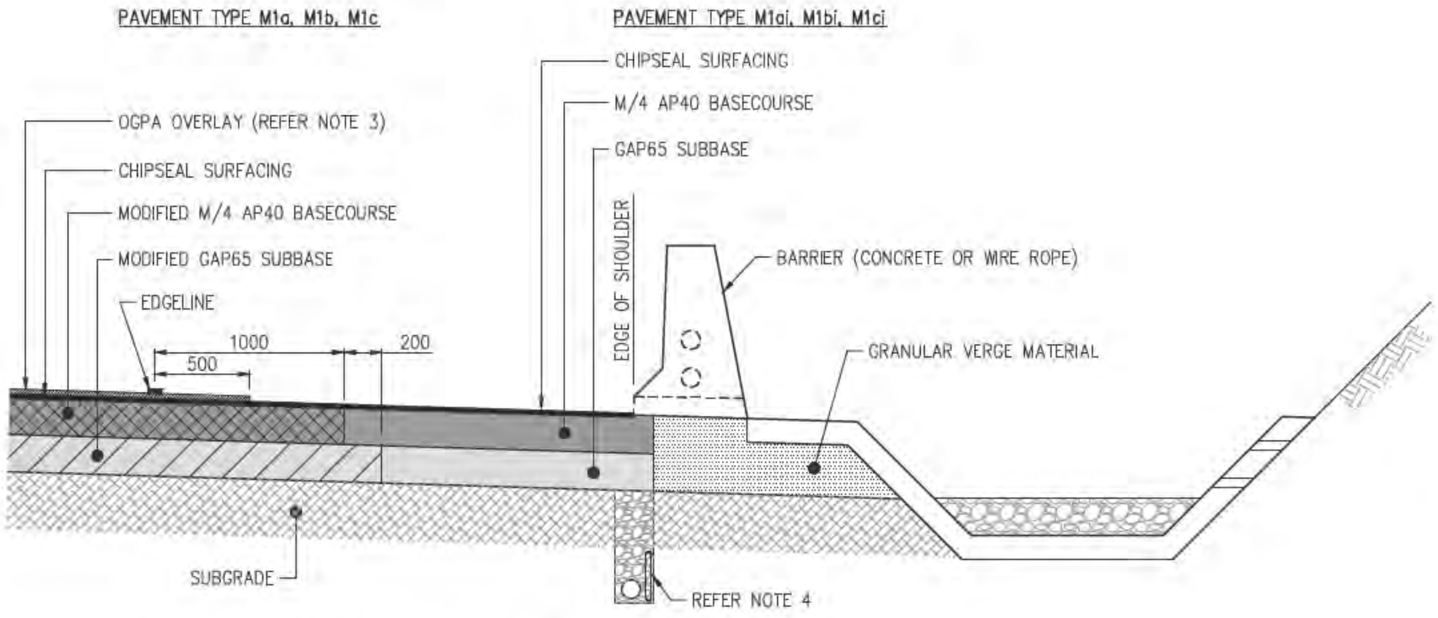
SCALE E 0 1 2 3 4 5m
1 : 200 (A3) 1 : 100 (A1)

WELLINGTON GATEWAY PARTNERSHIP

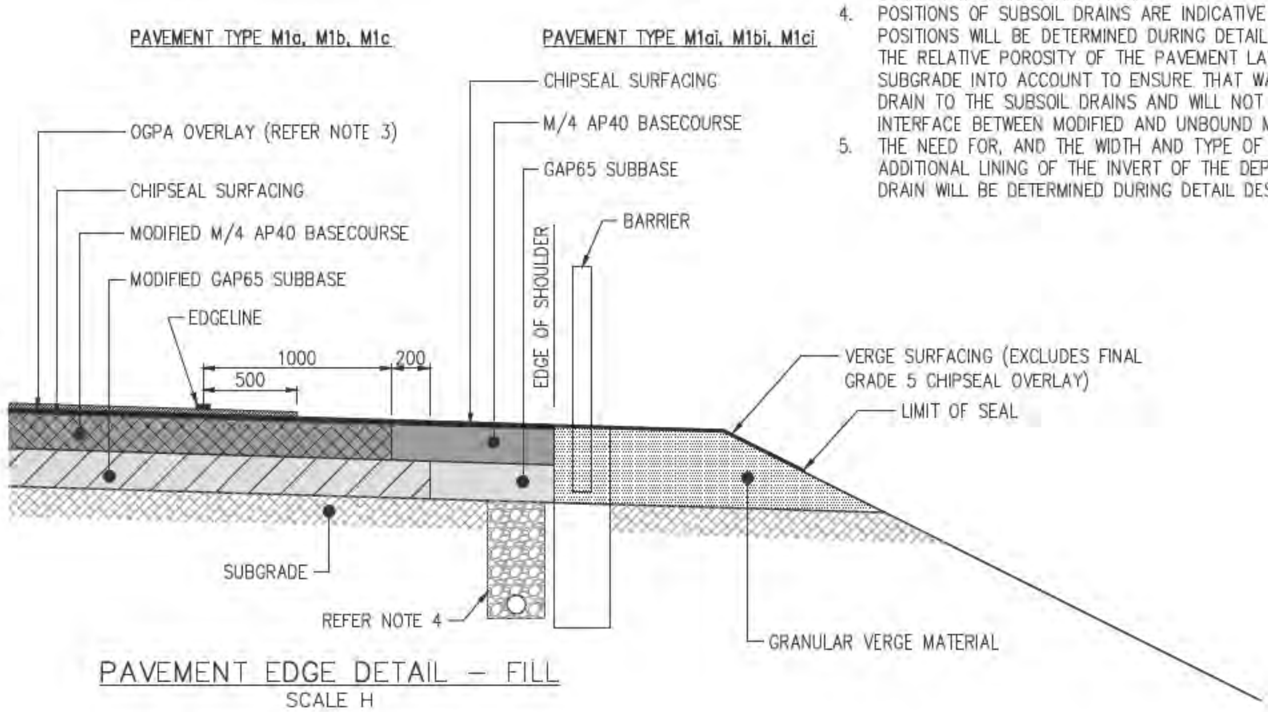
GEOTECHNICAL
GEOGRID ARRANGEMENT
TG-DRG-S11-GT-2401

NOTES:

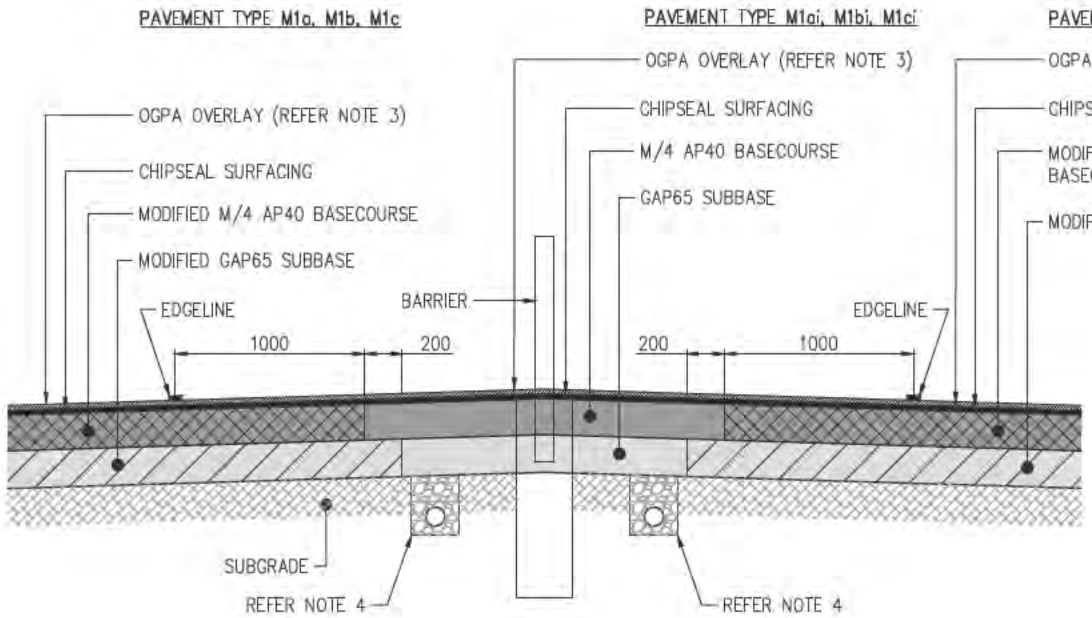
1. REFER TO DRAWING No. TG-DRG-S11-PV-2401 FOR PAVEMENT TREATMENT DETAILS.
2. REFER TO DRAWING No. TG-DRG-S11-PV-1401 TO 1461 FOR PAVEMENT TREATMENT PLANS.
3. REFER TO DRAWING No. TG-DRG-S11-PV-1401 TO 1461 FOR OVERLAY LOCATIONS AND EXTENTS.
4. POSITIONS OF SUBSOIL DRAINS ARE INDICATIVE ONLY. THE POSITIONS WILL BE DETERMINED DURING DETAIL DESIGN TAKING THE RELATIVE POROSITY OF THE PAVEMENT LAYERS AND SUBGRADE INTO ACCOUNT TO ENSURE THAT WATER WILL DRAIN TO THE SUBSOIL DRAINS AND WILL NOT DAM AT THE INTERFACE BETWEEN MODIFIED AND UNBOUND MATERIALS.
5. THE NEED FOR, AND THE WIDTH AND TYPE OF ANY ADDITIONAL LINING OF THE INVERT OF THE DEPRESSED MEDIAN DRAIN WILL BE DETERMINED DURING DETAIL DESIGN.



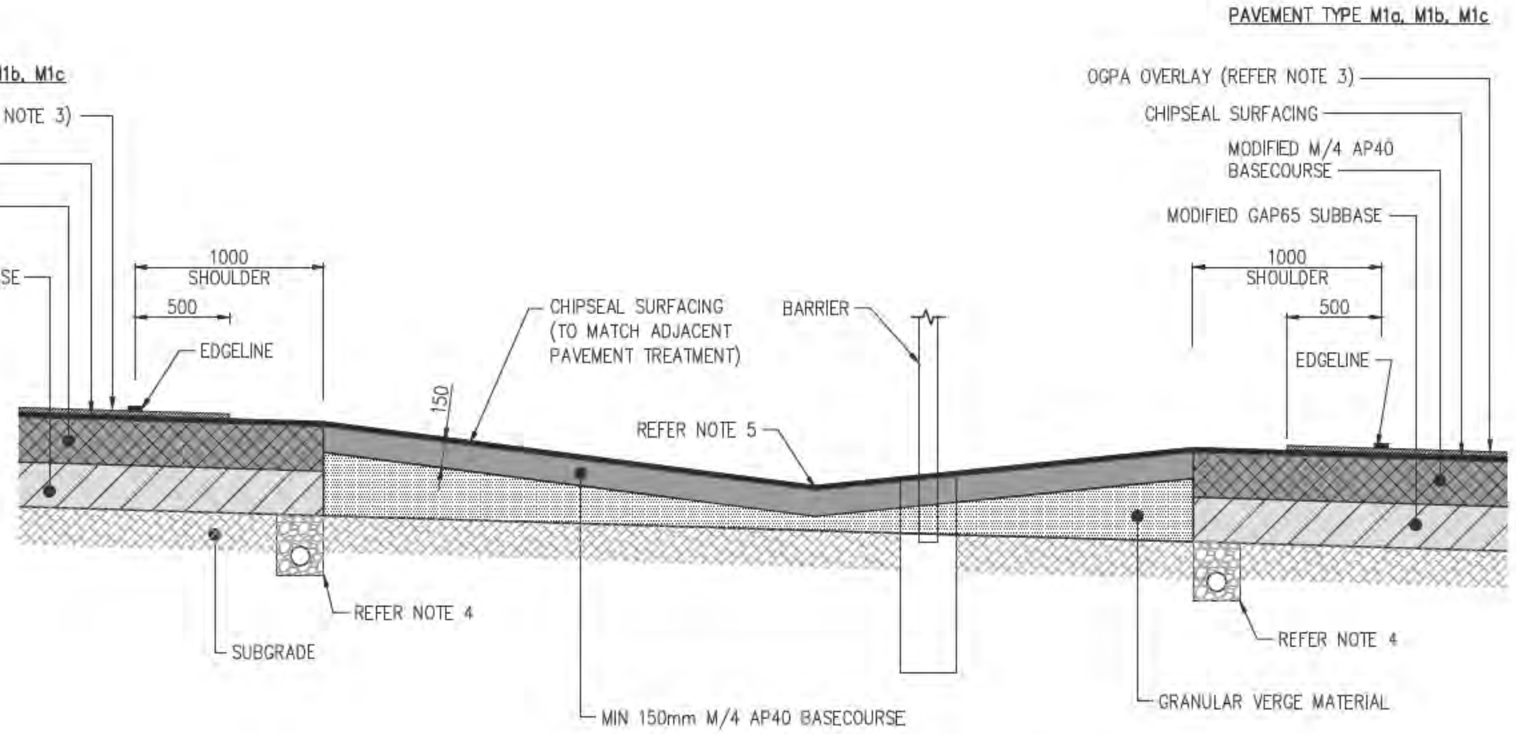
PAVEMENT EDGE DETAIL – CUTS
SCALE H



PAVEMENT EDGE DETAIL – FILL
SCALE H



PAVEMENT EDGE DETAIL – CENTRAL MEDIAN
SCALE H



PAVEMENT EDGE DETAIL – DEPRESSED MEDIAN

SCALE H

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV C

DATE 25 JUNE 2014

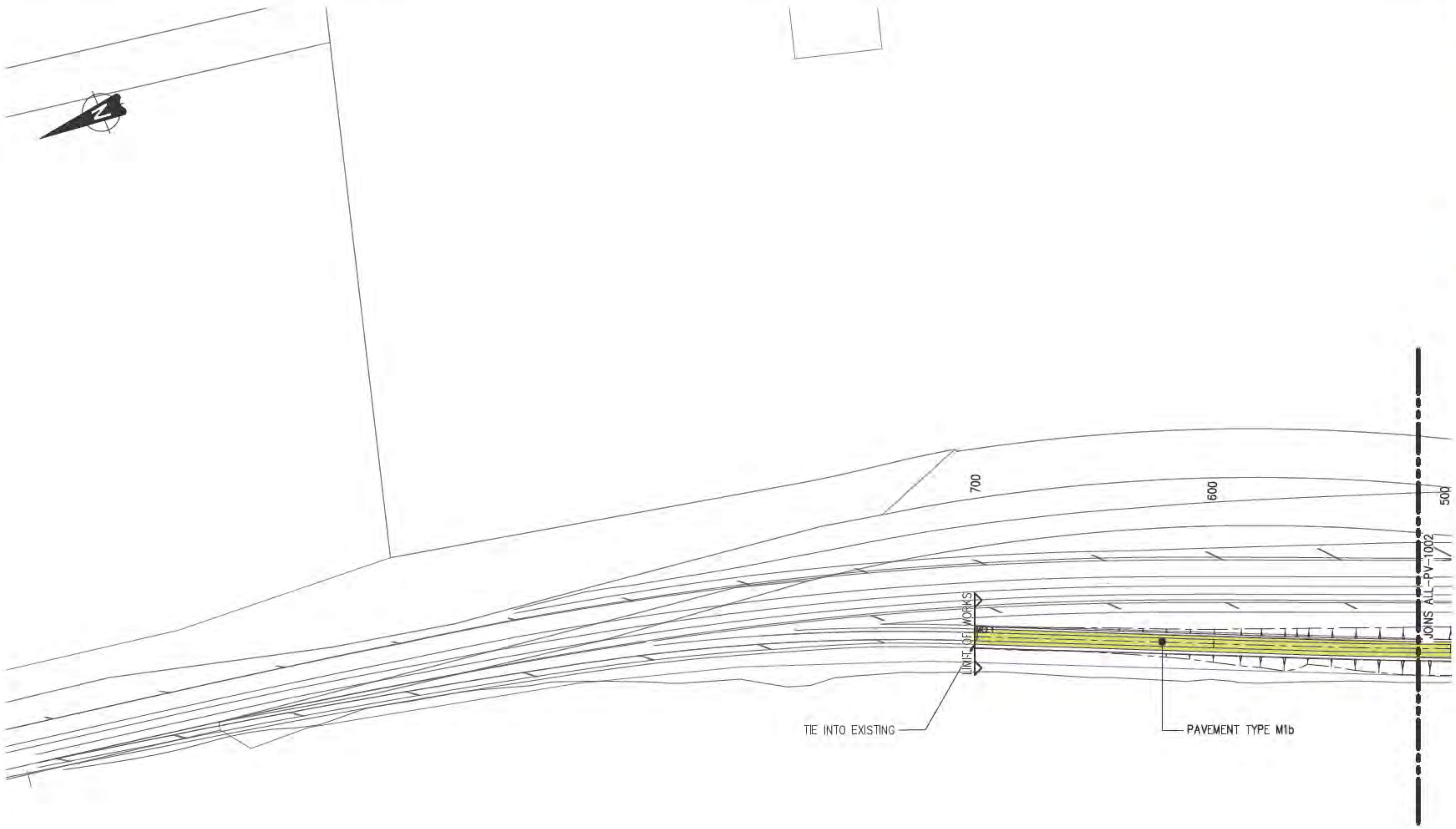
SCALE H 0 200 400 600 800 1000mm
1 : 40 (A3) 1 : 20 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT

PAVEMENT EDGE DETAILS

TG-DRG-S11-PV-2402



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN

TRANSMISSION GULLY PPP PROJECT

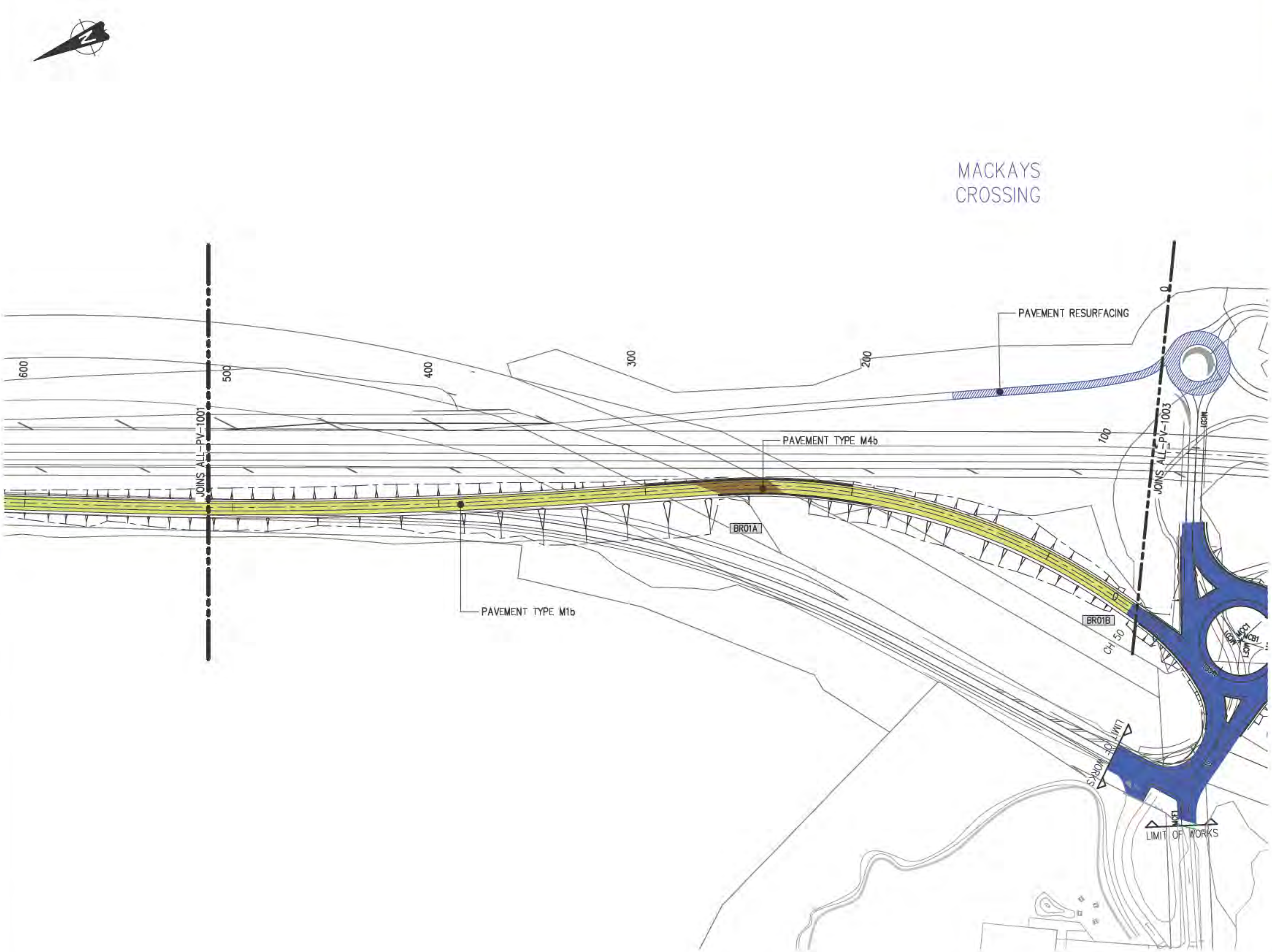
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 1

TG-DRG-S11-PV-1401



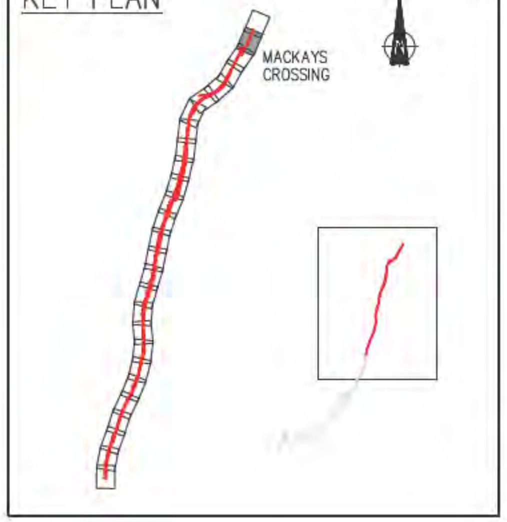
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

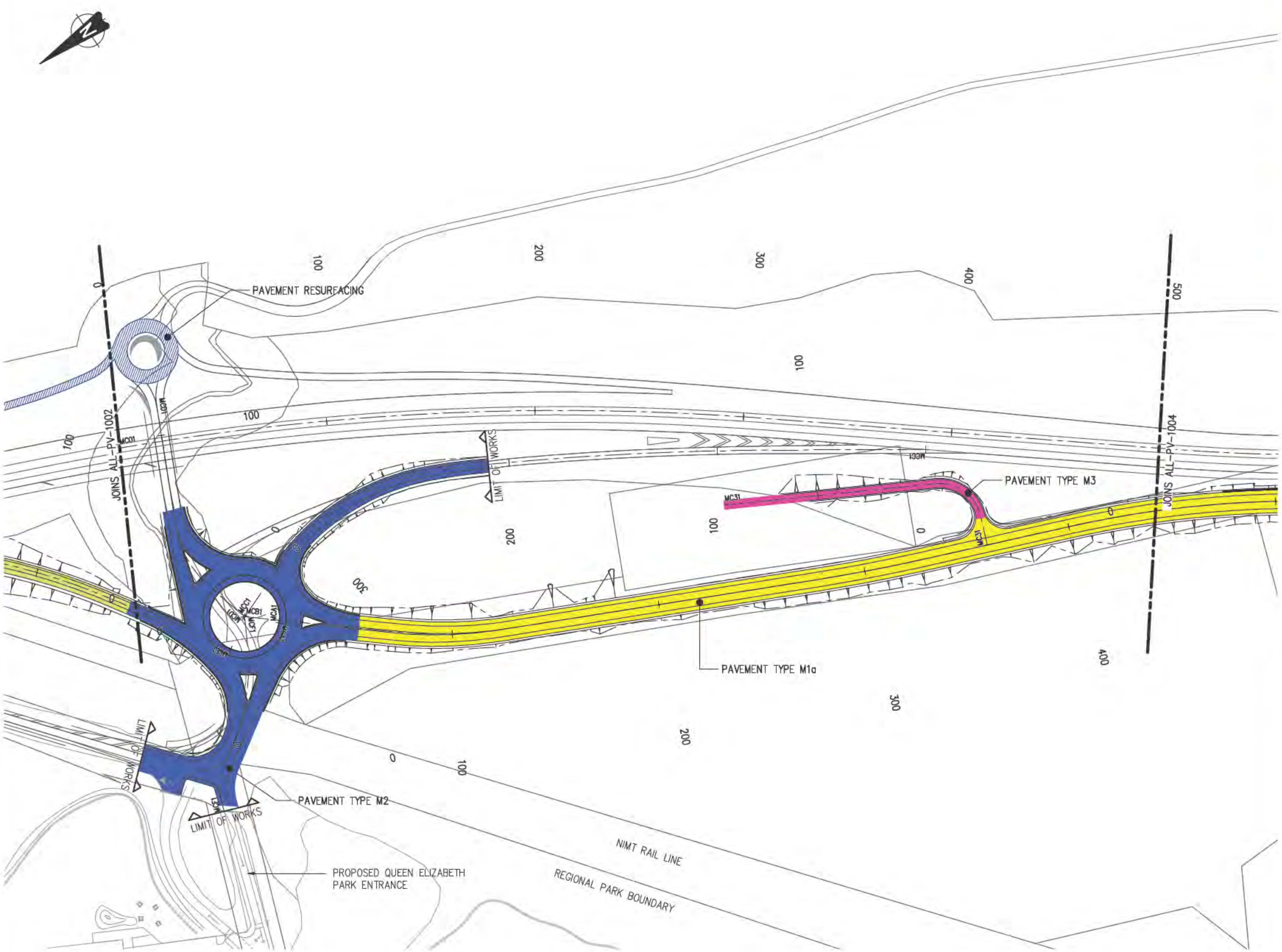
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 2

TG-DRG-S11-PV-1402



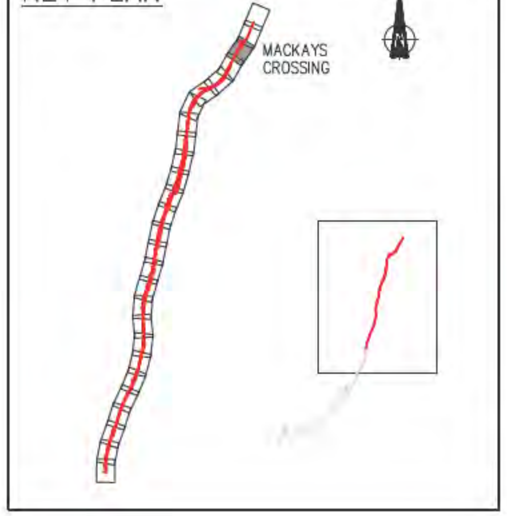
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



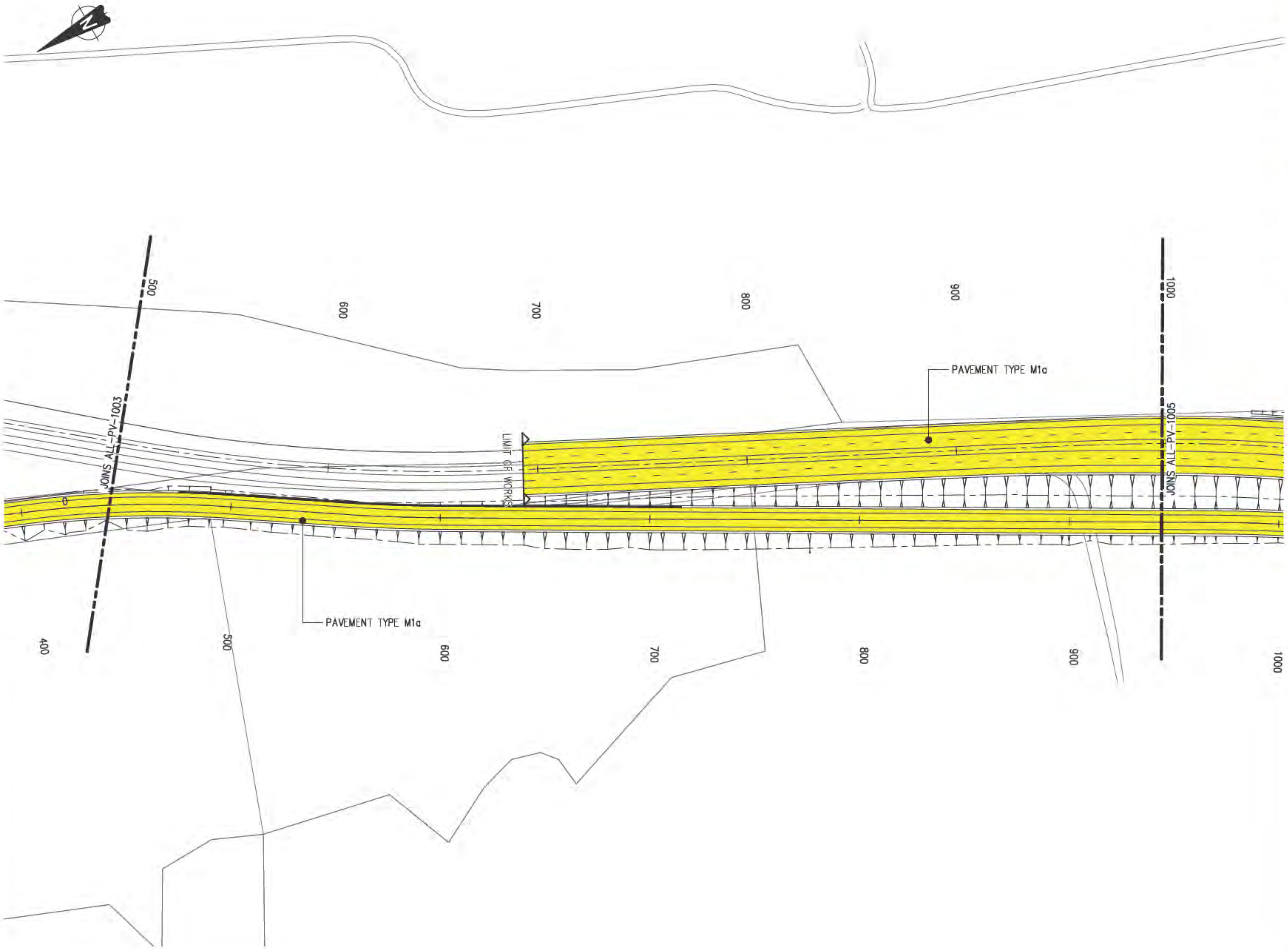
TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 3

TG-DRG-S11-PV-1403



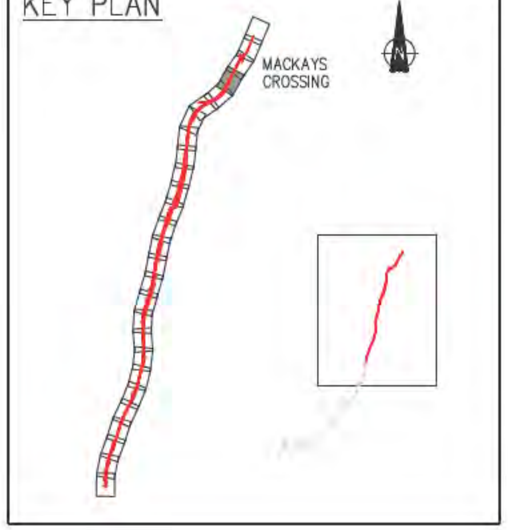
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV A

DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m 1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 4

TG-DRG-S11-PV-1404

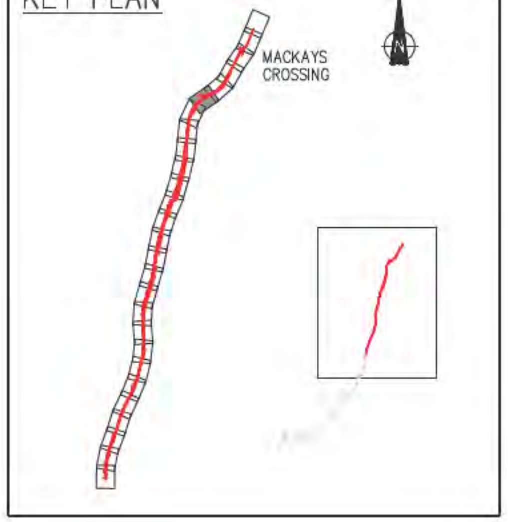
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG–DRG–S11–PV–2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



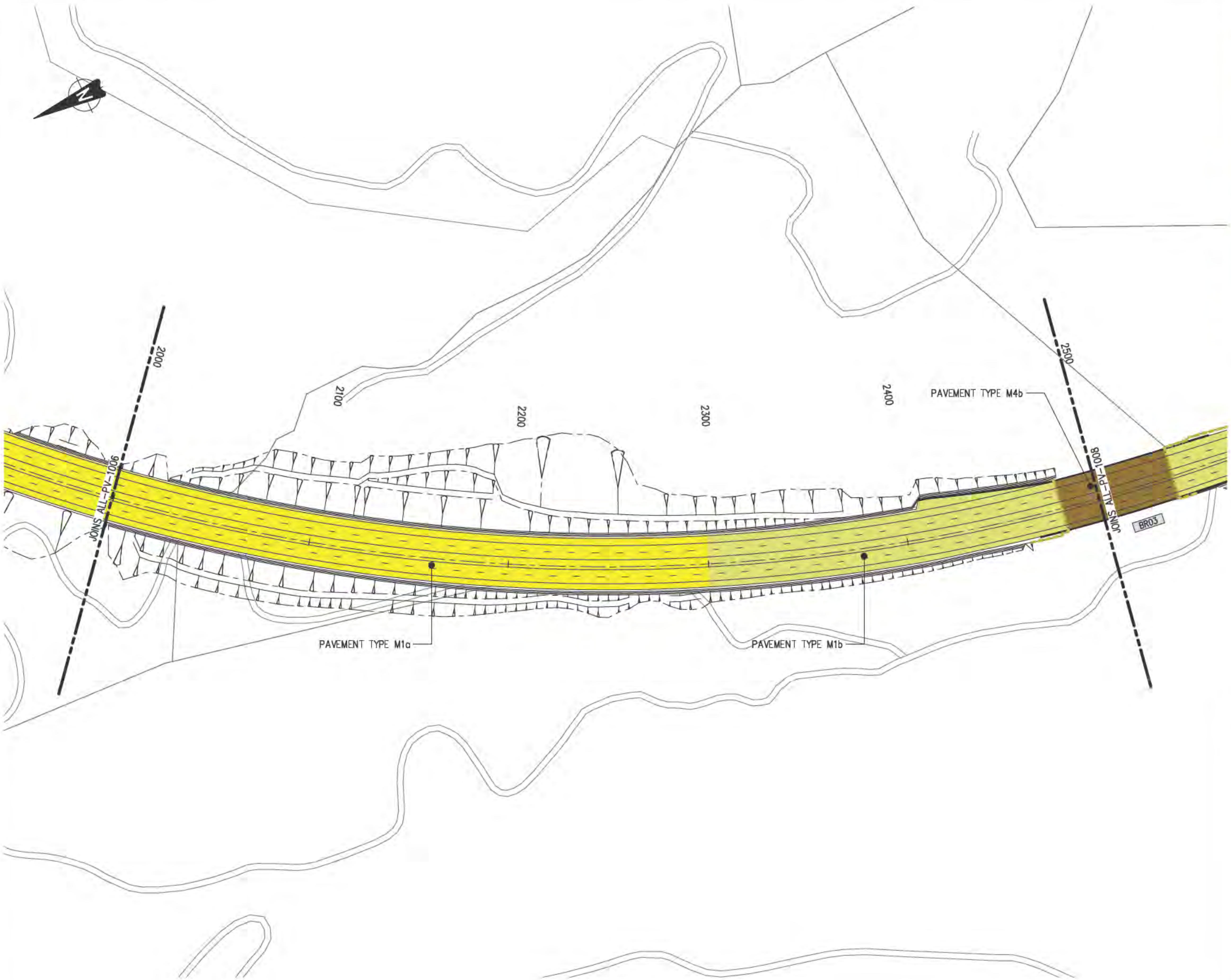
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT
PLAN - SHEET 6
TG-DRG-S11-PV-1406



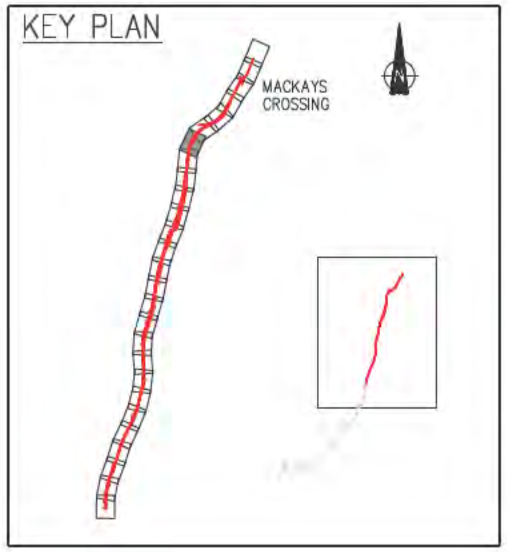
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

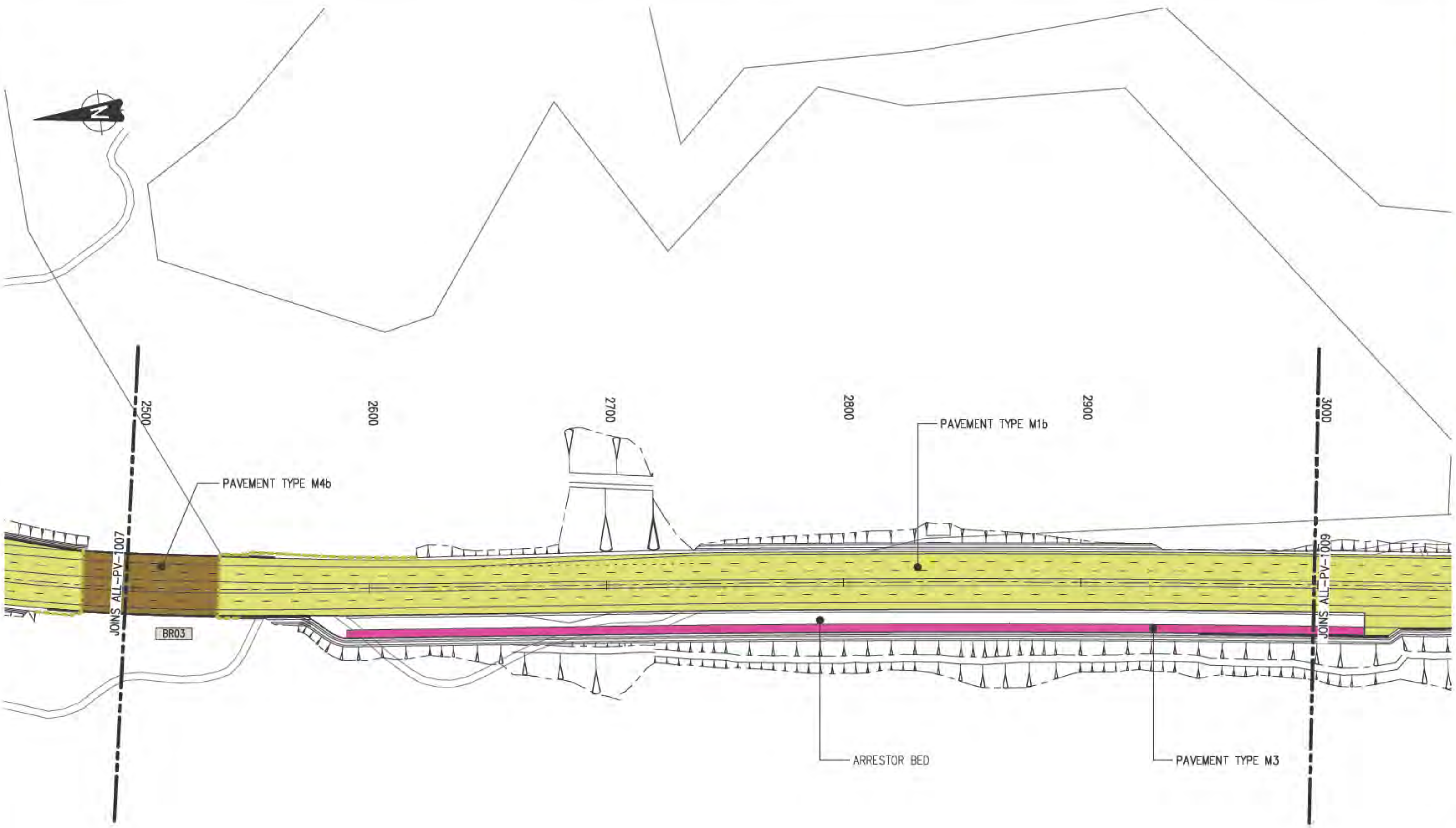
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 7

TG-DRG-S11-PV-1407



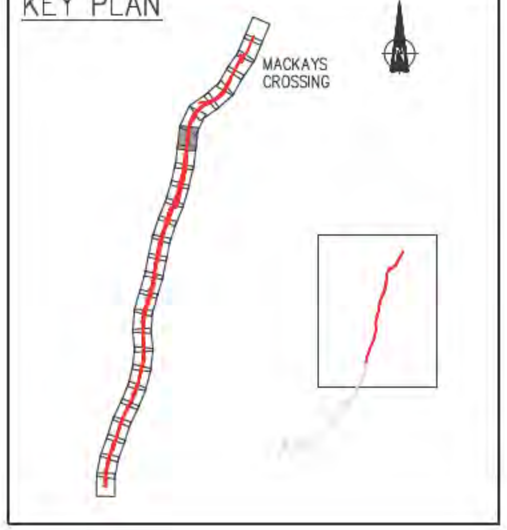
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

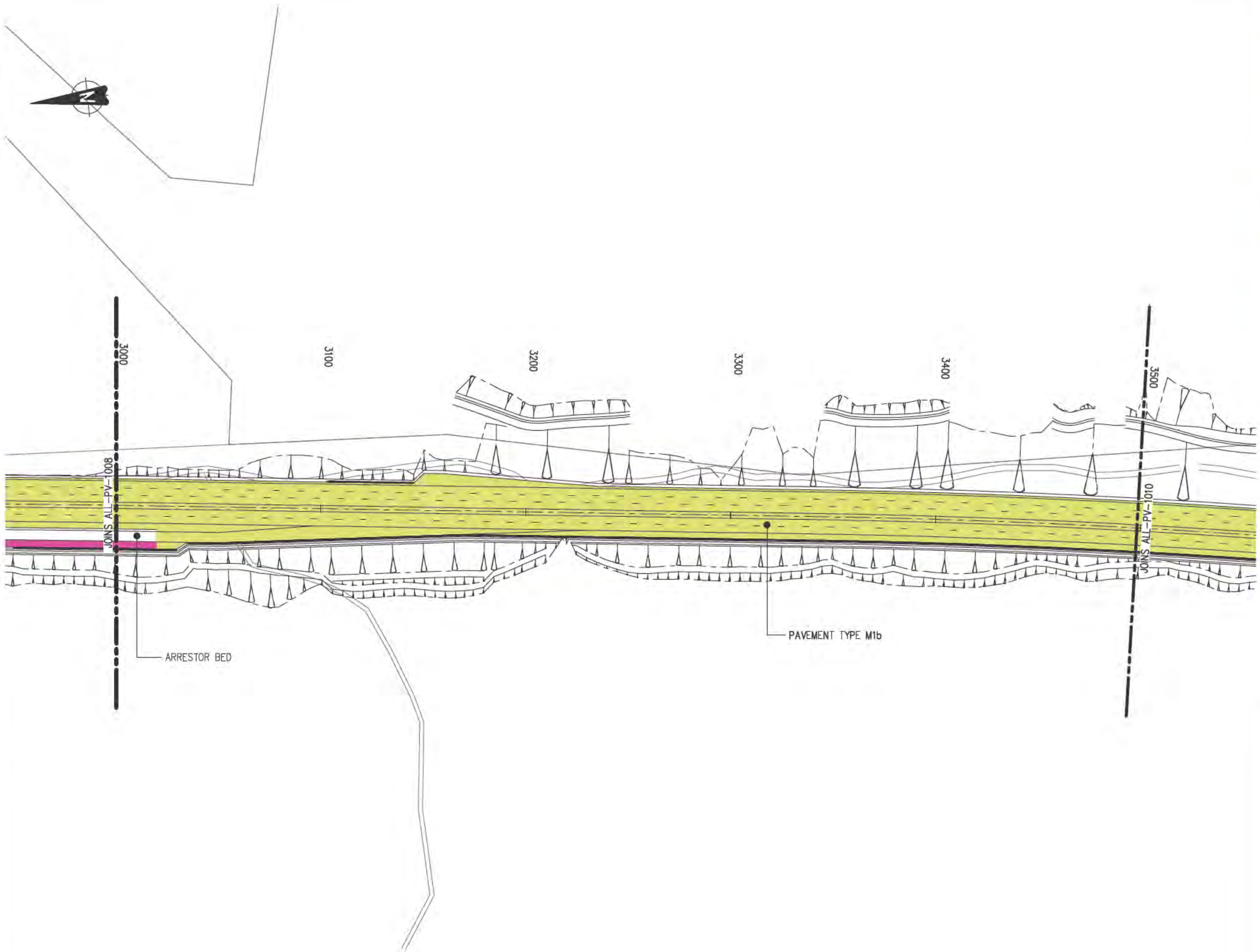
STATUS SCHEDULE 11
REV A
DATE 16 JUNE 2014

SCALE A 0 10 20 30 40 50m 1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 8

TG-DRG-S11-PV-1408



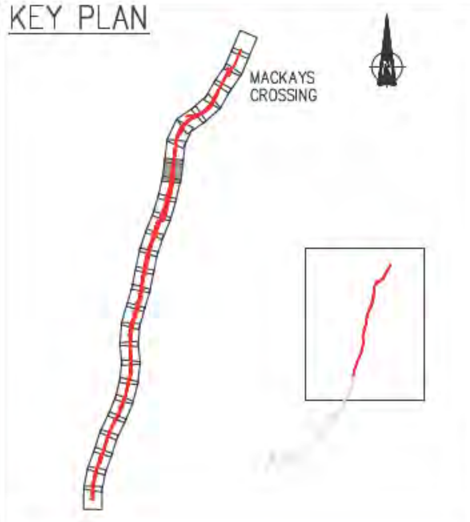
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

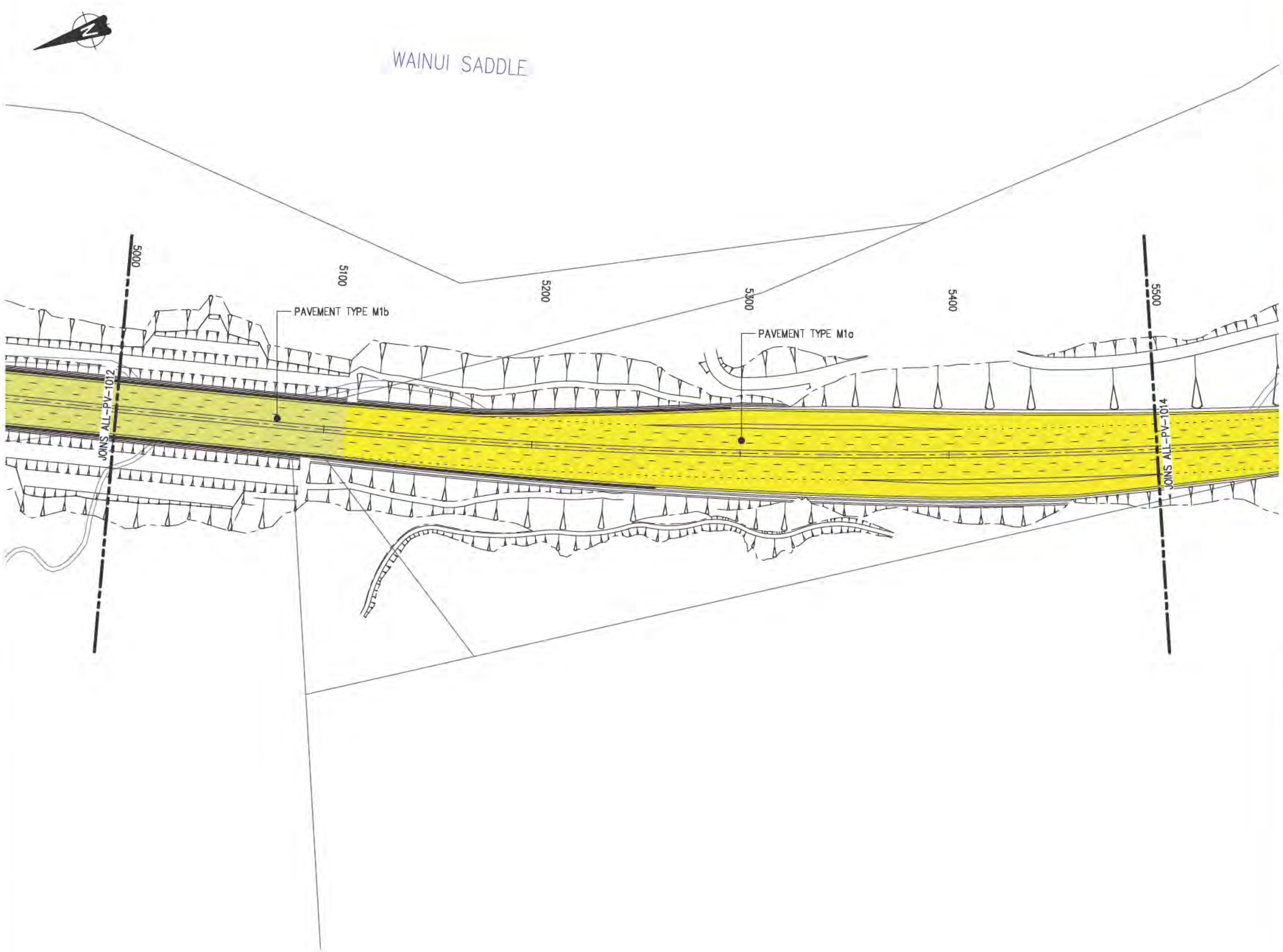
STATUS SCHEDULE 11
REV A
DATE 16 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 9

TG-DRG-S11-PV-1409



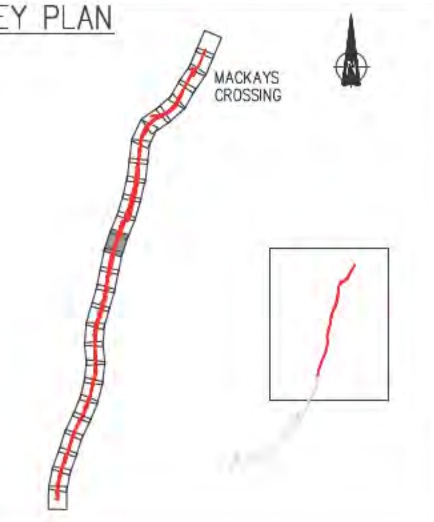
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV A

DATE 09 JUNE 2014

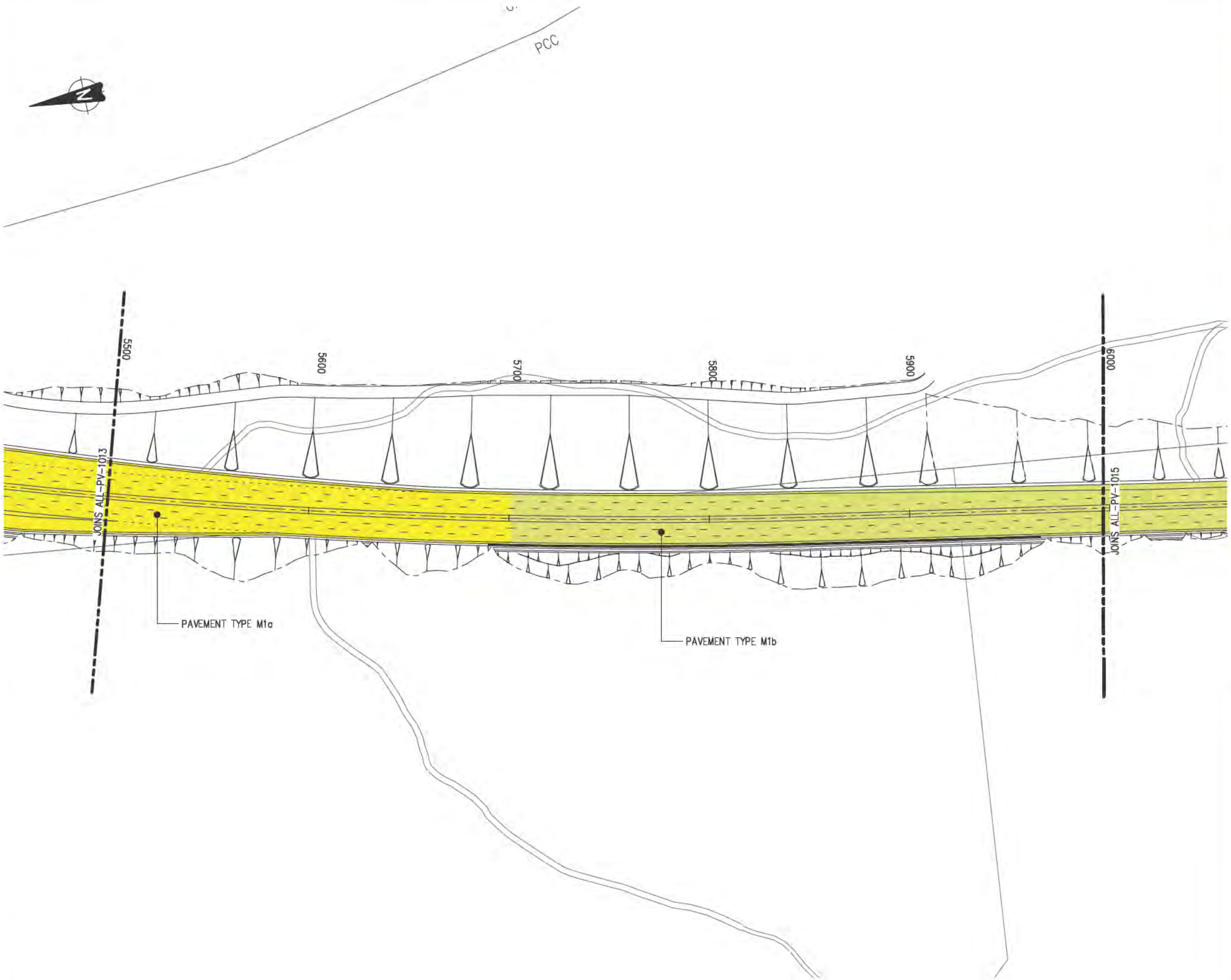
SCALE A 0 10 20 30 40 50m

1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 13

TG-DRG-S11-PV-1413



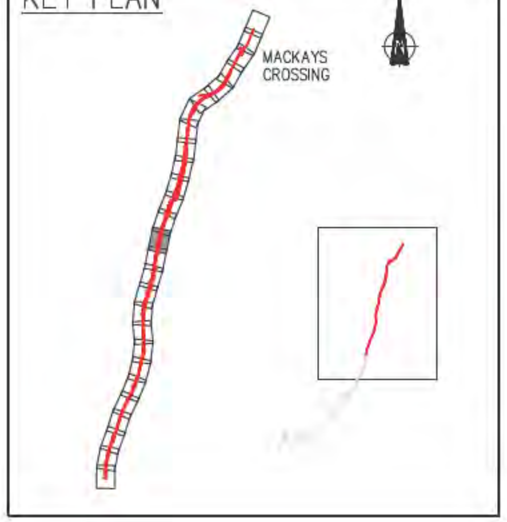
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 14

TG-DRG-S11-PV-1414

LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
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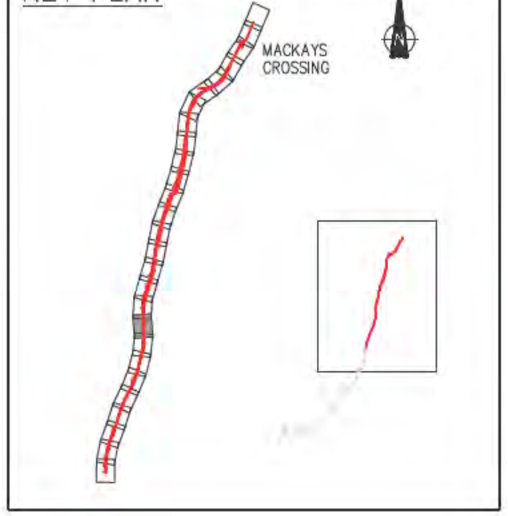
KEY PLAN



TRANSMISSION GULLY PPP PROJECT

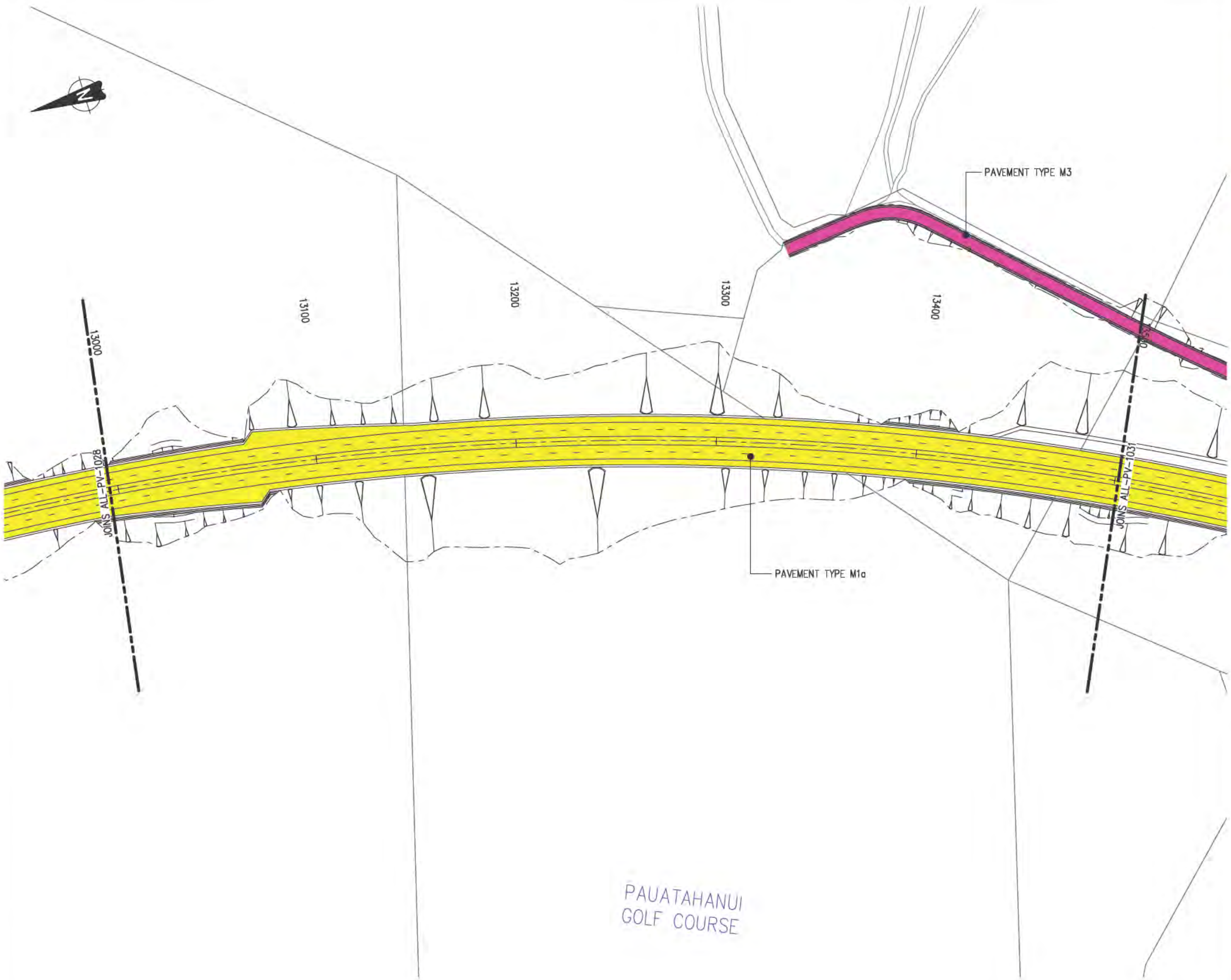
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 19

TG-DRG-S11-PV-1419



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
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KEY PLAN

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV A

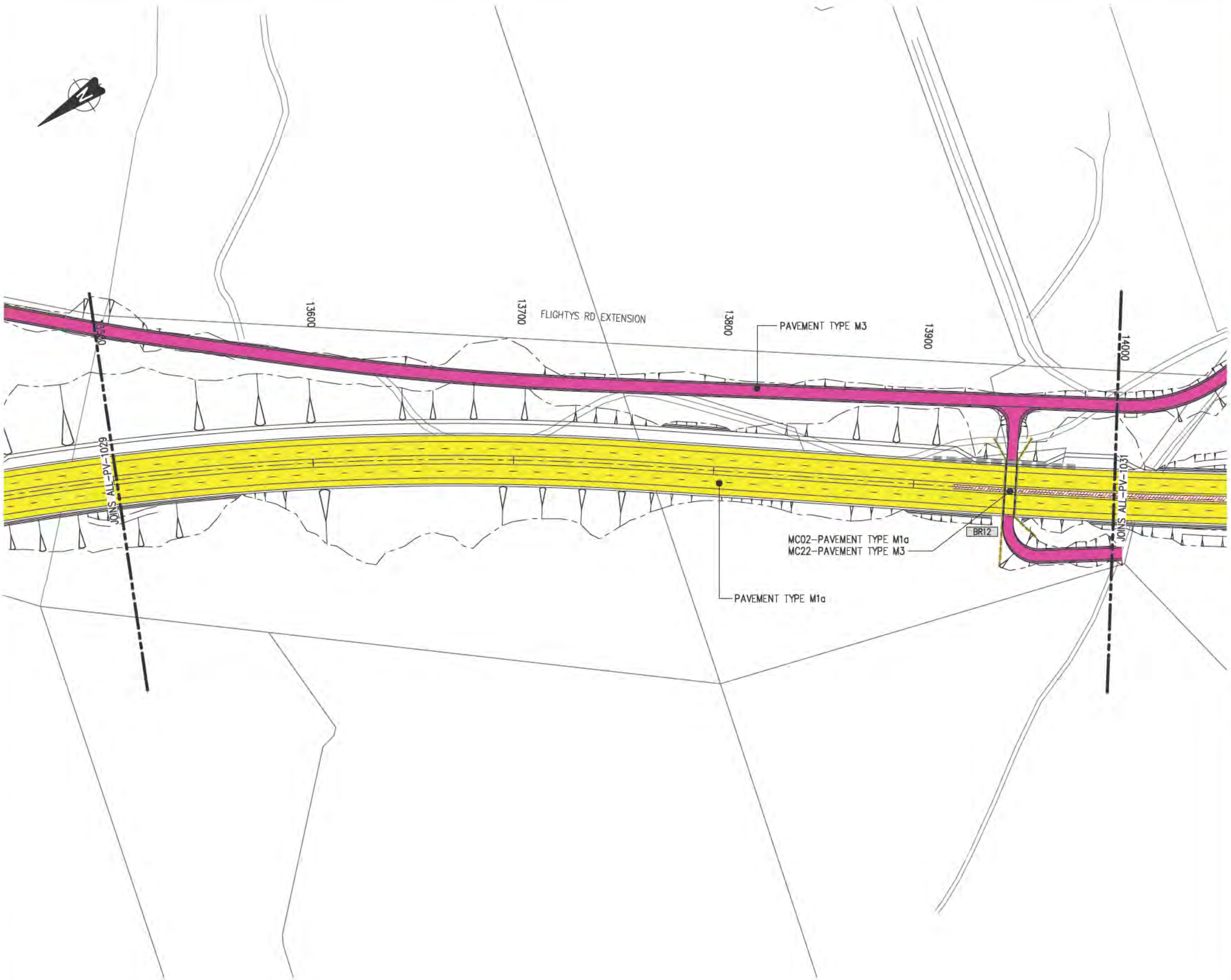
DATE 16 JUNE 2014

SCALE A 0 10 20 30 40 50m 1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 29

TG-DRG-S11-PV-1429



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

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KEY PLAN

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV A

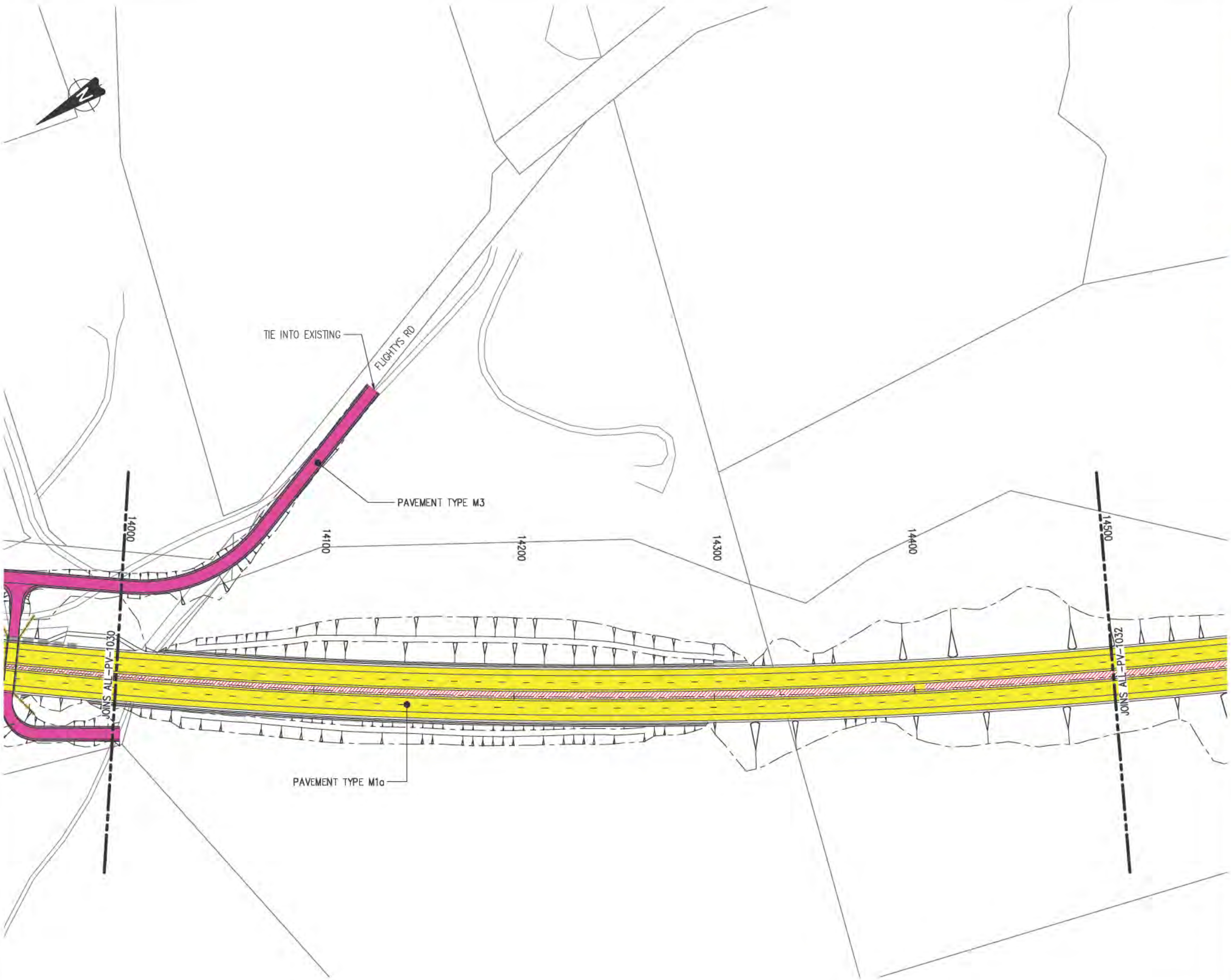
DATE 16 JUNE 2014

SCALE A 0 10 20 30 40 50m 1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 30

TG-DRG-S11-PV-1430



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

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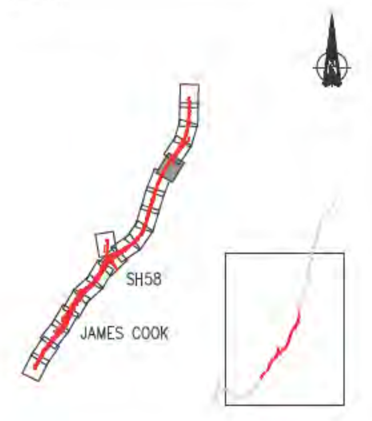
KEY PLAN



TRANSMISSION GULLY PPP PROJECT

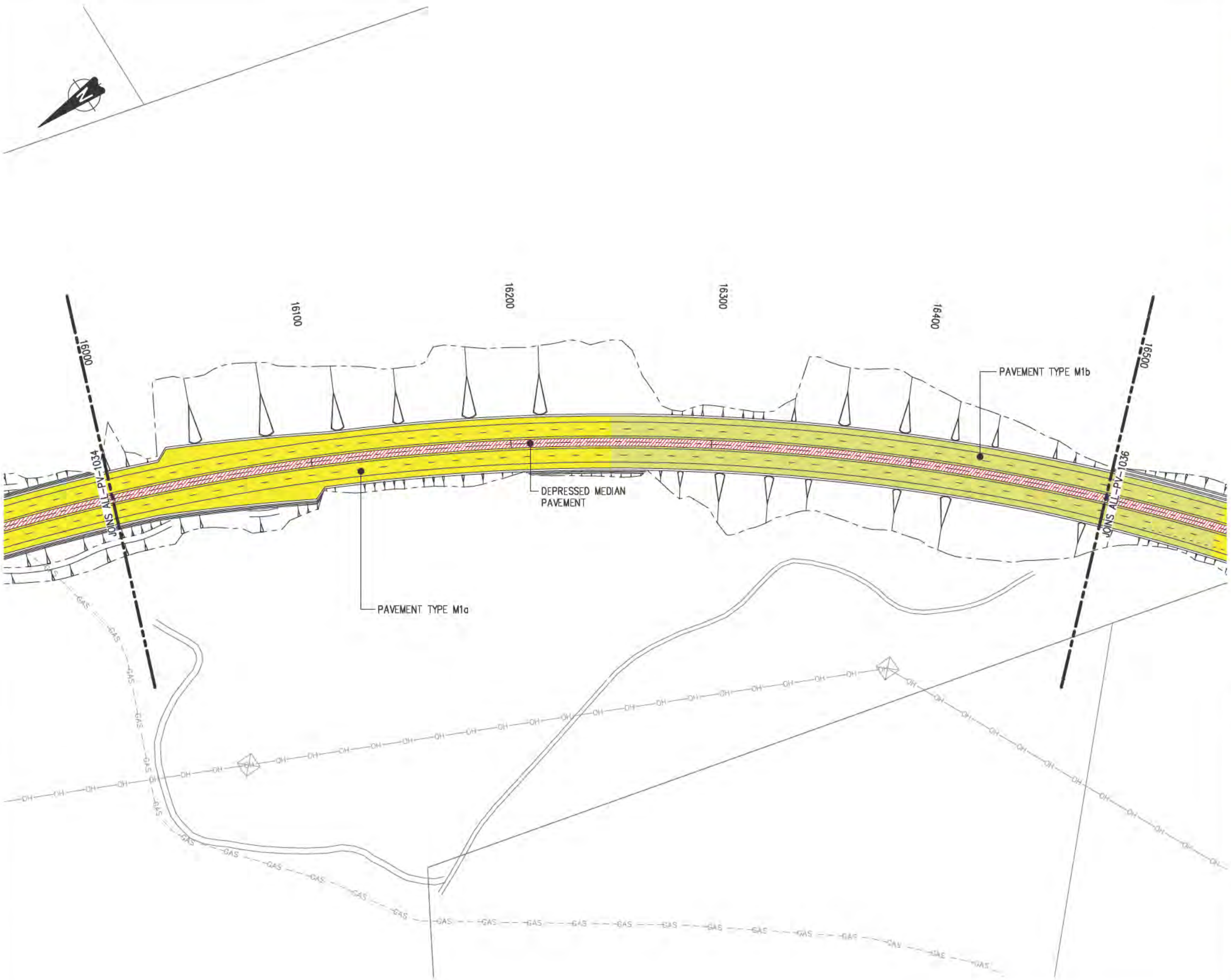
STATUS SCHEDULE 11
REV A
DATE 16 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 31

TG-DRG-S11-PV-1431



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
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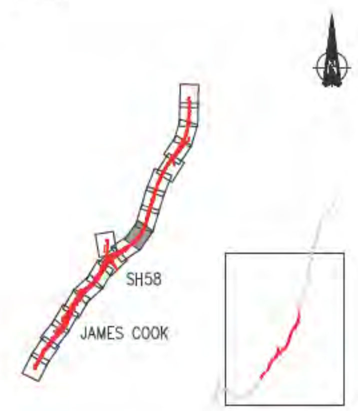
KEY PLAN



TRANSMISSION GULLY PPP PROJECT

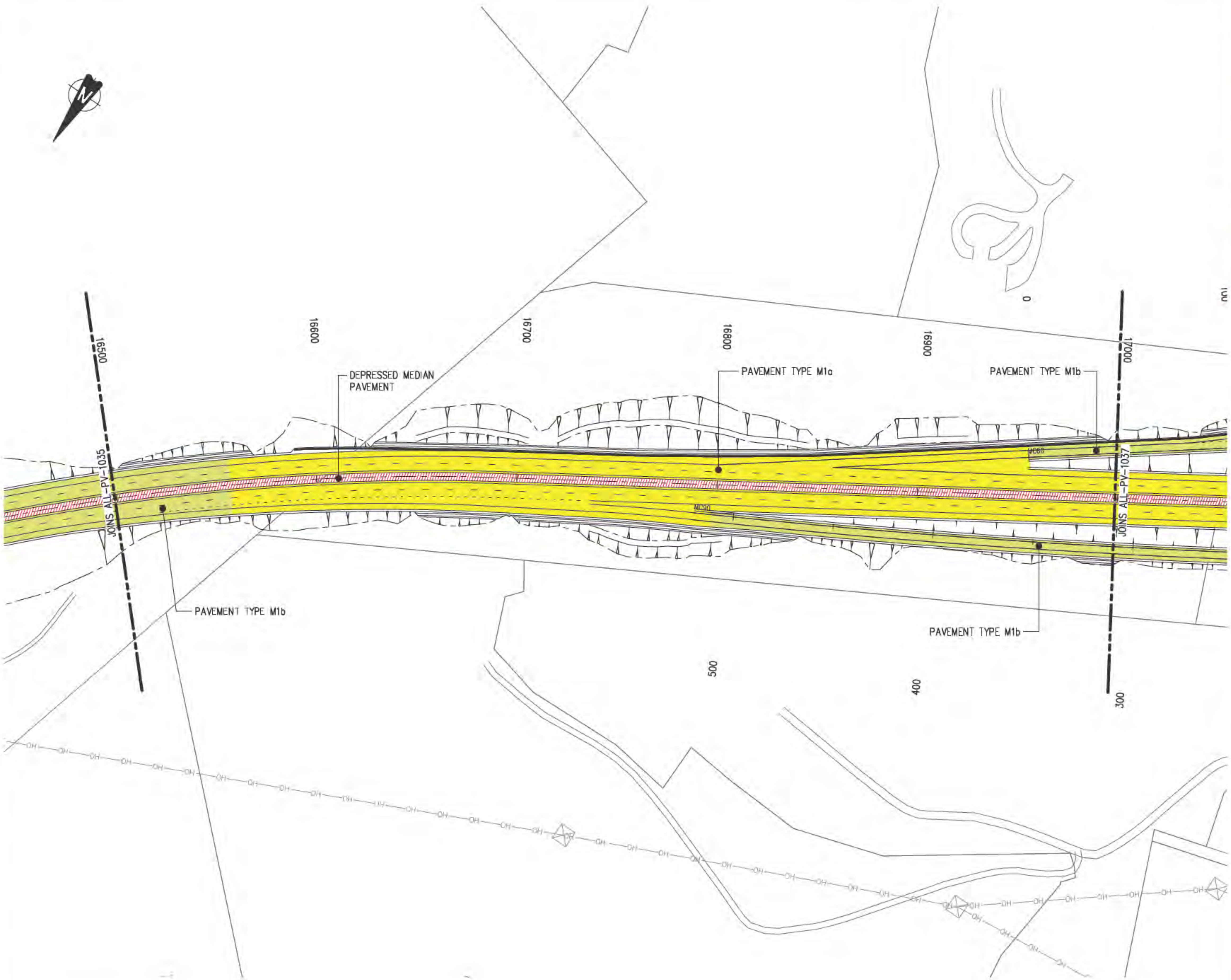
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 35

TG-DRG-S11-PV-1435



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
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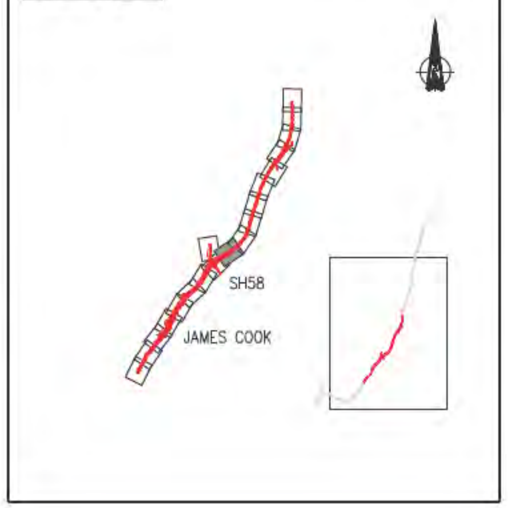
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 36

TG-DRG-S11-PV-1436

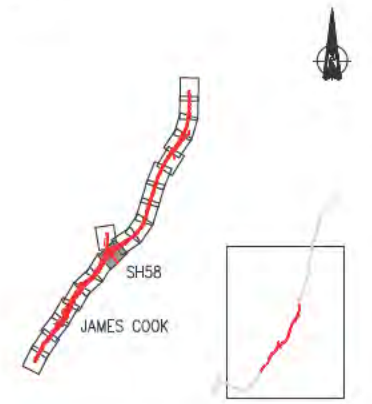
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG–DRG–S11–PV–2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 37

TG-DRG-S11-PV-1437

LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN

TRANSMISSION GULLY PPP PROJECT

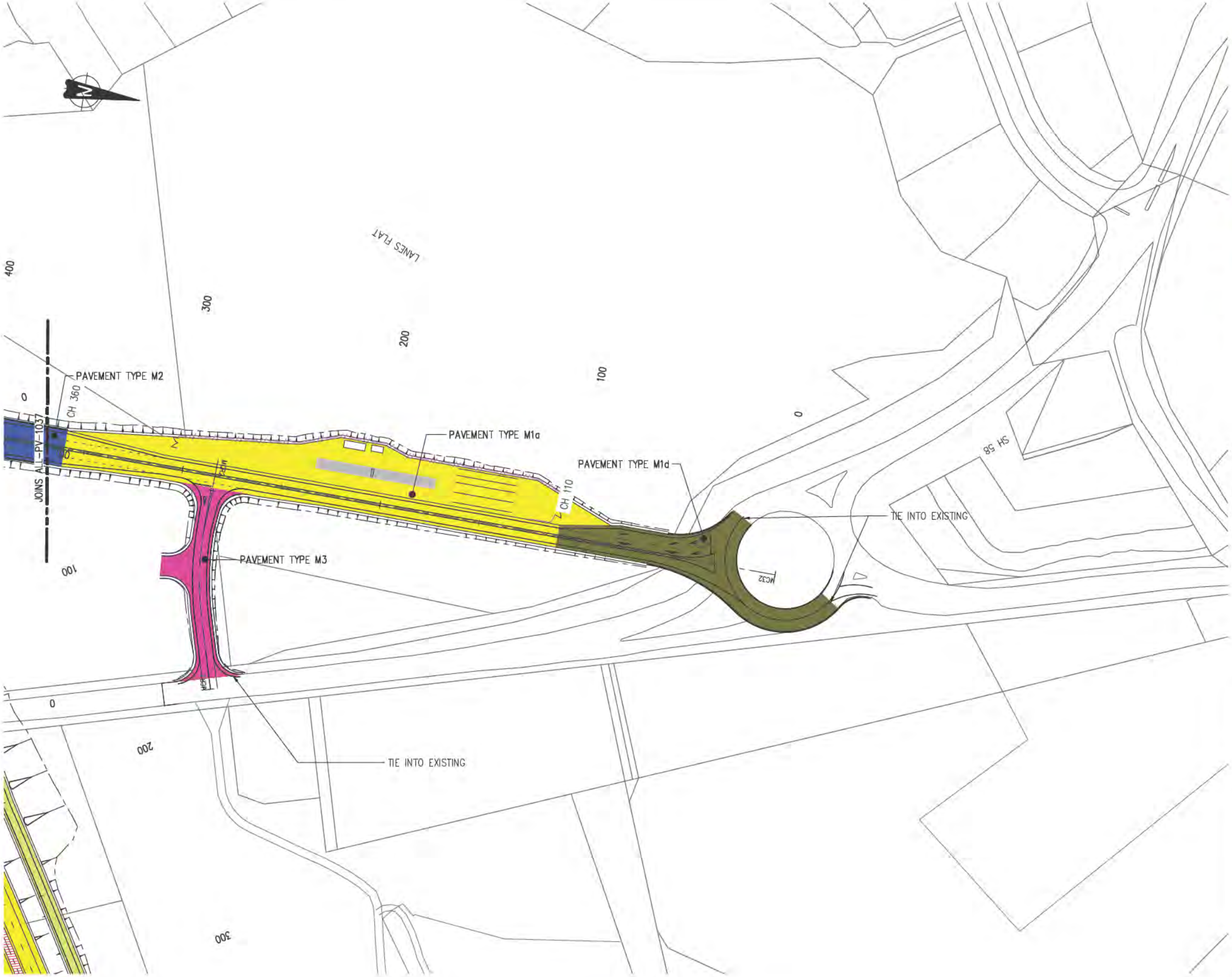
STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 38

TG-DRG-S11-PV-1438



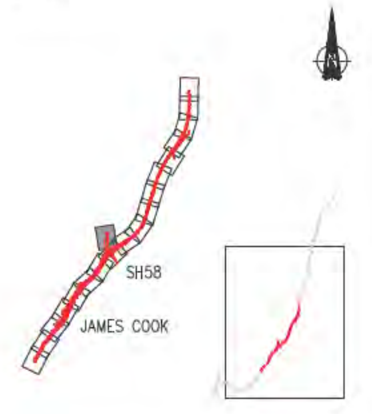
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 39

TG-DRG-S11-PV-1439

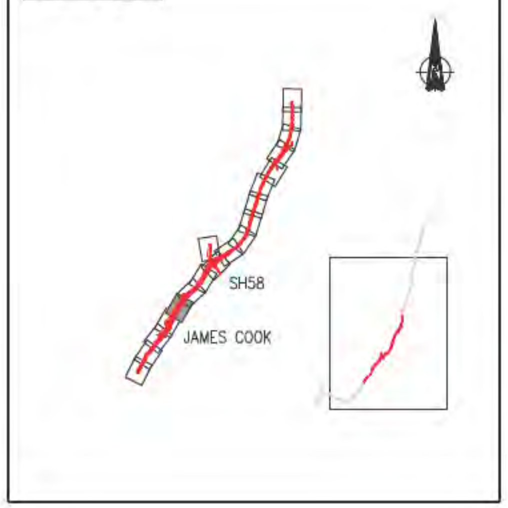
LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN



TRANSMISSION GULLY PPP PROJECT

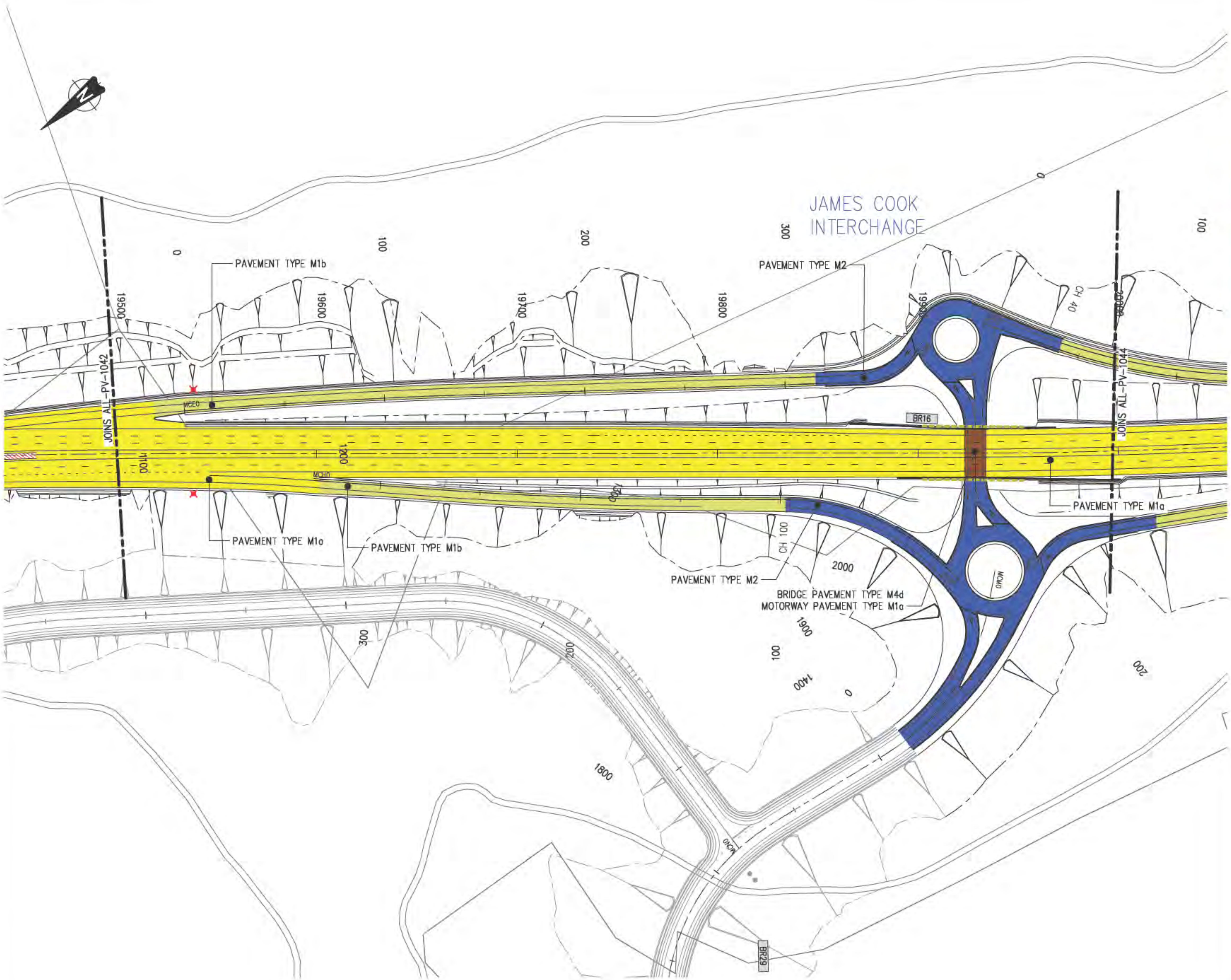
STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 41

TG-DRG-S11-PV-1441



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN

TRANSMISSION GULLY PPP PROJECT

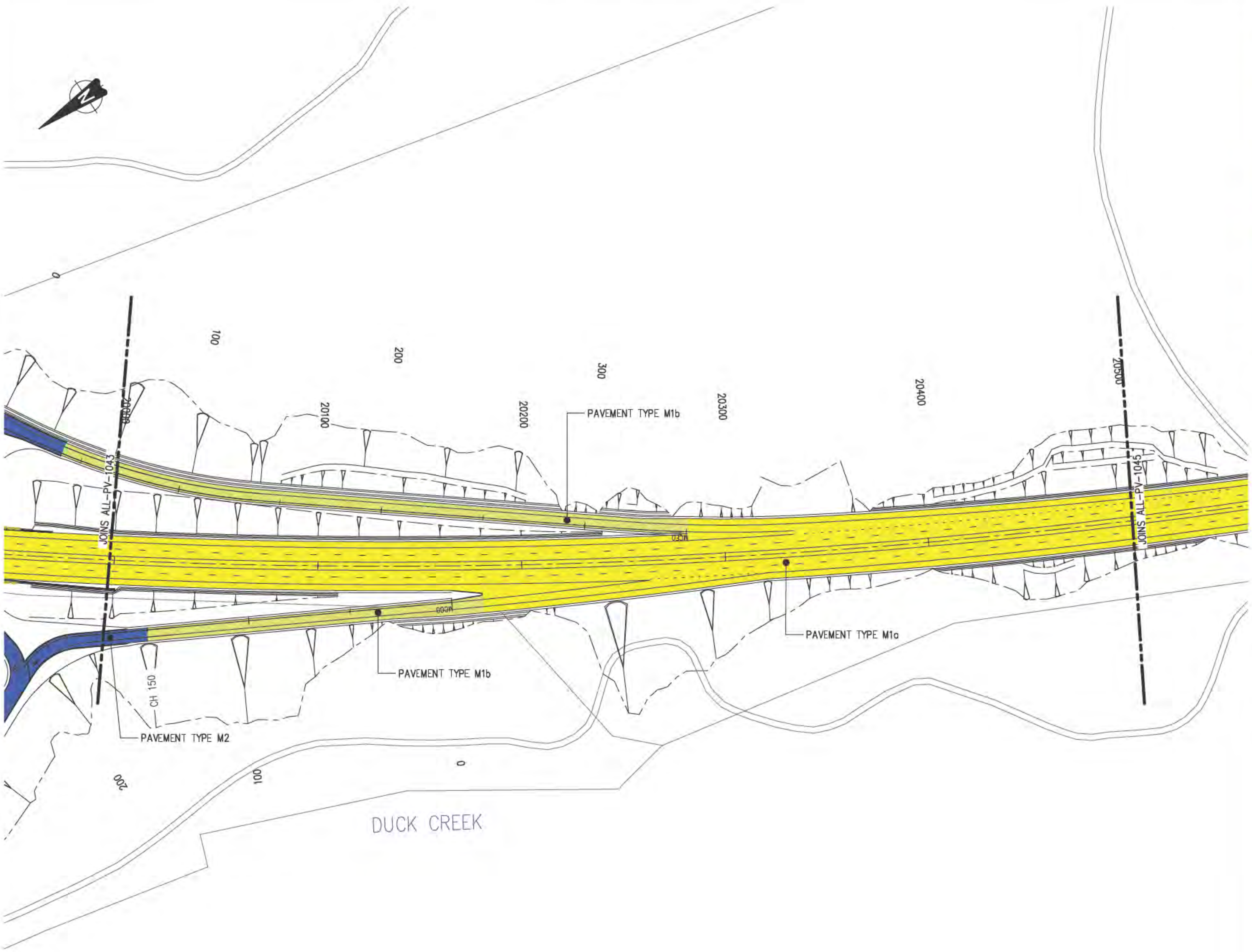
STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 43

TG-DRG-S11-PV-1443



LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m 1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 44

TG-DRG-S11-PV-1444

LEGEND

- PAVEMENT TYPE M1a & M1ai
- PAVEMENT TYPE M1b & M1bi
- PAVEMENT TYPE M1c & M1ci
- PAVEMENT TYPE M1c (SURFACING ONLY)
- PAVEMENT TYPE M1d
- PAVEMENT TYPE M2
- PAVEMENT TYPE M3
- PAVEMENT TYPE M4a
- PAVEMENT TYPE M4b
- PAVEMENT TYPE M4c
- PAVEMENT TYPE M4d
- DEPRESSED MEDIAN PAVEMENT
- RESURFACING

NOTES:

1. FOR PAVEMENT TYPE DETAILS REFER DRG No TG-DRG-S11-PV-2401.
2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

KEY PLAN

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV A

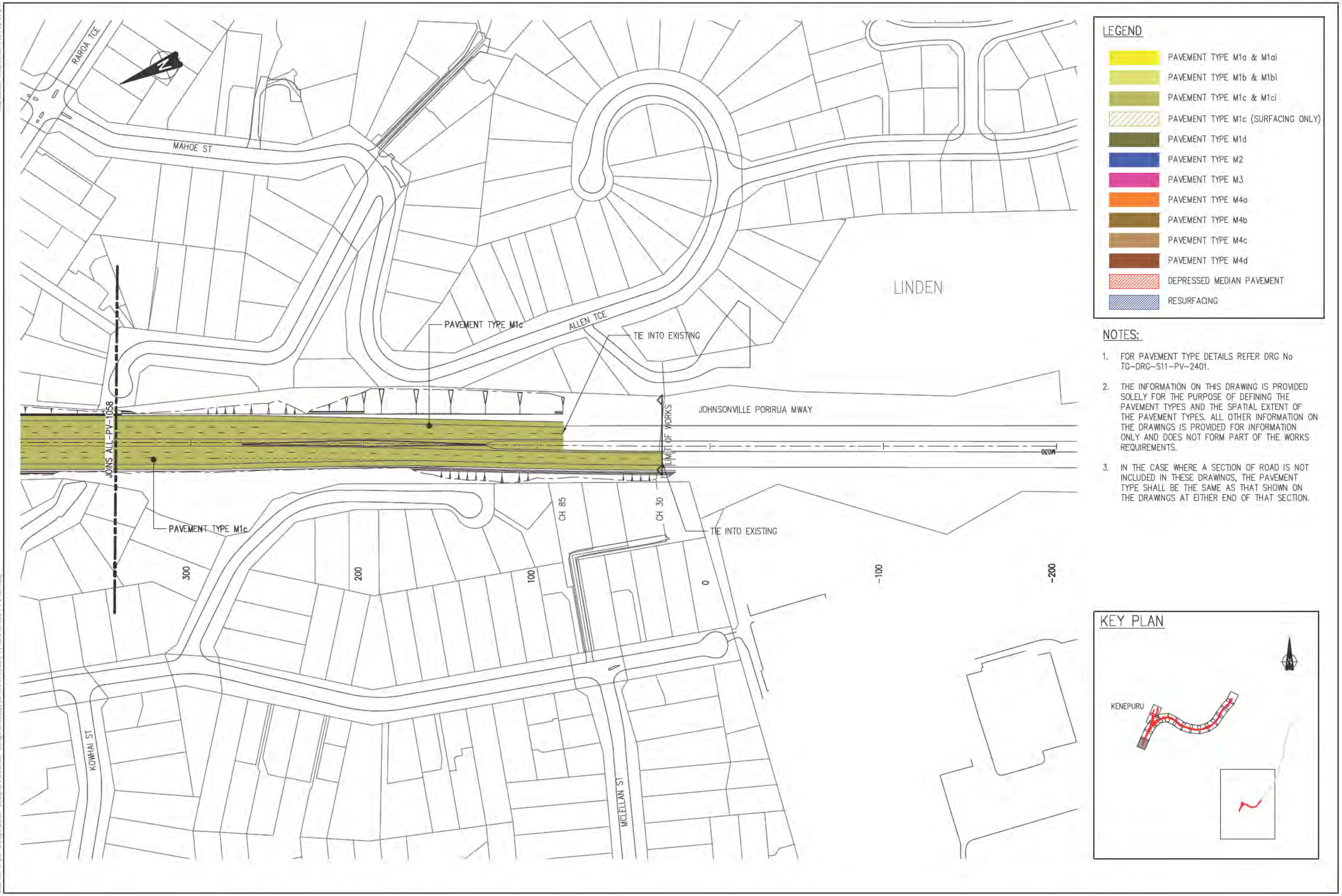
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m 1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT PLAN - SHEET 54

TG-DRG-S11-PV-1454



NOTES:

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2. THE INFORMATION ON THIS DRAWING IS PROVIDED SOLELY FOR THE PURPOSE OF DEFINING THE PAVEMENT TYPES AND THE SPATIAL EXTENT OF THE PAVEMENT TYPES. ALL OTHER INFORMATION ON THE DRAWINGS IS PROVIDED FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE WORKS REQUIREMENTS.
3. IN THE CASE WHERE A SECTION OF ROAD IS NOT INCLUDED IN THESE DRAWINGS, THE PAVEMENT TYPE SHALL BE THE SAME AS THAT SHOWN ON THE DRAWINGS AT EITHER END OF THAT SECTION.

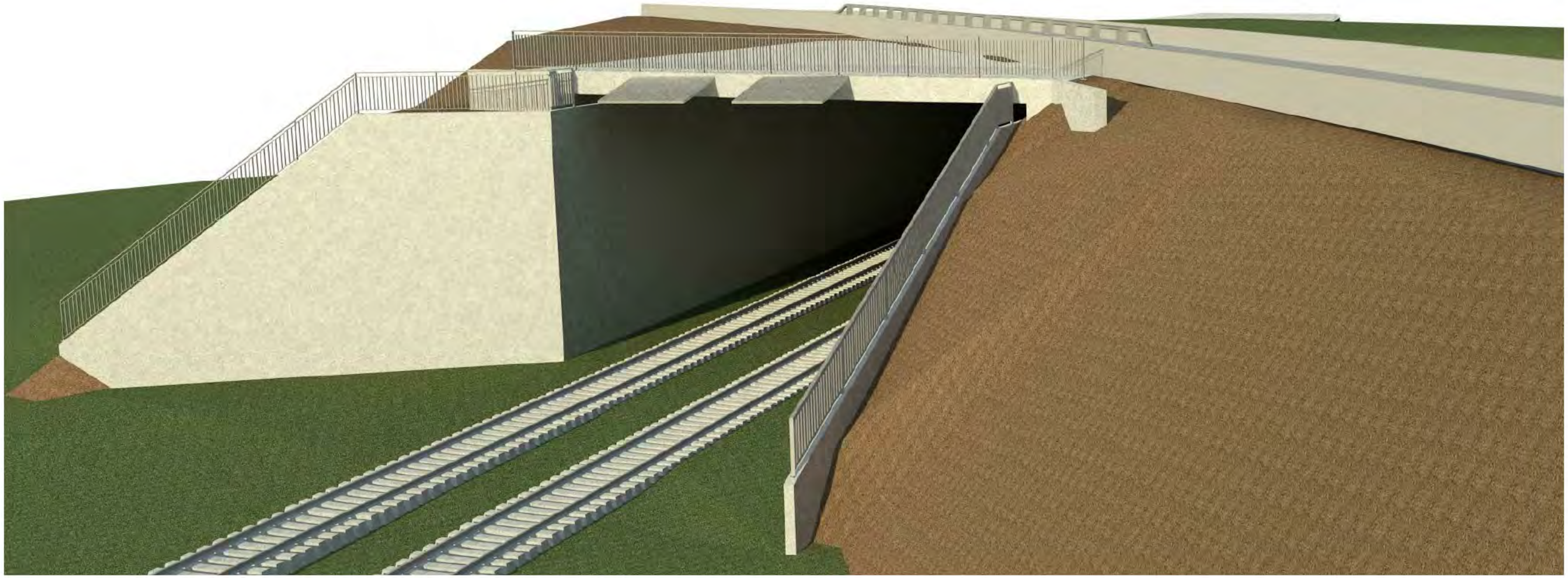
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV A
DATE 09 JUNE 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

PAVEMENT
PLAN - SHEET 59
TG-DRG-S11-PV-1459



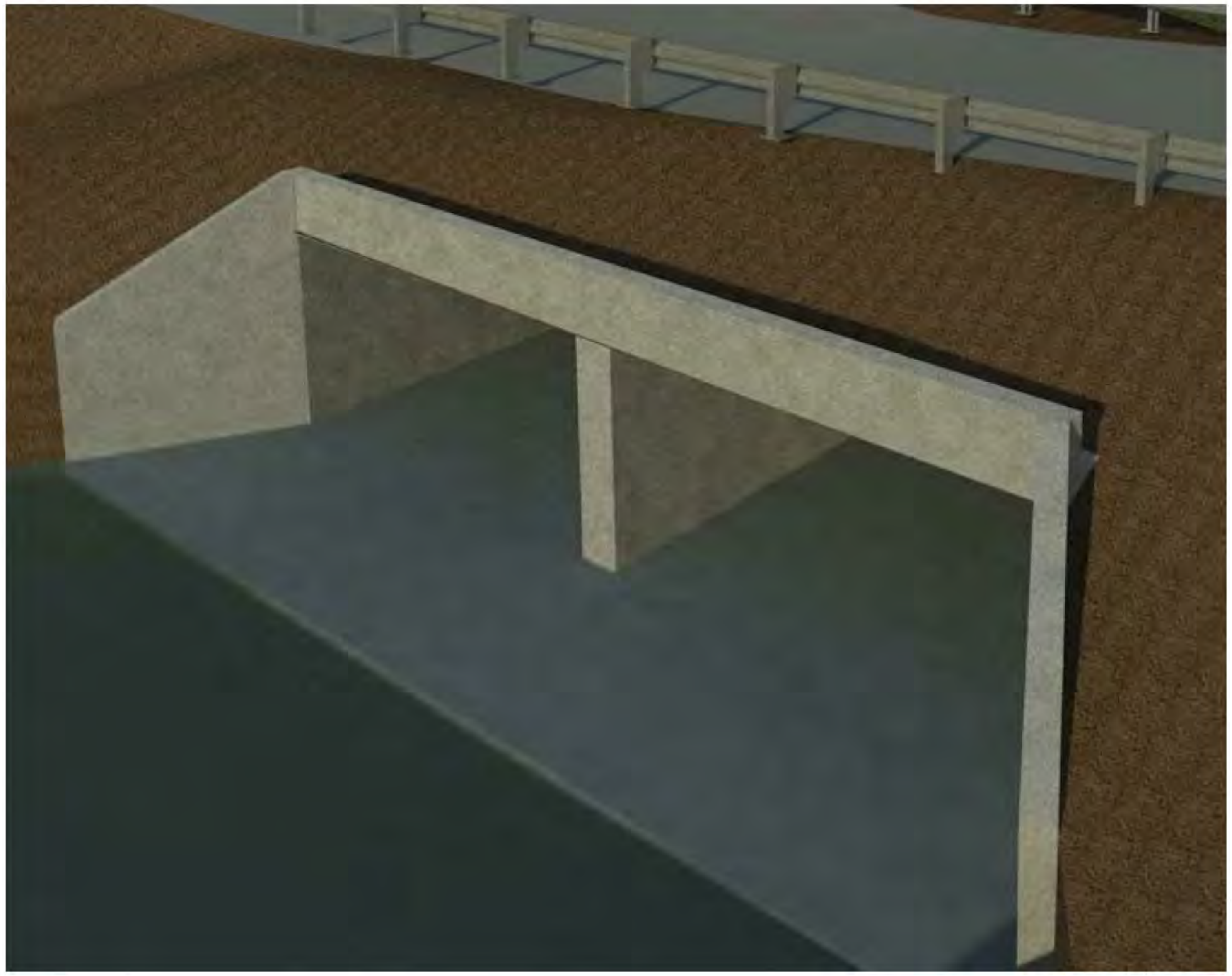
BRIDGE 01A LOOKING NORTH

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 01A
PERSPECTIVE VIEW
TG-DRG-S11-BR-3011



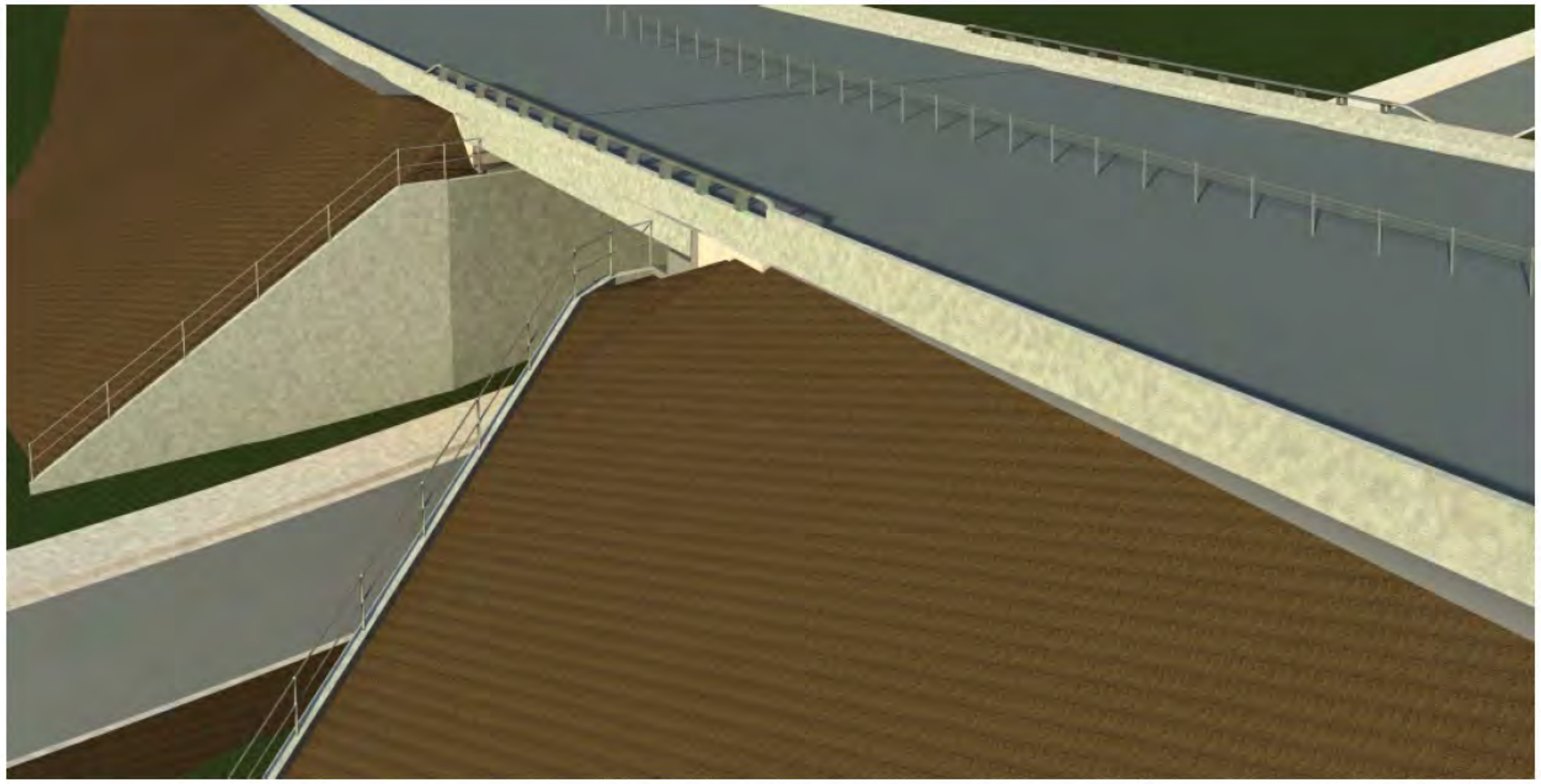
BRIDGE 01B LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 01B
PERSPECTIVE VIEW
TG-DRG-S11-BR-3012



BRIDGE 02 LOOKING NORTH

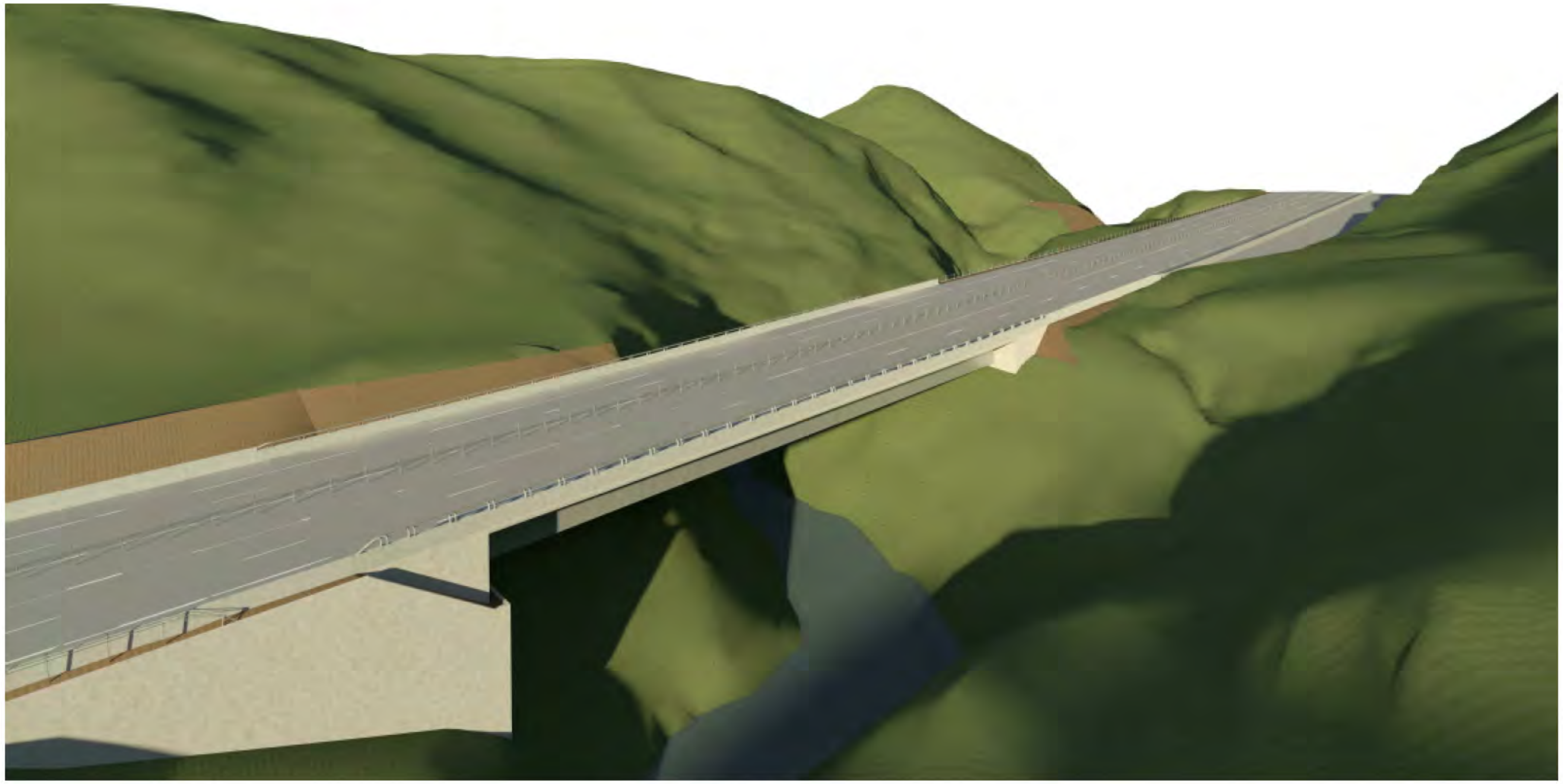
BRIDGE 02 LOOKING EAST

TRANSMISSION GULLY PPP PROJECT

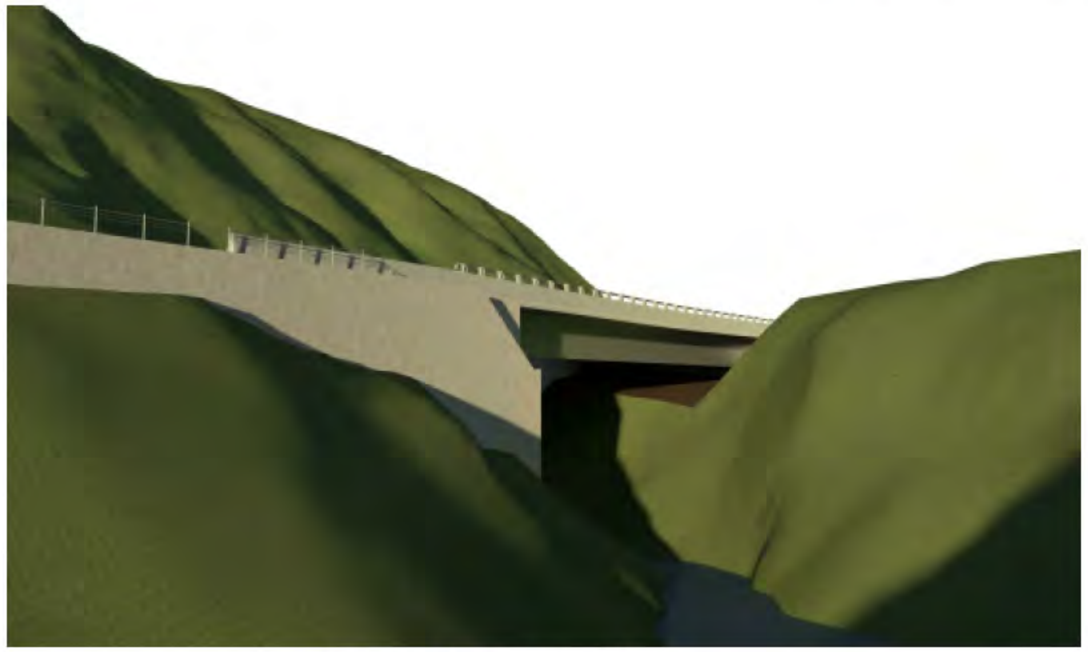
STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 02
PERSPECTIVE VIEW
TG-DRG-S11-BR-3013



BRIDGE 03 LOOKING SOUTH



BRIDGE 03 LOOKING NORTH

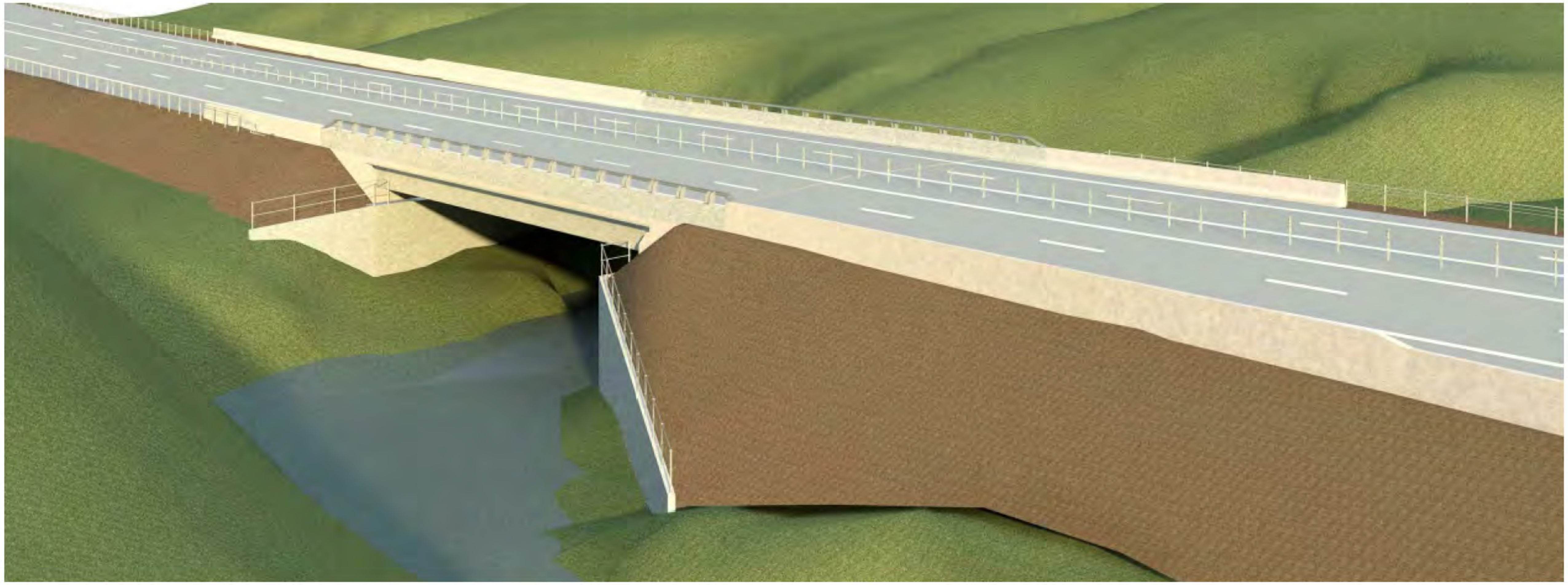
BRIDGE 03 LOOKING SOUTH-WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 03
PERSPECTIVE VIEWS
TG-DRG-S11-BR-3014



BRIDGE 04 LOOKING NORTH EAST

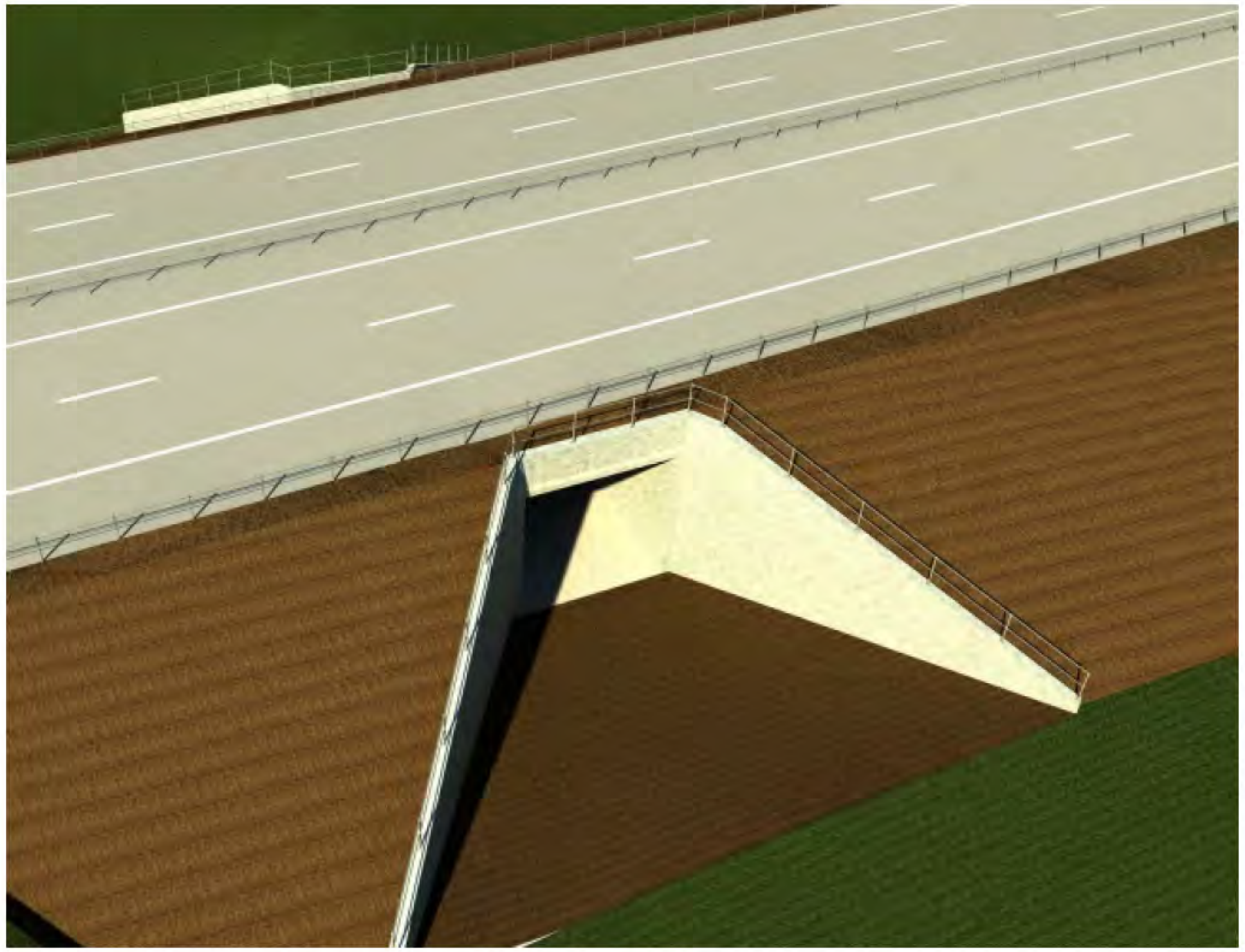
BRIDGE 04 LOOKING SOUTH WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 04
PERSPECTIVE VIEW
TG-DRG-S11-BR-3015



BRIDGE 05 LOOKING WEST

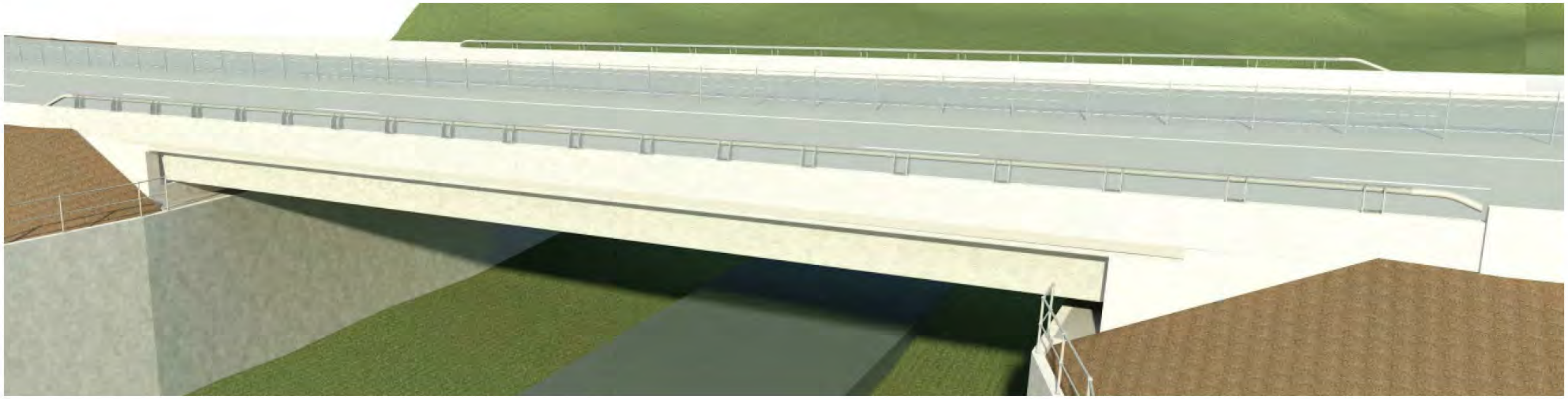
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 05 PERSPECTIVE VIEW

TG-DRG-S11-BR-3016



BRIDGE 06 LOOKING WEST

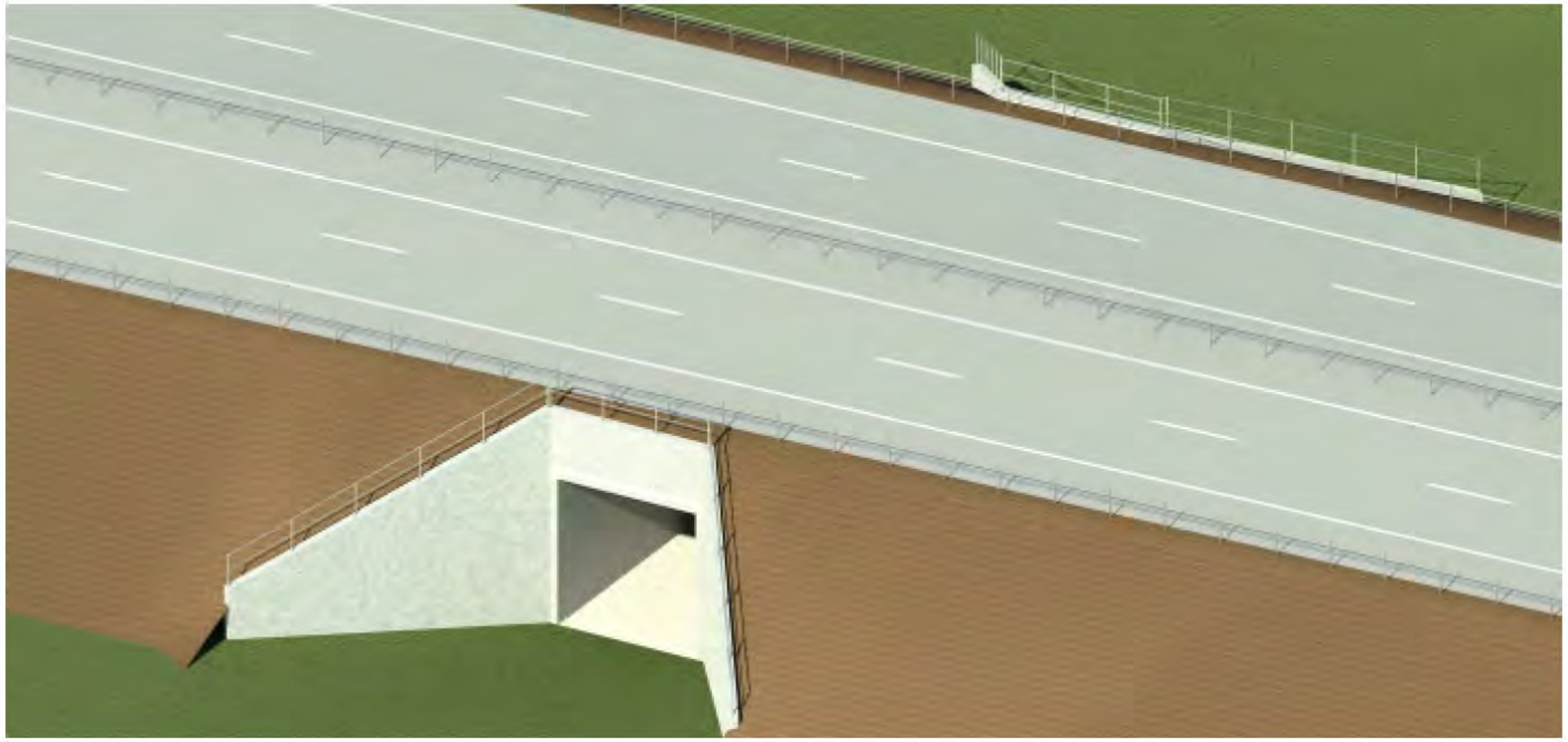
BRIDGE 06 LOOKING EAST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 06
PERSPECTIVE VIEW
TG-DRG-S11-BR-3017



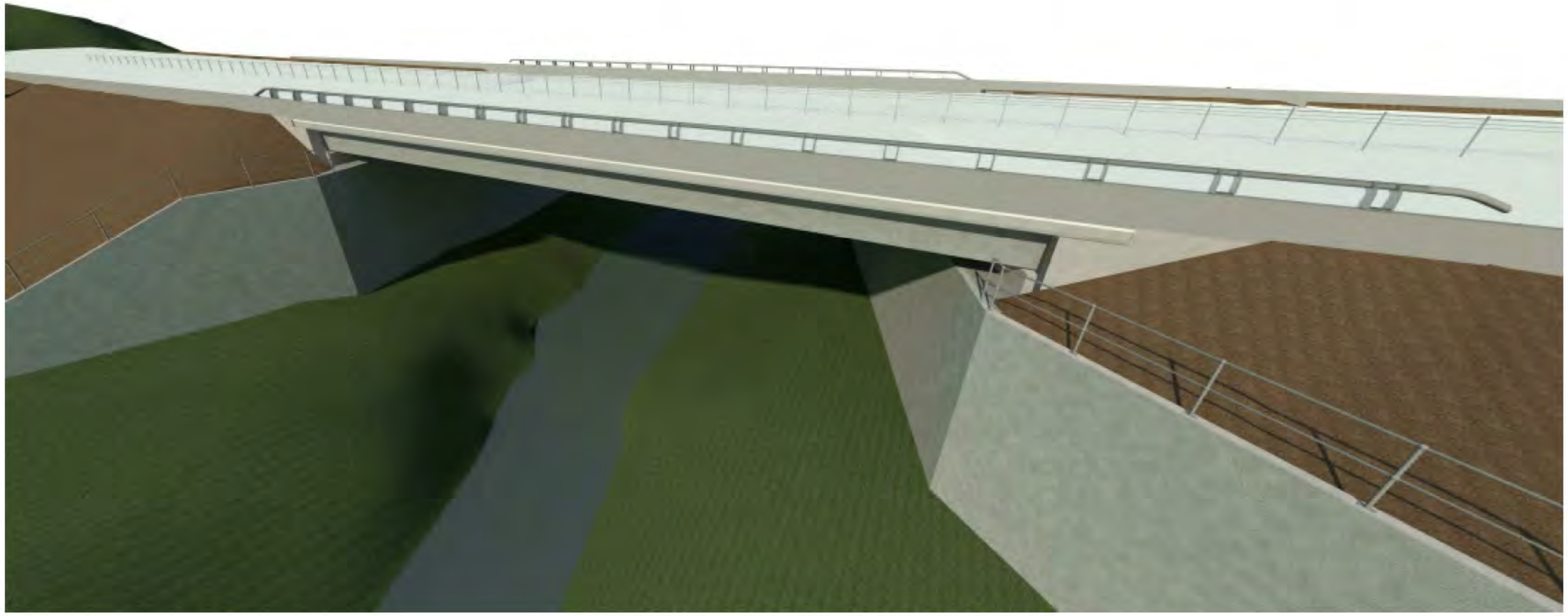
BRIDGE 07 LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 07
PERSPECTIVE VIEW
TG-DRG-S11-BR-3018



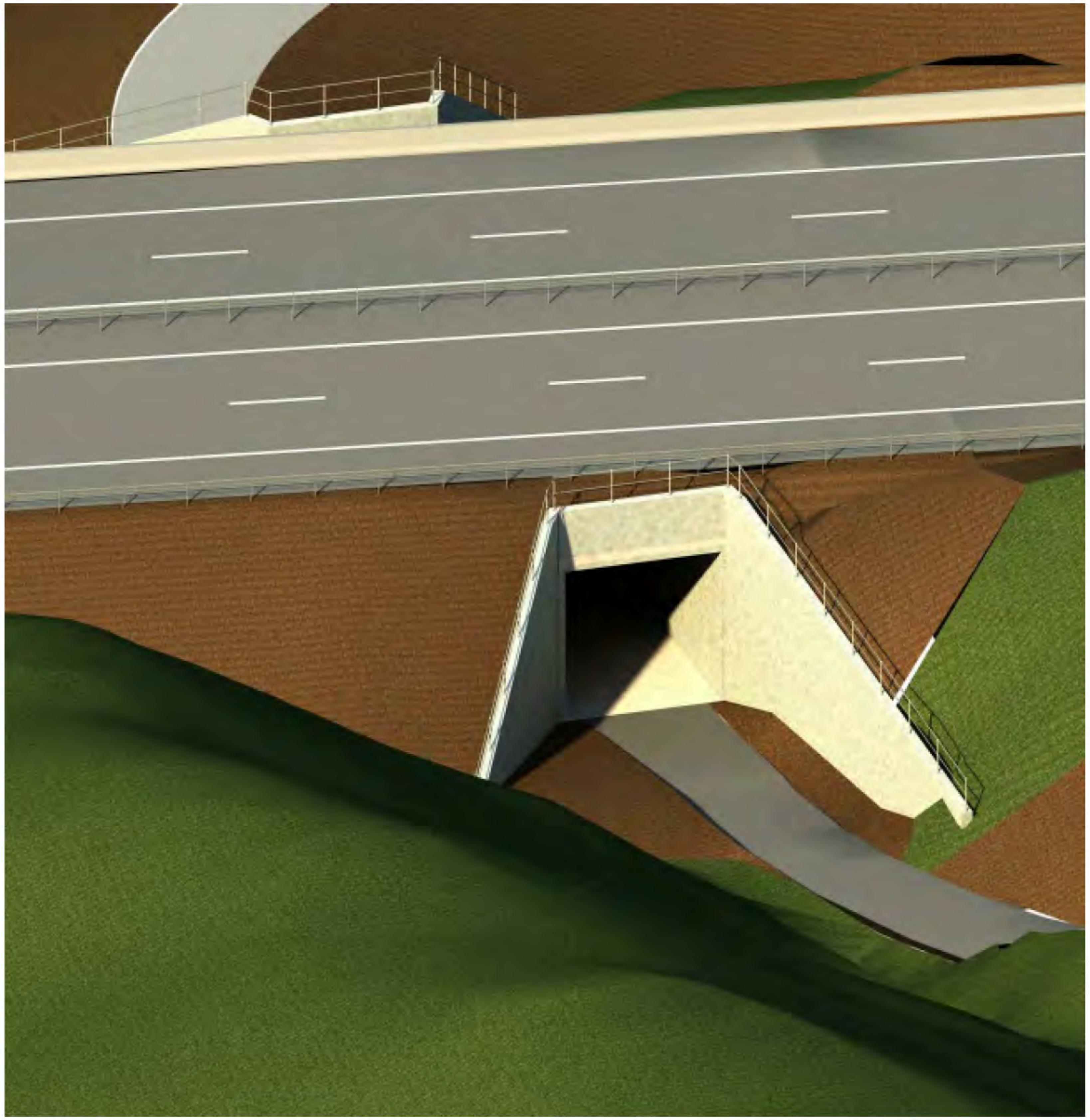
BRIDGE 08 LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 08
PERSPECTIVE VIEW
TG-DRG-S11-BR-3019



BRIDGE 10 LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 10
PERSPECTIVE VIEW
TG-DRG-S11-BR-3020

BRIDGE 11 LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 11
PERSPECTIVE VIEW
TG-DRG-S11-BR-3021

BRIDGE 12 LOOKING NORTH-WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 12 PERSPECTIVE VIEW

TG-DRG-S11-BR-3022

BRIDGE 13 LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11

REV B

DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 13
PERSPECTIVE VIEW

TG-DRG-S11-BR-3023

BRIDGE 14 LOOKING SOUTH

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 14
PERSPECTIVE VIEW
TG-DRG-S11-BR-3025

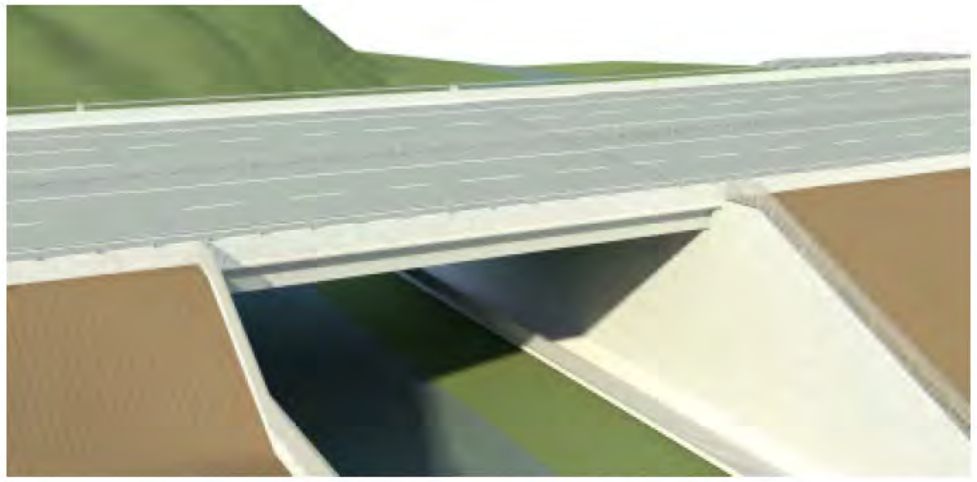
BRIDGE 14A LOOKING SOUTH

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 14A
PERSPECTIVE VIEW
TG-DRG-S11-BR-3026



BRIDGE 15 LOOKING WEST

BRIDGE 15 LOOKING EAST

BRIDGES 14, 14A AND 15 LOOKING EAST

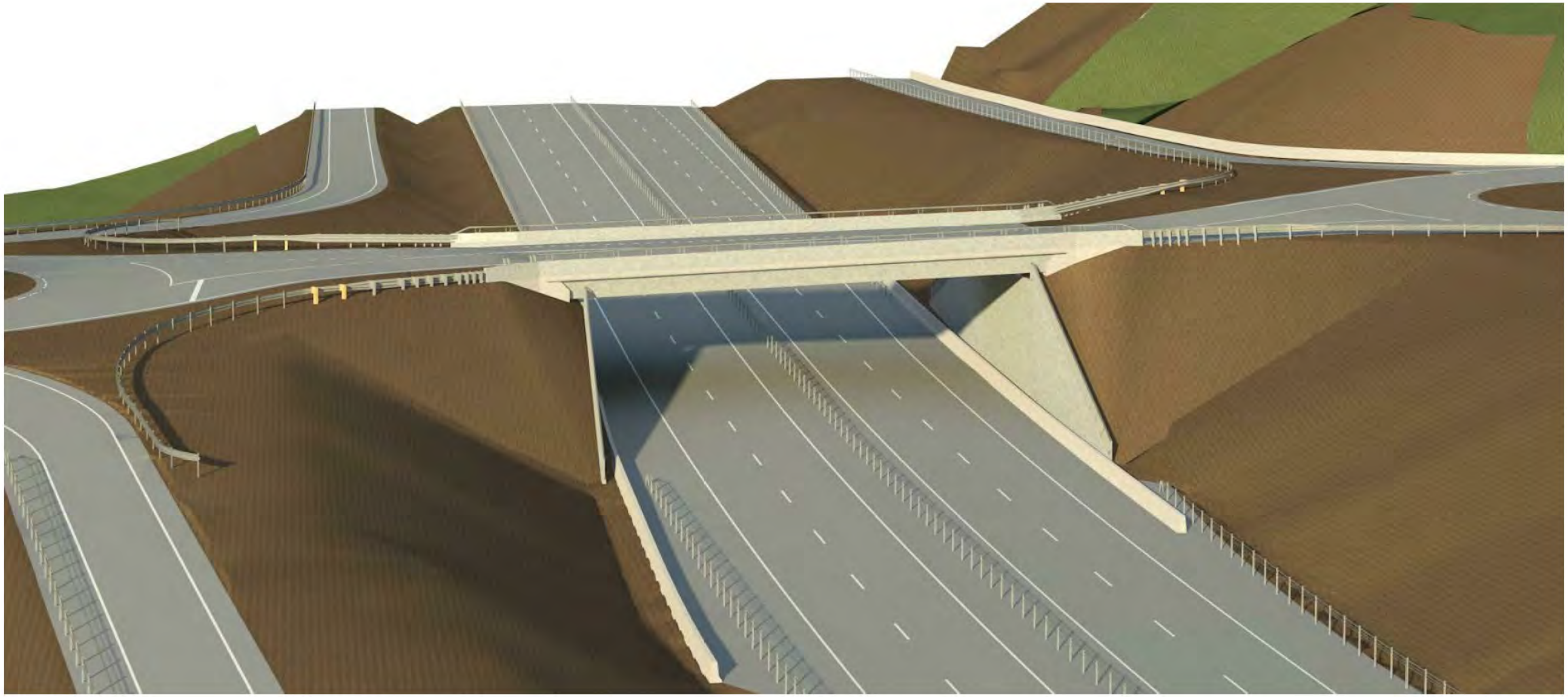
BRIDGES 14, 14A, AND 15 LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 15
PERSPECTIVE VIEW
TG-DRG-S11-BR-3027



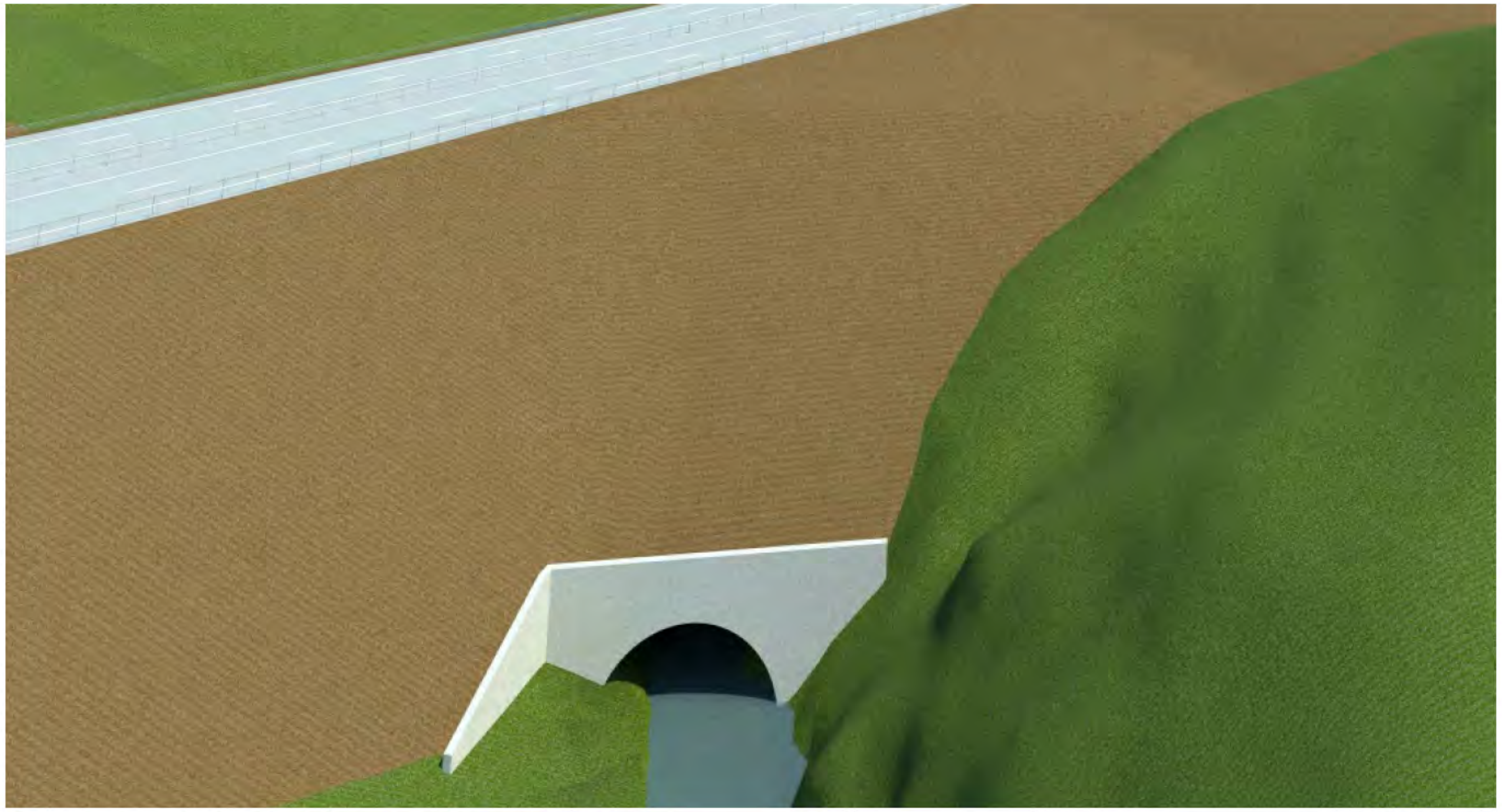
BRIDGE 16 LOOKING NORTH

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 16
PERSPECTIVE VIEW
TG-DRG-S11-BR-3028



BRIDGE 17 LOOKING NORTH

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 17 PERSPECTIVE VIEW

TG-DRG-S11-BR-3029

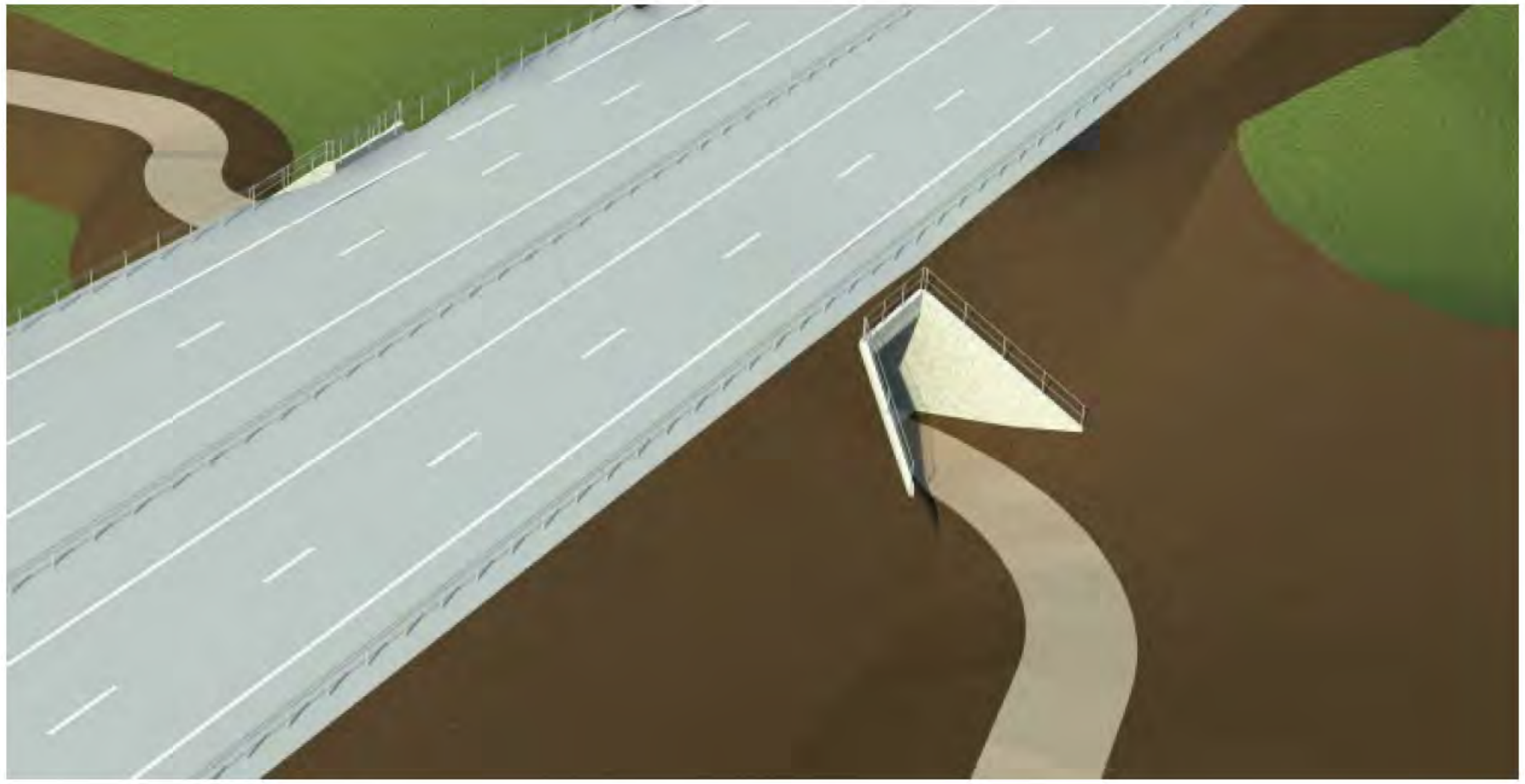
BRIDGE 18 LOOKING EAST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 18
PERSPECTIVE VIEW
TG-DRG-S11-BR-3031



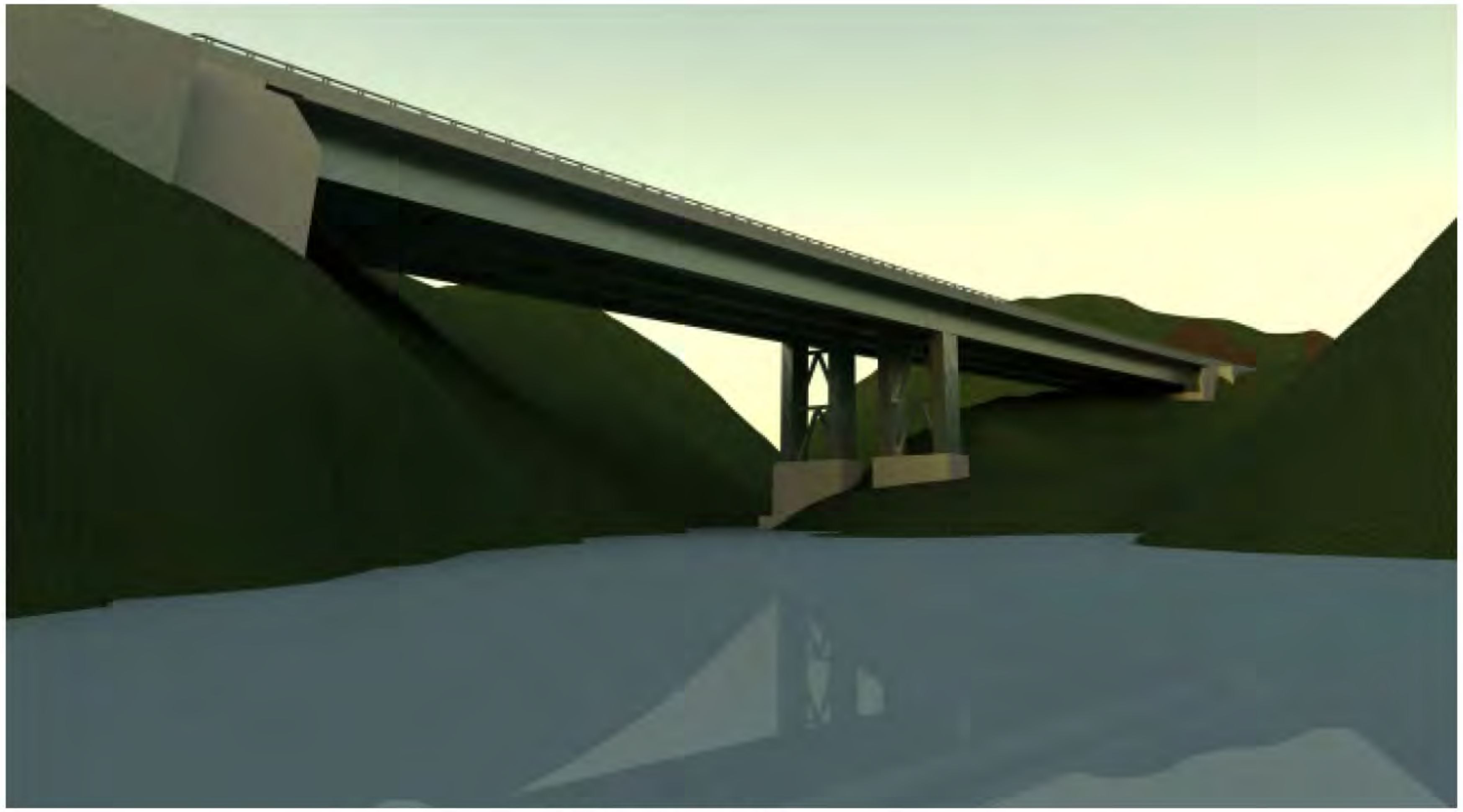
BRIDGE 18A LOOKING WEST

TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 18A
PERSPECTIVE VIEW
TG-DRG-S11-BR-3032



BRIDGE 19 LOOKING SOUTH

BRIDGE 19 LOOKING SOUTH

N:\109337 Transmission Gully\060 Drawings\062 HCG Drawing General\SCHEDULE 11\BR19\ TG-BR19_Central_R14.rvt

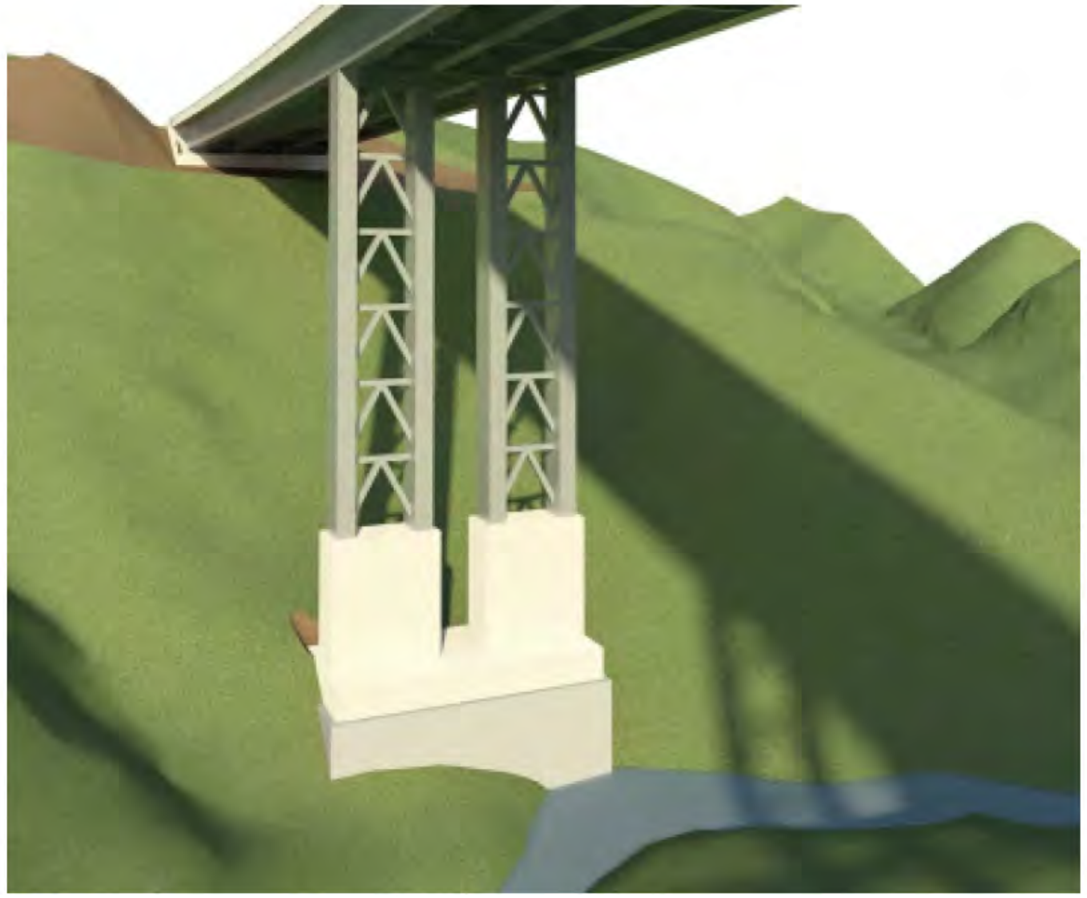
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

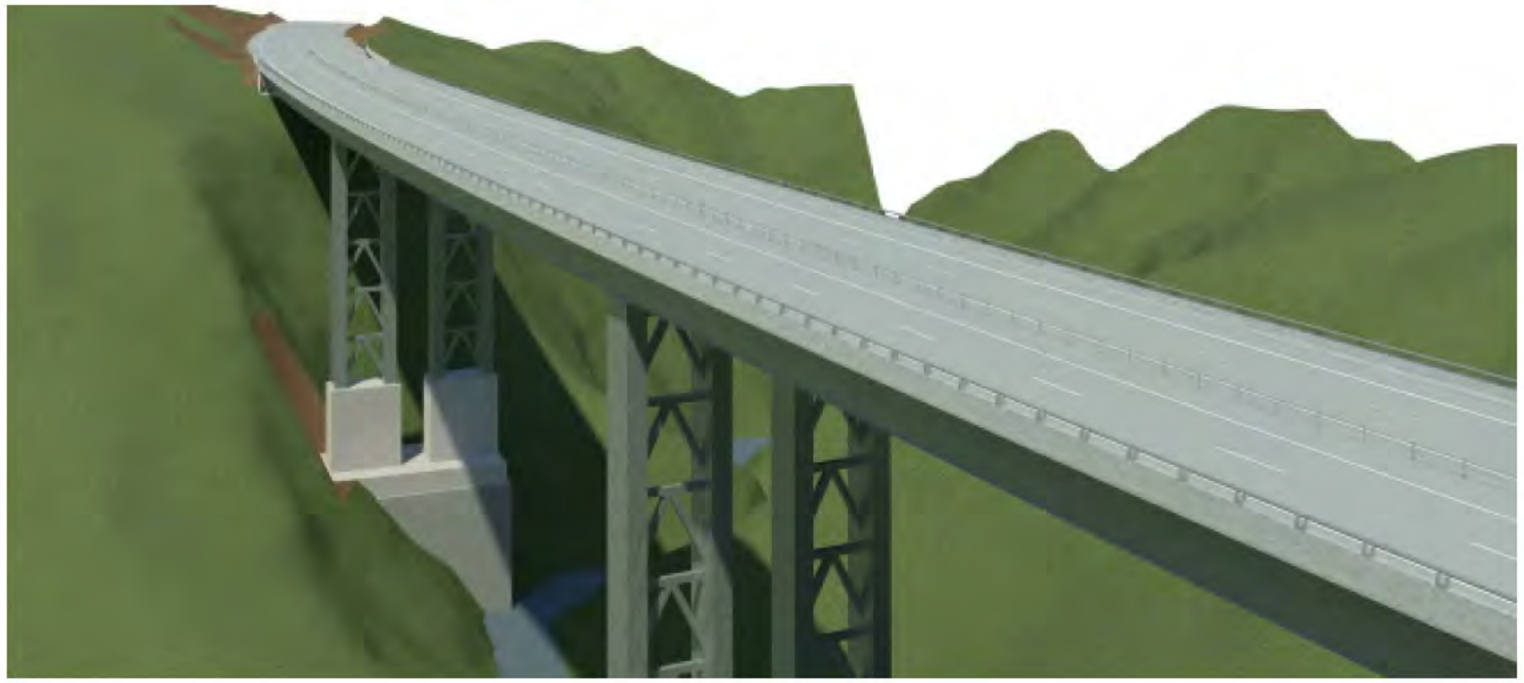
WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 19
PERSPECTIVE VIEW
TG-DRG-S11-BR-3033

BRIDGE 20 LOOKING NORTH



BRIDGE 20 LOOKING FROM BELOW



BRIDGE 20 LOOKING SOUTH

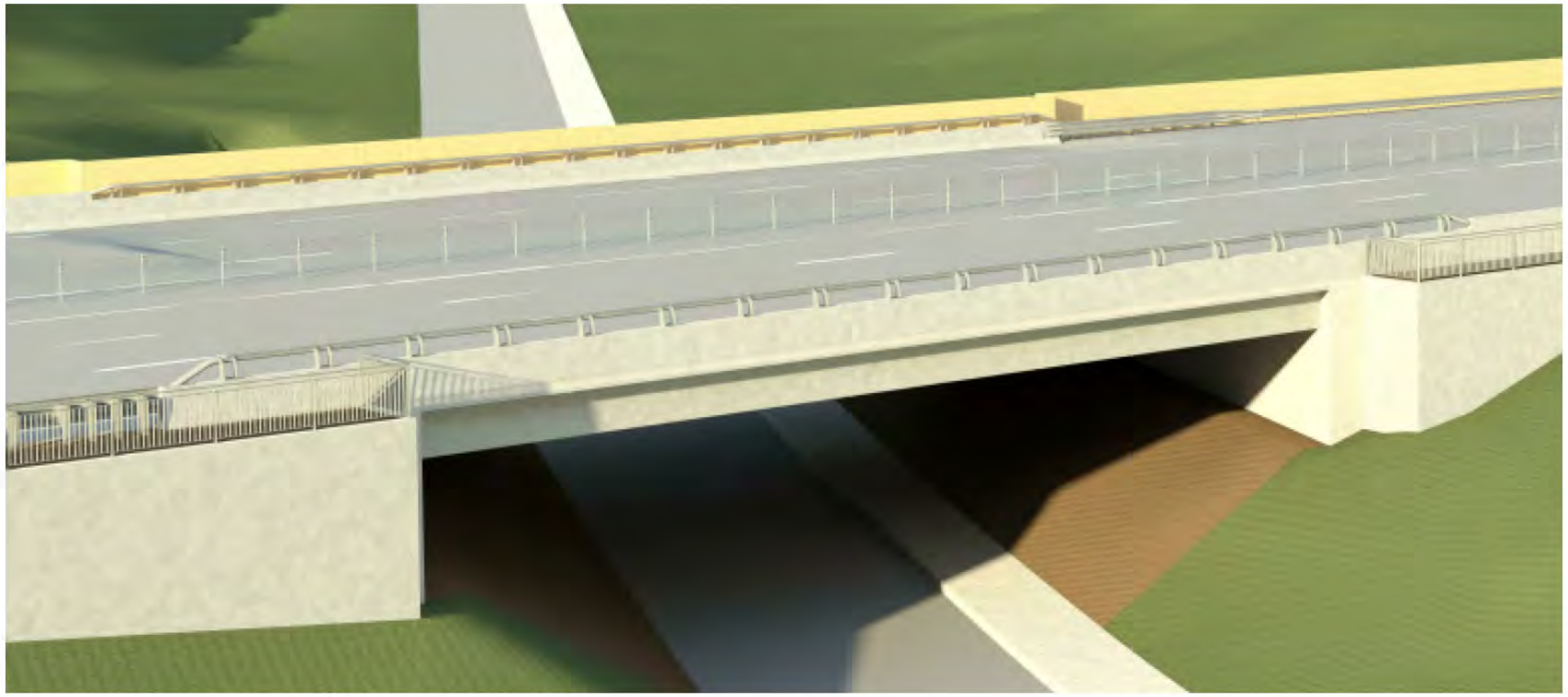
TRANSMISSION GULLY PPP PROJECT

STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

BRIDGE 20
PERSPECTIVE VIEW

TG-DRG-S11-BR-3034



BRIDGE 26 LOOKING SOUTH-EAST

BRIDGE 26 LOOKING SOUTH-EAST

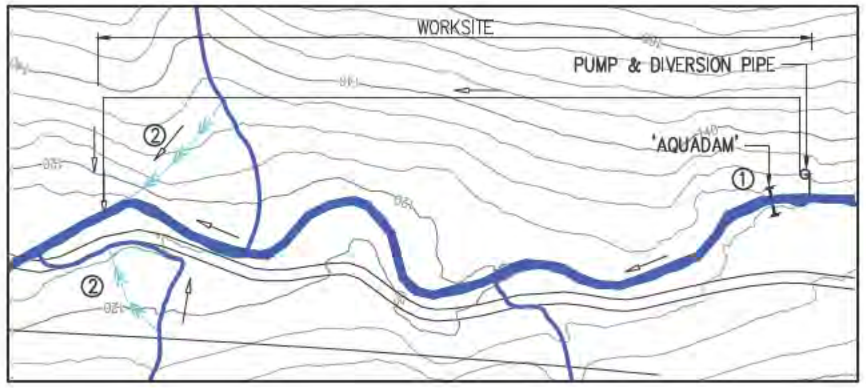
N:\109337 Transmission Gully\060 Drawings\062 HCG Drawing General\SCHEDULE 11\BR26\TG-BR26_Central_R14_NEW.rvt

TRANSMISSION GULLY PPP PROJECT

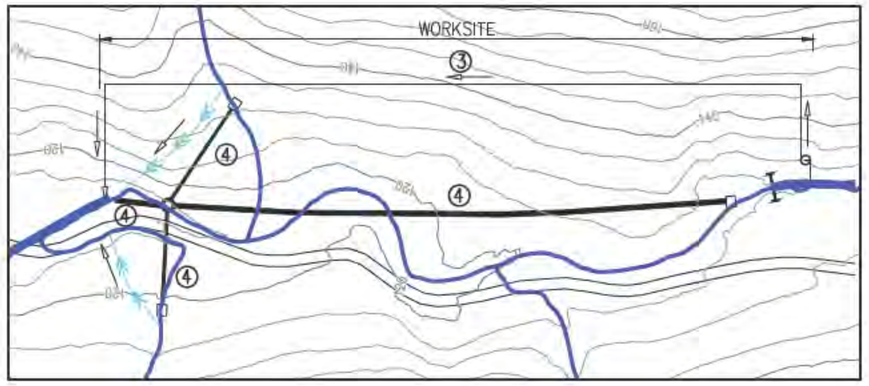
STATUS SCHEDULE 11
REV B
DATE 18 JUNE 2014

WELLINGTON GATEWAY PARTNERSHIP

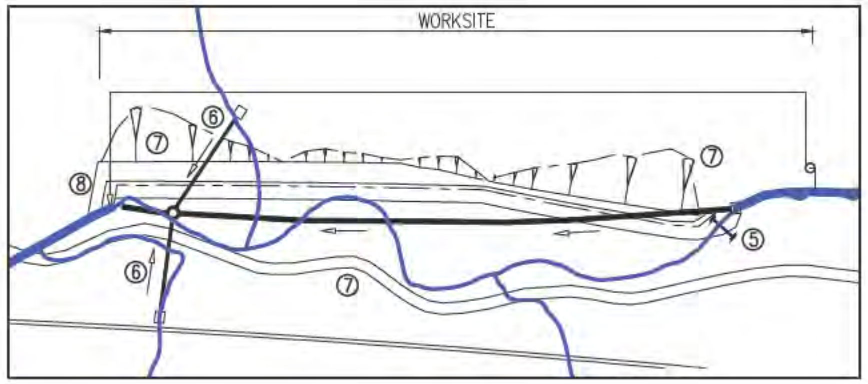
BRIDGE 26
PERSPECTIVE VIEW
TG-DRG-S11-BR-3037



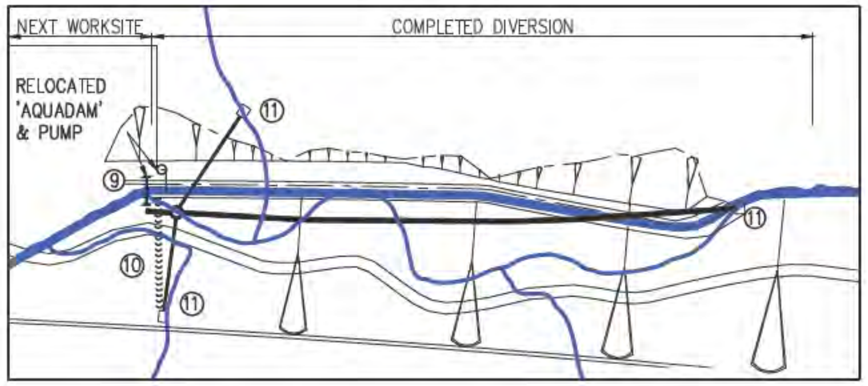
1. INSTALL 'AQUADAM' AND PUMP
2. DIVERT TRIBUTARY TO DOWNSTREAM LIMIT OF WORKSITE



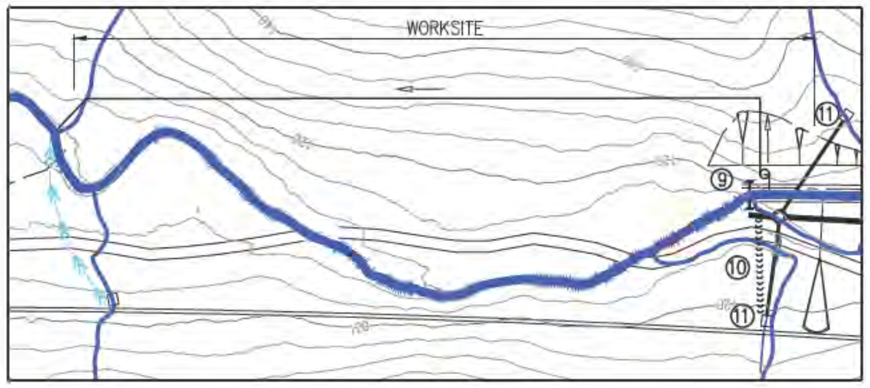
3. OVERPUMP MAIN STREAM
4. EXCAVATE FOR AND INSTALL INLET PIT, MANHOLE, MAIN DIVERSION PIPE & TRIBUTARY DIVERSION PIPE



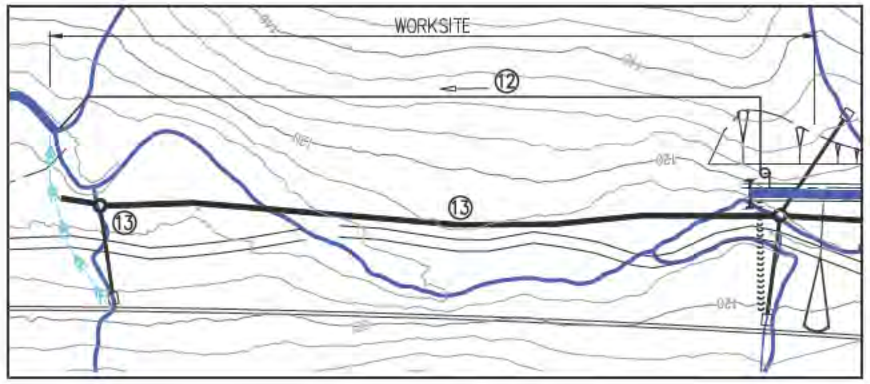
5. RELOCATE 'AQUADAM' DOWNSTREAM OF INLET PIT TO DIVERT MAINSTREAM TO DIVERSION PIPE.
6. RE-DIRECT TRIBUTARY TO TRIBUTARY DIVERSION PIPE.
7. CONSTRUCT EMBANKMENT & PERMANENT STREAM DIVERSION TO 3m ABOVE DIVERTED STREAM INVERT
8. CONSTRUCT TEMPORARY CONNECTION FROM DIVERTED TO EXISTING STREAM



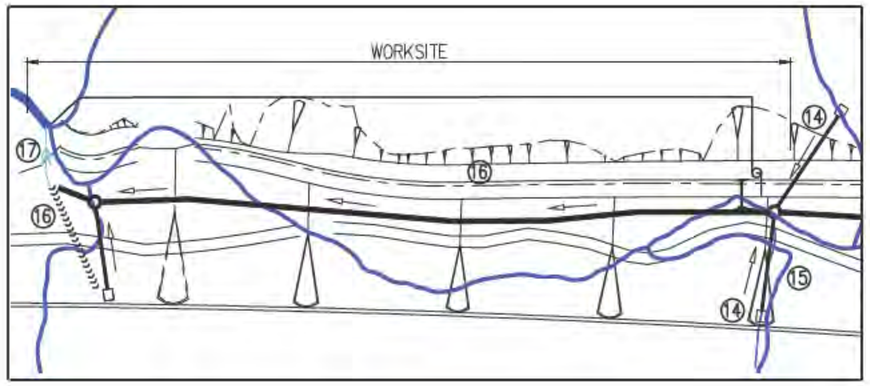
9. RELOCATE 'AQUADAM' AND PUMP TO DOWNSTREAM END OF DIVERTED STREAM.
10. INSTALL HALF PIPE TEMPORARY TRIBUTARY DIVERSION.
11. CLOSE INLET PIT AND DIVERT WATER TO COMPLETED DIVERTED STREAM.



9. RELOCATE 'AQUADAM' AND PUMP TO DOWNSTREAM END OF DIVERTED STREAM.
10. INSTALL HALF PIPE TEMPORARY TRIBUTARY DIVERSION.
11. CLOSE INLET PIT AND DIVERT WATER TO COMPLETED DIVERTED STREAM.



12. OVERPUMP MAIN STREAM
13. EXCAVATE FOR AND INSTALL MANHOLE, MAIN DIVERSION PIPE AND TRIBUTARY DIVERSION PIPE



14. OPEN INLET PIT TO DIVERT MAIN STREAM TO DIVERSION PIPE.
15. REMOVE TRIBUTARY HALF PIPE AND REDIRECT TRIBUTARY TO TRIBUTARY DIVERSION PIPE
16. CONSTRUCT EMBANKMENT AND PERMANENT STREAM DIVERSION TO 3m ABOVE DIVERTED STREAM TO EXISTING STREAM.
17. CONSTRUCT TEMPORARY CONNECTION FROM DIVERSION TO EXISTING STREAM
18. REPEAT 9–17

LEGEND

- WATERWAY MAJOR
- WATERWAY MINOR
- INLET STRUCTURE WITH SCREENS
- MANHOLE
- DIVERSION PIPE AND TRIBUTARY PIPE – HDPE
- HEADWALL
- WATER COURSE DIVERSION

TRANSMISSION GULLY PPP PROJECT
STATUS SCHEDULE 11
REV A
DATE 20 MAY 2014

SCALE A 0 10 20 30 40 50m
1 : 2000 (A3) 1 : 1000 (A1)

WELLINGTON GATEWAY PARTNERSHIP

DRAINAGE
TE PUKA STREAM DIVERSION - STAGING PLAN

TG-DRG-S11-DR-3101

Appendix 5: Geotechnical Design Philosophy Statement

See document #16660746, entitled "Geotechnical Design Philosophy Statement".

Geotechnical Design Philosophy Statement

Revision G

Table of Contents

LIST OF TABLES

LIST OF FIGURES

1.Geotechnical Design Philosophy Statement

1.1. Introduction

This Geotechnical Design Philosophy Statement sets out aspects of the geotechnical design to be advanced to "approved for construction" stage design of the Transmission Gully project.

This design philosophy statement is based on the following:

- RFP documentation considered during tender design development
- Tender stage geotechnical investigation data
- WGP tender stage geotechnical model and design solution
- NZTA Bridge Manual 3rd Edition (with acknowledgement of deviations as noted herein and at Schedule 11)
- GNS Site specific Seismic study (2008 and update 2013 with acknowledgement of minor deviations as noted herein)

This Design Philosophy Statement may be subject to modification during detailed design development to cater for the following potential scenarios:

- Variation in ground conditions from that known at tender
- Enhancement of the engineering function or durability of the design solution
- Enhanced value-for-money of the design solution considering whole-of-life of the asset
- Safety in Design considerations
- The adoption of enhanced engineering design methods relative to those described herein

1.2. Existing Geotechnical Data

1.2.1. Site Investigations and Laboratory Testing

Site Investigations have been undertaken along the Transmission Gully Route by several parties, as requested by the NZTA. These were carried out at both the Specimen Design and Tender Phases and have been listed in the Preliminary Geotechnical Design Report.

1.2.2. GIS Compilation

A GIS database for the project will be developed and maintained during design development that shall include as a minimum the following:

- Aerial photography
- Plan extents of project Geotechnical terrains adopted in design
- Hyperlinks to subsurface investigation data (ie boreholes, CPT, test pits, etc)

1.3. Site Investigations Performed

1.3.1. Geotechnical Mapping

The design shall incorporate the results of geotechnical mapping (where appropriate) as performed by WGP during tender.

1.3.2. Seismic Refraction Survey

The design shall incorporate the results of seismic refraction survey (where appropriate) as performed by WGP during the tender.

1.4. Geological and Geotechnical Model

The design documentation shall include presentation of the geotechnical model that informs the geotechnical design solution.

The primary objective of the geotechnical model is to provide a basis to adequately understand and categorise the distribution and nature of geological materials, structures and geohazards in the project area based on the available geotechnical information.

All geotechnical models should be objective driven. For Transmission Gully the model is required to contribute to a number of different engineering applications including:

- Cut slopes
- Embankments
- Retaining walls
- Foundations
- Material reuse
- Seismic design
- Geohazards.

The model building philosophy includes the concept of “Total Geology” which incorporates both the geology and geomorphology of the site with a focus on reducing uncertainty and managing geotechnical risk.

The model shall include, as a minimum, the following components:

- Terrain model of Geological materials
- Bedrock geological units, including
    - Torlesse Composite Terrain
    - Quarternary conglomerate
- Hydrogeology as applicable to design
- Geohazards

1.4.1. Geological Terrains

The Geotechnical model shall incorporate the use of geological terrains to define the extents of varying geotechnical conditions. The geological terrains to be adopted shall be developed from those assumed at tender as presented at **Table 1**.

Table 1: Identified Geological Terrains along the TG Alignment

Terrain	Genesis	Brief Description
Coastal Swamp (CSw)	Marginal Marine/ Estuarine (soil)	Accumulation of fine-grained sediments and organic material (peat) on low-lying coastal areas. Only occurs in the MacKay’s Crossing area.
Coastal Dunes (CDu)	Aeolian (wind-blown) (soil)	Accumulation of aeolian sand in low-lying coastal areas. Occurs in the MacKay’s Crossing area to approximate chainage 1,500m only.
Alluvial Channel (Alc)	Alluvial (soil)	Alluvial material deposited or being eroded along active perennial stream channel or flow path. Associated with all streams within designation.
Gully Infill (Gi)	Alluvial/Colluvial (soil)	Soils deposited by gravity and surface water flows along incised or rounded tributary drainage alignments.
Alluvial and Colluvial Fans (Fa)	Alluvial/Colluvial (soil)	Generally granular soils deposited as fans and lobes at the base of moderate to steep slopes. Variable soil types fed by gullies. Located across the project often associated with larger streams.
Colluvial Apron (Ca)	Colluvial (soil)	Granular material deposited in an ‘apron’ form (blanket of colluvium/tallus) along the base of moderate to steep slopes. Associated with steeper terrain north of Battle Hill along Te

Terrain	Genesis	Brief Description
		Puka and Horokiri Valleys.
Alluvial terrace (Alt)	Alluvial (soil)	Alluvial deposition occurring in the base of valleys as terrace deposits. Located in major stream valleys associated mainly with Te Puka and Horokiri Valleys.
Interlayered Alluvium and Estuarine (Es)	Estuarine/Alluvial/ Marginal Marine (soil)	Granular alluvial soils interlayered with fine-grained estuarine and shallow marine soils. Located near Pauahatanui Estuary near SH58.
Conglomerate (Cng)	Sedimentary (rock)	Weakly cemented conglomerate formed by induration (cementing) of old alluviual terraces. Located within the Horokiri Valley between SH58 and Wainui Saddle, and at the north end of Te Puka Valley.
Deep Regolith over Torlesse (Dt)	Sedimentary (rock)	Deep soil mantle comprising loess, colluvium/slope wash and residual soil (regolith) overlying generally highly weathered Torlesse bedrock. Located in places across the entire route length.
Thin Regolith over Torlesse (Tt)	Sedimentary (rock)	Thin to no soil comprising loess, colluvium/slope wash (regolith) overlying fresh to highly weathered Torlesse bedrock. Occurs mainly north of Battle Hill and in southern parts of the route.

1.4.2. Typical Geotechnical Sections

Typical generic geotechnical sections were developed at tender for selected locations along the route. These sections display typical anticipated sub-surface conditions at these locations and provide context as to the geological distribution of the various units that may be encountered. These sections are not intended to capture all possible scenarios; rather they provide a broad overview of key geological environments along Transmission Gully.

North of Wainui Saddle (Te Puka Stream)

This generic section captures the steep terrain in Te Puka stream valley, north of Wainui Saddle, as well as a section in the Horokiri valley south of the saddle, shown in **Figure 1**. The TG route will generally comprise side cuts and fills in this area. Potential features associated with this area comprise:

- Steep lower side slopes (30 to 45°), flattening towards the top of ridge (10 to 20°).
- Typically deeper weathering profile on upper slopes, with fresh to moderately weathered Torlesse bedrock close to surface on lower slopes.
- Slope wash and Loess mantle located at the ridge crests.
- Localised colluvial/alluvial fans extending out of side tributaries.
- Colluvial aprons on lower slopes in places.
- Valley floor comprises alluvial and colluvial deposits over Torlesse bedrock.
- Seepage is common on side slopes.
- The major, active, Ohariu Fault traverses the valley, with splays extending into the side slopes. The fault branches away to the east towards the north.
- Some active shallow instability is occurring in the regolith materials on the side slopes.
- Evidence of debris flows is observed in some tributaries.

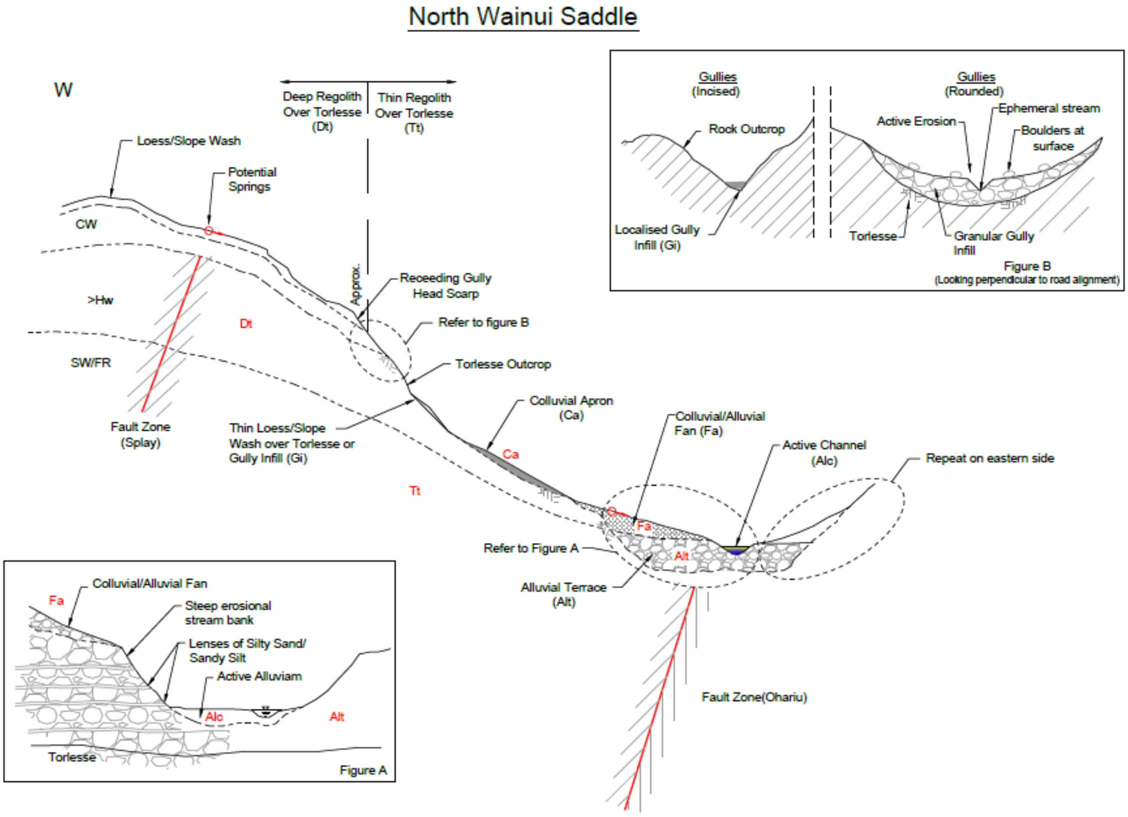


Figure 1: Typical section of North of Wainui Saddle (Te Puka Stream)

Battle Hill (Horokiri Stream)

This generic section captures the typical terrain in the Horokiri stream valley, south of Wainui Saddle, where the TG route will comprise side cuts and fills, as well as raised embankments, shown in **Figure 2**. . Potential features associated with this area comprise:

- Broader valley floor with steep sides in places (30 to 40°).
- Dissected older raised alluvial terraces occur in parts of the valley resulting in undulating hilly terrain.
- Valley floor comprises gently sloping alluvial terraces.
- Alluvial fans extending out of side tributaries over valley floor.
- Occasional swampy/saturated areas on valley floor.
- Localised seepage on side slopes.
- Slope wash and Loess mantle the gently sloping slopes.
- Weathered Torlesse bedrock underlying alluvial terraces.
- Minor shallow instability in regolith materials, particularly on the flanks of older, weathered terraces (appear to be controlled by groundwater seepage).

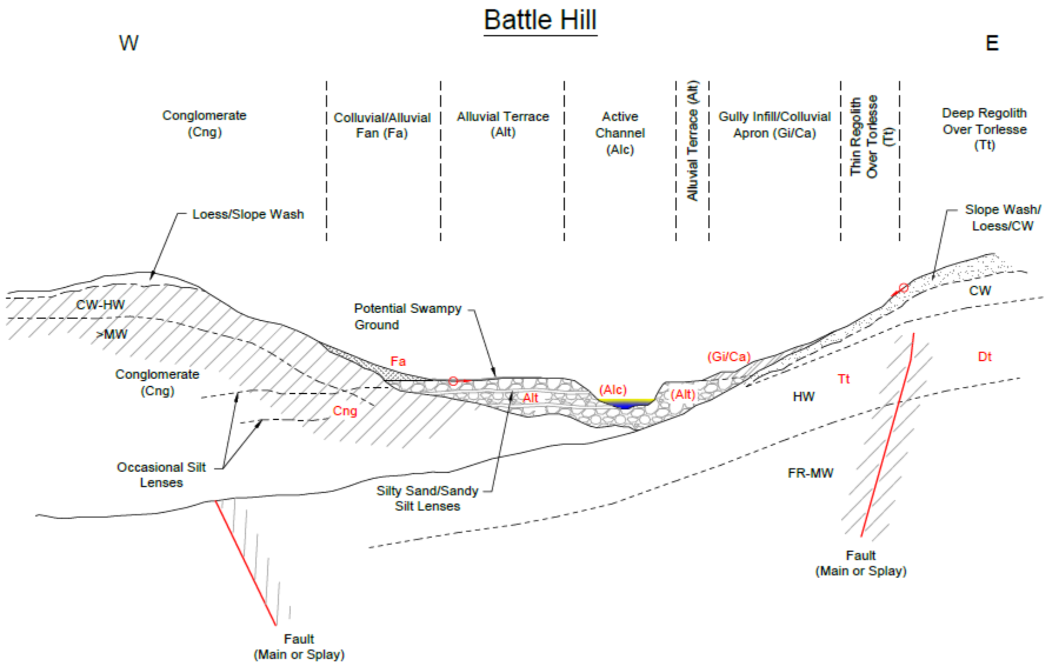


Figure 2: Typical section of Battle Hill (Horokiri Stream)

SH58 Interchange

This section indicates the sub-surface conditions below the low-lying area at the neck of the Pauahatanui Estuary, as shown in **Figure 3**. Potential features associated with this area comprise:

- Low-lying swampy area with groundwater table close to surface.
- This area is an ancient river valley which has been through several transgressive and regressive sea level cycles. This has resulted in interlayered alluvium, estuarine and shallow marine sediments to a depth of over 50m in the valley floor. These older sediments are overlain by 10 to 15 m of Holocene alluvium, comprising interbedded silts sands and gravels.

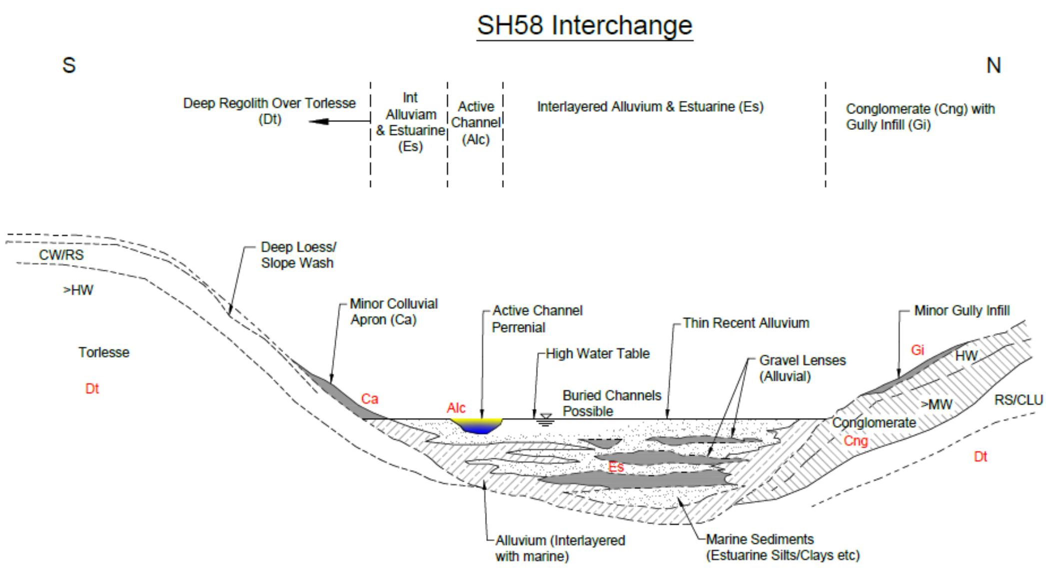


Figure 3: Typical section of SH58 Interchange

Duck Creek

Duck Creek is a narrow valley with steep uplifted fault facet slopes on the western side, and moderately sloping slopes on the east side, as shown in **Figure 4**. Potential features associated with this area comprise:

- Deeper weathering layer of Torlesse Bedrock on east side and upper ridge crests.
- Shallow regolith and weathering over Torlesse on steeper slopes.
- Swampy gully infill deposits in places.
- Slopewash and Loess may be associated with gently sloping terrain.
- Alluvial channels and terraces infill the valley floor.
- Colluvial/alluvial fans extending out of side tributaries.
- Localised seepage on side slopes.
- The active Moonshine Fault traverses the valley floor and lower side slopes.
- Evidence of localised shallow instability is observed on steeper slopes.

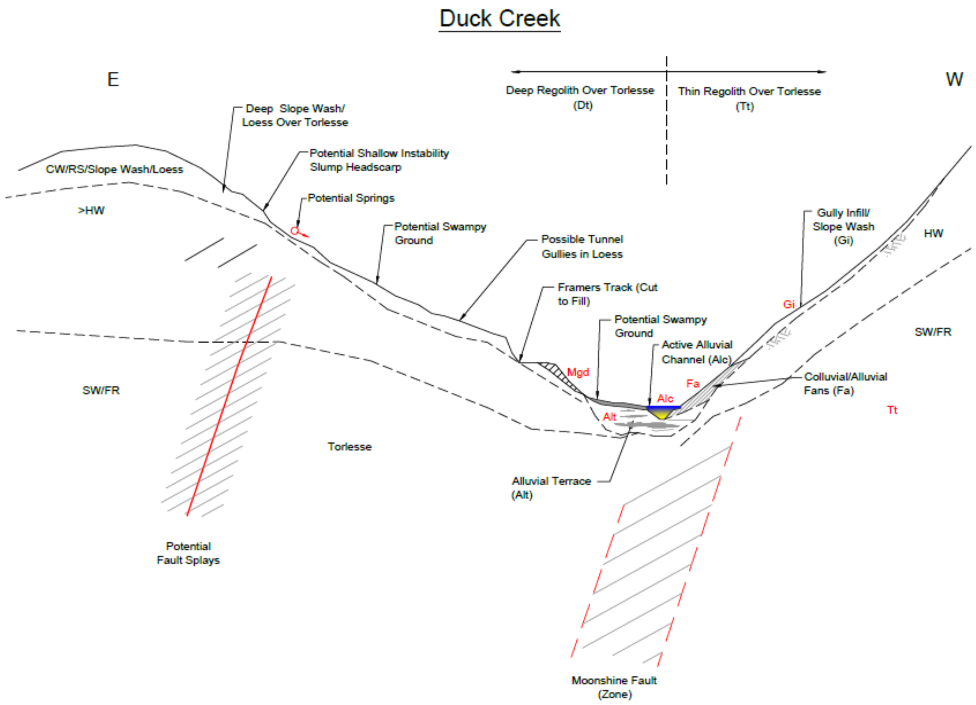


Figure 4: Typical section of Duck Creek

Cannons Creek

This is a section close to the Cannons Creek bridge crossing, presented in **Figure 5**. Potential features associated with this area comprise:

- Steep valley flanks, with gently sloping ridge tops.
- Potential for deep weathering of Torlesse bedrock on ridge tops.
- Shallow weathering on steep slopes.
- Slopewash and colluvium on side slopes.
- Colluvial/alluvial fans, alluvial terraces and active stream channel deposits in base of valley.
- Localised seepage on side slopes.
- Potential splinter fault or splays in places.
- Potential for localised shallow instability on side slopes.

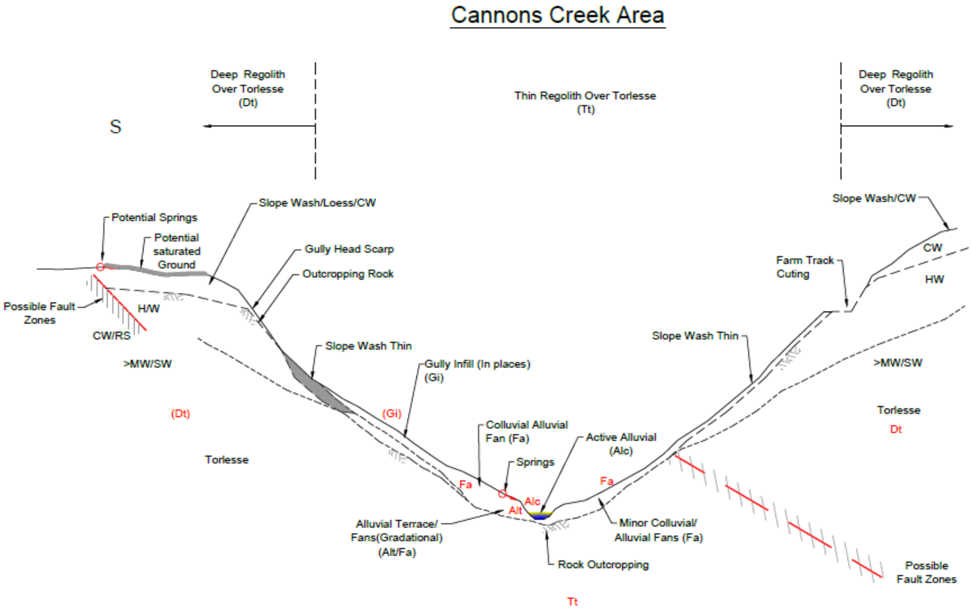


Figure 5: Typical section of Cannons Creek

West of Cannons Creek

This area comprises moderate to steeply inclined Torlesse bedrock slopes with a variable weathering profile, as shown in **Figure 6** Potential features associated with this area comprise:

- Very deep weathering zone and regolith mantle in places, particularly on ridge crests. Slopewash and Loess mantles gently sloping terrain.
- Shallow weathering zone and regolith mantle on steeper slopes.
- Steeply incised gullies in places.
- Seepage common.
- Occasional older fault zone intersects route.

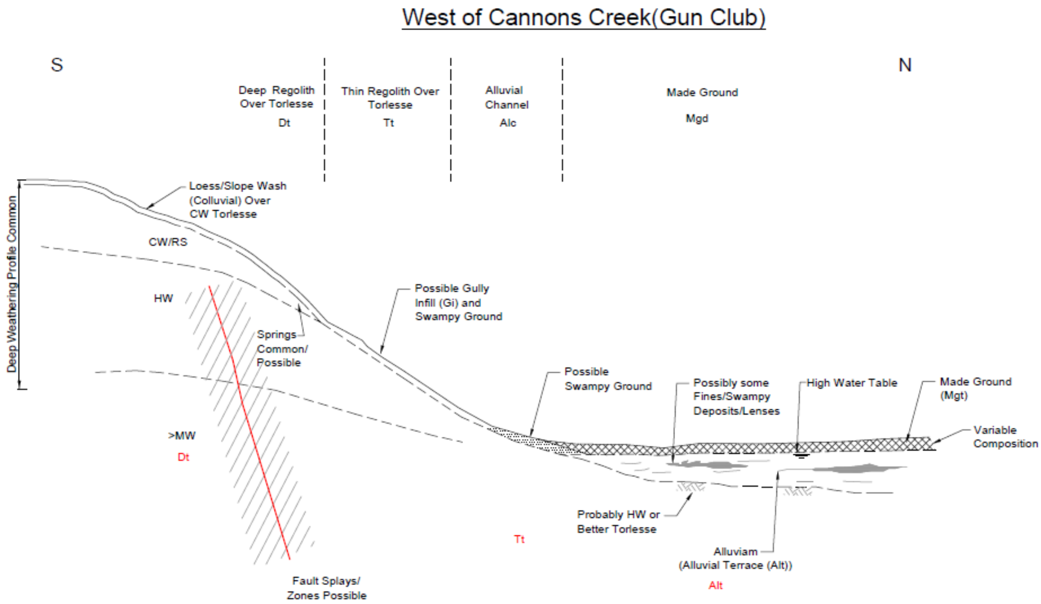


Figure 6: Typical section of West of Cannons Creek

1.4.3. Bedrock Geotechnical Units

A rock mass classification system shall be adopted for the Torlesse rock unit for use in design. This shall be developed from those assumed at tender described at **Table 2**.

Table 2: Torlesse Rock Mass Units

Rock Mass Unit	Brief Description
CW Torlesse	Greywacke and argillite. Original rock mass weathered to soil strength material, typically silty sands and clays.
HW Torlesse	Greywacke and argillite. Majority of original rock strength has been lost with 25-50% weathered to a soil strength material. Moderately to highly fractured and typically weak to very weak.
MW-UW Class I Torlesse	Greywacke and argillite. little deformation evident (not observed in study area)
MW-UW Class II Torlesse	Greywacke is fractured to highly fractured. Mudstone is highly fractured to fragmented.
MW-UW Class III Torlesse	Greywacke is typically moderately fractured to highly fractured. Mudstone is highly fractured to fragmented.
MW-UW Class IV Torlesse	Greywacke is typically moderately fractured to fragmented. Mudstone is highly fractured to fragmented. Often located proximal to fault zones, increased shearing evident.
MW-UW Class V Torlesse	Rock mass is generally fragmented and occurs in zones along major fault zones. May contain some gouge zones with higher clay content. May be weakly re-healed.

1.4.4. Geological Structure

Structural Domains

The Geotechnical Model shall incorporate the consideration of Structural Domains (where applicable to design, eg structural controlled cut slopes in rock) representing the varying structural geology conditions along the project alignment. This shall be developed further from the tender structural domain model (as presented at **Table 3** following) to incorporate additional data obtained during detailed design investigations.

Table 3: Tender stage Structural Domain Model

Structural domain	Specimen Design Chainage		Approx New Chainage		Structural patterns
	CH From	CH To	CH From	CH To	
SD_A	0	3100	0	2840	No distinct patterns.
SD_B	3100	4900	2840	4640	Bedding primarily dips steeply to the west. Faults and shears dip moderately to sub-vertically to the north west.
SD_C	3200	3900	2940	3640	Bedding dips steeply to the south east. Faults and shears primarily dip moderately to the south east.
SD_D	4900	5200	4640	4940	Bedding, faults and shears dip moderately to steeply towards south east.
SD_E	5200	7500	4940	7240	Bedding, faults and shears dip moderately to the west/north west.
SD_F	7500	9400	7240	9140	Bedding, faults and shears dip moderately to steeply to the west.
NO DOMAIN	9400	12000	9140	11740	n/a
SD_G	12000	12900	11740	12640	Faults and shears dip moderately to the north west.
NO DOMAIN	12900	18850	12640	18600	n/a

Structural domain	Specimen Design Chainage		Approx New Chainage		Structural patterns
	CH From	CH To	CH From	CH To	
SD_H	18850	23100	18600	22840	Bedding, faults and shears dip moderately to the south east.
SD_I	23100	24050	22840	23760	Bedding dips steeply towards east. Faults and shears dip moderately between NE and SE.
SD_J	23500	24050	23220	23760	Two main bedding sets, one dipping steeply to the NE, the other dips moderately to the west. Faults and shears are primarily dipping to the NE.
SD_K	24050	29000	23760	27800	Bedding is primarily dipping moderately to the NE (scattered plot). Faults and shears dip moderately to the south.

1.4.5. Seismicity

The geotechnical design solutions shall consider seismic design adopting the requirements of the NZTA Bridge Manual and the GNS Site specific seismic study (and deviations as defined at Schedule 11 or herein). The GNS site specific seismic study determined the seismic intensity for 9 sectors along the project route. The sector boundaries are defined by Opus (July 2008).

Table 4 following shall be used to define the unweighted horizontal design Peak Ground Acceleration (PGA) for each sector of the project route for the varying seismic recurrence intervals applicable to Geotechnical Design as defined within the NZTA Bridge Manual.

Maximum Considered Earthquake (MCE)

Where required to be considered in accordance with the NZTA Bridge Manual, the MCE earthquake accelerations shall consider a M_w 8.1 earthquake at zero distance in accordance with clause 5.2.3 of the NZTA Bridge Manual as presented at Table 8 following.

Table 4: Seismic PGAs and complementary effective magnitudes for each geotechnical sector for use in design

		Unweighted Horizontal PGA (g) - based on GNS(2013)					
		SLS		ULS			
Sector		25yr	100yr	500yr	1000yr	2500yr	MCE
1	Rock	[redacted]					
	Shallow Soil						
	Effective Magnitude						
2	Rock						
	Shallow Soil						
	Effective Magnitude						
3	Rock						
	Shallow Soil						
	Effective Magnitude						
4	Rock						
	Shallow Soil						
	Effective Magnitude						

		Unweighted Horizontal PGA (g) - based on GNS(2013)					
		SLS		ULS			
Sector		25yr	100yr	500yr	1000yr	2500yr	MCE
5	Rock	[redacted]					
	Shallow Soil						
	Effective Magnitude						
6	Rock						
	Shallow Soil						
	Effective Magnitude						
7	Rock						
	Shallow Soil						
	Effective Magnitude						
8	Rock						
	Shallow Soil						
	Effective Magnitude						
9	Rock						
	Shallow Soil						
	Effective Magnitude						

Topographic Amplification for Cut Slopes

Topographic amplification and scale effects shall be considered in the design of cut slopes. The design framework presented as follows shall be adopted for selecting "pseudo-static" seismic loading for the design of cut slopes using limit equilibrium methods:

Some definitions:

- H = vertical distance from valley floor to natural crest (m).
- h = vertical distance from valley floor to upslope extent of failure mechanism (m).
- y = vertical distance between upslope and downslope extents of failure mechanism (m).
- $PGA_{flat\ ground}$ = PGA from GNS seismic hazard assessment. This relates to flat ground, valley floors, and low points in natural topography (% of g).
- $A_{natural}$ = natural topographical amplification factor, describes amplification from valley floor to natural crest.
- $PGA_{natural\ crest}$ = PGA at crest of natural topography (independent of cut slope location) (% of g).
- $A_{slip\ surface}$ = slip surface amplification factor, describes amplification from valley floor to upslope extent of slip surface, assumes linear interpolation between $PGA_{flat\ ground}$ and $PGA_{natural\ crest}$. This may be conservative for low values of (h / H) so may be reviewed subject to supporting analyses or literature research.
- $PGA_{slip\ surface}$ = PGA at the upslope extent of the slip surface (% of g).
- k_h = earthquake coefficient for "pseudo-static" limit equilibrium analysis, assessed as being the average acceleration experienced within a rigid mechanism at the instant that the mechanism experiences the $PGA_{slip\ surface}$ (% of g).

Step 1. Obtain PGAflat ground

Step 2. Estimate Anatural from the values in following table

		H		
		0 to 50 m	**50 to 200 m**	**200 to 1000 m**
Average natural slope angle	0 to 15 deg	1	1	1
	15 to 30 deg	1.2	1.5	2
	> 30 deg	2	3	4

Step 3. Calculate Aslip surface = 1 + (h / H) * (Anatural - 1)

Calculate $A_{slip\ surface}$ separately for each mechanism. Judgement should be used to assess which mechanisms may be critical to design.

Step 4. Calculate PGAslip surface = Aslip surface * PGAflat ground

Step 5. Estimate kh = [1 – 0.3 * (y / H)] * PGAslip surface

Active Faults

Per GNS site specific seismic study, the faults within the project route are determined to have a recurrence interval for fault rupture of greater than 2000 years. In accordance with Bridge Manual clause 2.1.2 there is no requirement to consider movement potential associated with fault rupture for design.

1.4.6. Hydrogeology

The design solutions shall consider the hydrogeological conditions in determining groundwater assumptions for design in accordance with the requirements of the NZTA Bridge Manual.

1.4.7. Geohazards

The design shall include consideration of the influence of geohazards on the function and maintenance of the geotechnical design solutions in accordance with the requirements of the NZTA Bridge Manual. This shall include but not be limited to the geohazards listed as follows.

- Rainfall Induced Landslides
- Earthquake Induced Landslides
- Fault Rupture
- Liquefaction

1.4.8. Tsunami

Tsunami risk for the TG route is considered by Hancox 2005 to be minimal (very low). A minor Tsunami risk to the TG route has been identified at Pauahatanui Inlet from Ohariu Fault rupture (Opus PGAP 2007).

On this basis, the potential impact of tsunami will not be assessed during detailed design.

1.5. Geotechnical Design Parameters

Geotechnical design parameters shall be developed in accordance with the requirements of the NZTA Bridge Manual including consideration of a literature review, the geotechnical model, and from existing and new site investigation and laboratory test data.

While these Tender Stage Parameters in section 1.5.1 and 1.5.2 informed our Design Philosophy and Tender submission, they will be reviewed and refined, as additional data is developed from new site investigations and laboratory analysis.

1.5.1. Adopted Parameters In-Situ

In Situ Soil Strength Parameters

The parameters to be adopted for in-situ soil materials shall be developed from those assumed at tender as presented at Table 5.

Table 5: Material parameters for natural soils

Material designation	Effective Drained Cohesion c' (kPa)	Effective Angle of Internal Friction ϕ (°)	Effective Bulk Unit Weight γ' (kN/m^3)
Interlayered Alluvium and Estuarine (Es)	[redacted]		
Colluvial Apron (Ca)			
Gully Infill (Gi)			
Alluvial Fans (Fa)			
Alluvial Terrace (Alt)			
Alluvial Channel (Alc)			
Landslide Debris (Lsd)			
Regolith/soil (Interlayered/slope-wash/Loess/Residual)			

In Situ Rock Strength Parameters

The parameters to be adopted for in-situ rock materials shall be developed from those assumed at tender as presented at Table 6.

Table 6: Summary of Geotechnical Parameters – Rock Mass Parameters

UNIT	UNIT WEIGHT γ (KN/M^3)	HOEK-BROWN PARAMETERS				MOHR-COULOMB SHEAR STRENGTH			ANTICIPATED BEHAVIOUR UNDER SEISMIC LOADING
		UCS (MPA)	GSI	M_I	D	STRESS RANGE MAX Σ_N (MPA)	C' (KPA)	ϕ' (DEG)	
Weathered Conglomerate	[redacted]								Ductile to Brittle
Completely Weathered Torlesse									Ductile to Brittle
Highly Weathered Torlesse									Ductile to Brittle
Class V Torlesse (Fault Crush Material)									Mainly ductile but may be brittle/ strength-loss where light

UNIT	UNIT WEIGHT γ (KN/M^3)	HOEK-BROWN PARAMETERS				MOHR-COULOMB SHEAR STRENGTH			ANTICIPATED BEHAVIOUR UNDER SEISMIC LOADING
		UCS (MPA)	GSI	M_I	D	STRESS RANGE MAX Σ_N (MPA)	C' (KPA)	ϕ' (DEG)	
	[redacted]								cementation and high pore pressure.
Class IV Torlesse (Fault Breccia)	[redacted]								Ductile
Class III Torlesse	[redacted]								Ductile
Class II Torlesse	[redacted]								Ductile
Conglomerate (rock)	[redacted]								Brittle? (weak rock – lightly cemented)

Rock Defect Strength Parameters

The parameters to be adopted for rock defect strength shall be developed from those assumed at tender as presented at Table 7.

Table 7: Defect shear strength

Rock Mass Unit	Defect Type	Effective Cohesion, c' (kPa)	Effective Angle of Friction, (°)
Regolith / Rock Interface	Contact	[redacted]	
Torlesse	Joint	[redacted]	
Torlesse	Shear	[redacted]	

1.5.2. Adopted Parameters for Material Reuse

Adopted Soil and Rock Strength Parameters for Reuse

The parameters to be adopted for material reuse shall be developed from those assumed at tender as presented at Table 8.

Table 8: Material Reuse Parameters Assessment

Material Type	Unit Weight, γ (kN/m^3)	Effective Cohesion, c' (kPa)	Effective Angle of Friction, φ' (°)
Type A1	[redacted]		
Type A2	[redacted]		
Type B	[redacted]		
Type C	[redacted]		
Type D	[redacted]		
Type E	[redacted]		
Type F	[redacted]		
Type G	[redacted]		
Type H	[redacted]		

1.6. Geotechnical Design Philosophy

1.6.1. General

The geotechnical design shall provide seismically resilient solutions consistent with the requirements of the NZTA Bridge Manual and Schedule 11 including consideration of operations and maintenance.

1.6.2. Standards Adopted

The geotechnical design shall be developed in accordance with:

- The NZTA Bridge Manual Third Edition, Amendment 0 (Ref SP/M/022) May 2013 (with acknowledgement of deviations as noted within this Geotechnical Design Philosophy or Schedule 11)
- The Site Specific Seismic Study completed by GNS (2008 and update in 2013)
- An Importance Level 3 as defined within the NZTA Bridge Manual
- A design life of geotechnical design elements of 100 years.

1.6.3. Seismic Design

The following table defines the requirements for the three design limit states for geotechnical performance in accordance with the NZTA Bridge Manual. The scale of seismic event for each limit state shall be as defined within the NZTA Bridge Manual for varying geotechnical assets.

Design Limit State	NZTA Bridge Manual Definition	TG Design Performance Requirement
Undamaged Limit State (Serviceability SLS1)	Defined simply as "undamaged"	Emergency vehicle unimpeded access Motorway trafficked lanes fully operational after assessing seismic event consequence Seismic effects require only routine motorway maintenance (eg drain clearing, rockfall clearing) Pavement remains serviceable at design speeds Rockfall permitted within design measures/ expectations
Operational Continuity Limit State (Serviceability SLS2)	*full live load capacity is maintained* *the road shall be useable by emergency traffic* *full vehicle access is restorable within 24 hours* *any necessary repairs shall be of such a nature that they can be completed within one month.*	Emergency Vehicle Access Maintain one trafficable lane in each direction after assessing seismic event consequence Element maintains required load capacity Trafficked lane pavement serviceable, albeit at potentially reduced speed Maintenance and rehabilitation to return to motorway condition can be achieved within 1 month assuming resource availability "Non-routine" maintenance provisions permitted (eg crack sealing, rockfall removal, drainage measures)
Ultimate Limit State (ULS)	*Post Earthquake function - Useable by Emergency Traffic* *Post Earthquake function (After reinstatement) - Feasible to reinstate to cater for all design-level actions, including repeat design level earthquakes* *Acceptable Damage - Damage possible, temporary repair may be required*	Emergency Vehicle access at low speed Cut can be reinstated to stable slope for remainder of asset life. Stabilisation and scaling works to cutting likely required Differential settlement does not exceed 150mm step in trafficked lane pavement Required load capacity of embankment can be reinstated after remediation (ie without reconstruction).

1.6.4. Risk Assessment

The geotechnical design may incorporate the adoption of risk assessment methods (as required) to demonstrate the design satisfies the requirements of the NZTA Bridge Manual, Schedule 11 and this Design Philosophy Statement.

1.6.5. Assumptions

The following assumptions are applicable to the geotechnical design:

- The NZTA Bridge Manual third edition has been adopted for design including the following assumptions:
  - Deformation of geotechnical elements may adopt a single method, for example either the Jibson 2007method or the Bray and Travasarou 2007 method, whichever is most appropriate for the relevant slope in accordance with Good Industry Practice
  - Geotechnical stability assessment may incorporate the use of probabilistic methods.
- The Maximum Credible Earthquake (MCE) has been determined per Section 5.2.3 of the Bridge Manual. Other references within the bridge manual to the MCE being 1.5 times the design PGA (ie the 1/2500 event for bridges) shall not apply to geotechnical design.
- Seismic topographic amplification shall be considered for cut slope design in accordance with the method described within this Geotechnical Design Philosophy Statement.
- The design of embankments shall adopt a structural performance factor (Sp) of 1 per the requirements of the NZTA Bridge Manual. No additional topographic amplification is required consistent with the intent Sp of 1 being adopted (ie an Sp factor of 1 allows for some component of amplification and/or scale factors to be applied).
- The post surcharge and preload settlement criteria for peat consolidation at Mackays assumes 100mm over 25 years.
- The cut slope design considers potential for small scale rockfall and soil failure via provision of a rockfall catch ditch at the base of the cut. Thus rockfall or soil failure within this ditch is part of the acceptable long term performance of the cut and natural slopes.
- A tolerable risk to person for road users in assessing the risk of natural landslide hazards shall be an annual probability of loss of life to person most at risk of $1x10^{-4}$.
- The Transmission Gully alignment is not expected to influence the ancient Paekakariki landslide located at approximately CH1900. From the limited information available, this is a large deep seated ancient landslide feature up to 20m thick. The TG alignment traverses the landslide toe area in shallow cut/fill that is expected to have negligible impact on the existing stability of the landslide.
- Per the requirements of the NZTA Bridge Manual, the design does not require consideration of performance post Fault Rupture.
- The design for repeat earthquakes >1/100 recurrence (ie Operational Continuity) shall assume the performance of maintenance (eg crack sealing, etc) will occur in between earthquake events.
- The combined effect of earthquake and extreme rainfall events is not required to be considered beyond the recommendations of the Bridge Manual.

1.7. Cut Slope Design

1.7.1. Cut Slope Design Philosophy

The cut slope design shall consider:

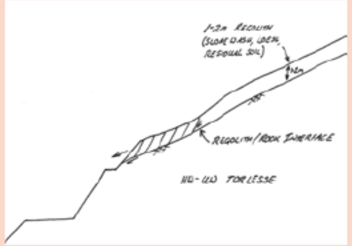
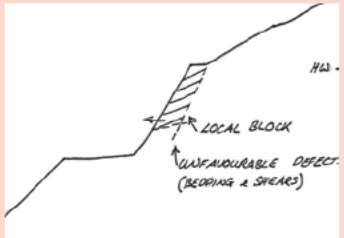
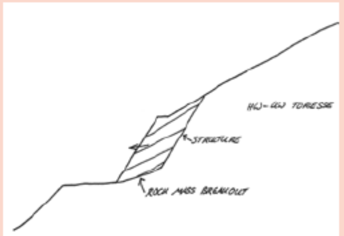
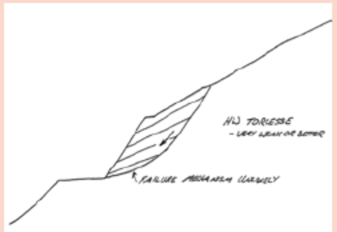
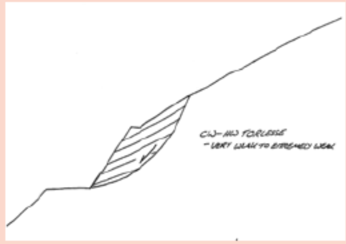
- Global Stability
- Local Stability
- Rockfall
- Erosion

The design solution shall consider:

- Design in accordance with the NZTA Bridge Manual, including seismic events
- Constructability
- Maintenance

The design of cut slopes shall incorporate the requirements of the limit states defined at Section 1.6.3 as described at **Table 9**. These have been conceived at the Tender Stage and inform this Design Philosophy Report; they will be reviewed and refined, as additional data is developed.

Table 9: Slope Stability Mechanisms – Design Philosophy

	LOCAL STABILITY MECHANISMS		GLOBAL STABILITY MECHANISMS		
	1 Soil slide/slip	2 Local block failure	3 Structurally controlled failure with rock mass breakout	4 Circular failure in highly fractured rock	5 Circular failure in very weak to extremely weak rock
Mechanism Sketch					
Seismic Behaviour **Brittle or Ductile**	Ductile	Brittle – defect controlled	Ductile up to where strain reaches δ > 5% of rock mass break out failure path	Ductile	Brittle displacement No strength loss-ok to <30mm Some strength loss 30-300mm -Assess consequence Full strength loss (Run away) >300mm
Statics	FoS > 1.1 drained Limit equilibrium Small scale failures tolerable	FoS > 1.5 Kinematic or Limit equilibrium Small scale failures tolerable Assumed ground support installed where required	FoS > 1.5 Limit equilibrium	FoS > 1.5 Limit equilibrium	FoS > 1.5 Limit equilibrium
SLS Undamaged	FoS < 1.0 Displacements acceptable and/or consequence	FoS > 1.1 or FoS<1.0 assessed	FoS > 1.1	FoS > 1.1	FoS > 1.1

1/25	acceptable	consequence is acceptable			
SLS Operational Continuity 1/100	FoS > 1.0 Or FoS < 1.0 + displacement <100mm Or FoS < 1.0 + small volume + consequence ok	Scale dependent **1. Small (to 10m^3/m)** FoS < 1.0 ok **2. Medium (to 100m^3/m boxcut, to 300m^3/m sidecut)** FoS > 1.0 if FoS < 1.0 and assessed consequence is acceptable **3. Large (>300m^3/m)** Refer Mech 3,4,5 or FoS>1.1	FoS > 1.0 Or FoS < 1.0 but δ < 1% of rock mass break out failure path length	FoS > 1.0 Or FoS < 1.0 but indicated displacement < 50mm	FoS > 1.0 Or FoS < 1.0 but indicated displacement < 10mm
Design Case ULS 1/500 (non bridges)	FoS < 1.0 + displacement <300mm Or FoS<1.0 and assessed consequence is acceptable	Scale dependent **1. Small (to 10m^3/m)** FoS < 1.0 ok **2. Medium (to 100m^3/m box, to 300m^3/m side)** FoS < 1.0 ok **3. Large (>300m^3/m)** Refer Mech 3,4,5 or FoS<1.0 and assessed consequence is acceptable	FoS > 1.0 Or FoS < 1.0 but δ < 5% of rock mass break out failure path length Or FoS<1.0 and assessed consequence is acceptable	FoS > 1.0 Or FoS < 1.0 and δ < 5% of failure path Or FoS<1.0 and assessed consequence is acceptable	FoS > 1.0 Or FoS<1.0 and displacement < 30mm Or FoS<1.0 and displacement > 30mm and assessed consequence is acceptable

1.7.2. Cut Slope Design Methodology

The cut slope design shall be performed in accordance with the NZTA Bridge Manual including consideration of:

- Geotechnical conditions and failure mechanisms associated with those conditions.
- Global stability using either structural kinematic or limit equilibrium methods or more complex (eg finite element methods) for static mechanisms.
- Global stability using either structural kinematic or pseudo-static limit equilibrium methods or more complex (eg finite element methods) for seismic scenarios.
- Local stability including consideration of rockfall and erosion processes.
- Interaction of proposed slope design with surrounding topography and infrastructure
- Slope stabilisation measures (where required)

1.7.3. Global Stability

Slope Stability Analysis

The methodology for analysing seismic scenarios is described below:

- Assessment and selection of PGA and magnitude for each sector, material type (rock or shallow soil) and event (SLS or ULS) using the GNS reports.
- Assessment of slope amplification factor for typical cases along the route.
- Assessment of scale effects of indicated slope failure mechanism to determine k_h acceleration for use in pseudo-static analysis.
- Pseudo-static limit equilibrium slope stability analyses for the following seismic cases:
  - SLS (1/100 year event).
  - ULS (1/500 year event).
- Assessment of FOS for selected models and seismic events.
- Where the FOS<1 assess whether the indicated geological model and failure mechanism will behave in a brittle or ductile manner:
- Where ductile mechanism is indicated, assess indicated coseismic displacement of failure mass as per Schedule 11. If displacements are tolerable, accept indicated design.
- Where brittle mechanism is indicated or displacements are large assess consequence of failure (eg volume of debris on road), if not acceptable then modify slope design.

1.7.4. Local Stability

The assessment of the stability of slopes will include consideration of local stability to inform rockfall management measures. Localised instability mechanisms (as shown on Table 9) may include:

- Failures at crest of slope in soil materials involving sliding or slumping.
- Localised block failure, including:
  - Wedge or block failures along geological structure.
  - Undercutting of weak seams leading to failure of above material.
  - Unravelling of rock mass.

Rockfall Management

Local instability that generates rockfall shall be acceptable subject to consideration of the consequence of rockfall. Where the consequence is demonstrated to be unacceptable, rockfall management measures shall be adopted. This may include adoption of, but not limited to, one or a combination of the following:

- Rockfall catch ditch to capture rockfall debris. This may include rockfall arrest material (where required); or
- Removal of rock slope benches to control rockfall trajectory or enhance maintenance; or
- Crestal drainage; or
- Shotcrete application; or
- Rockfall protection mesh applied direct to the rock face; or
- Rock bolting; or
- Criteria for the cut face profile (eg to mitigate undulations that may generate adverse rockfall trajectory).

The choice of rockfall management mechanism or combination thereof, or its dimension will be a function of a variety of factors including, inter alia, the slope height, slope length, slope angle and the in-situ geological, geotechnical and drainage conditions.

Erosion

The cut slope design shall incorporate measures to mitigate erosion where required. This may include adoption of, but not limited to, one or a combination of the following:

- Revegetation of soil slopes; or
- Crestal drainage; or
- Shotcrete; or
- Soil nails; or
- Down slope drains/drop structures.

1.7.5. Cut Slope Protection and Stabilisation Measures

Subject to an appraisal of aggressivity class and the consequences of failure, in accordance with the NZTA Bridge Manual soil nails (not supporting bridges), rock bolts, rockfall protection mesh, shotcrete and other cut treatment measures shall be designed to corrosion Class 2 requirements.

1.7.6. Cut Slope Crest Treatment

The cut slope crest treatment shall be developed considering challenges of constructability and maintenance applicable to the prevailing local topography and acceptance of localised instability subject to acceptability of consequence.

1.8. Embankment Design

1.8.1. Embankment Design Philosophy

The following table defines the limit state criteria applicable to embankment design.

Table 10: Summary of limit state design criteria

Designation	Description	Limit State	Criteria#	Comment
Static	End of construction	SLS	[redacted]	Relevant for soft soil foundation and/or cohesive fills with potential for locked-in pore water pressures.
	Long Term	SLS		Effective stress parameters with design operating piezometric conditions
	Post liquefaction	ULS		Using post liquefied strength material parameter
Flooding	Flooding	SLS/ULS		
Seismic	Undamaged 1/25 year event	SLS		Using applicable design PGA
	Operational continuity 1/100 year event	SLS		Using applicable design PGA
	Embankment ≤ 6m high 1/500 year event	ULS		Using applicable design PGA
	Embankment ≥ 6m high 1/1000 year event	ULS		Using applicable design PGA
	Post Liquefaction	ULS		

[redacted]

1.8.2. Embankment Stability Assessment

1.5H:1V slope design commentary:

The road alignment design through the challenging topography of the TePuka and Horikiri valleys requires a 1.5H:1V embankment slope to be adopted. The design of these slopes, including the specification of material parameters, will be performed to satisfy the requirements of this design philosophy statement.

1.8.3. Peat Consolidation at Mackay's Crossing

The design of treatments for peat shall adopt post construction settlement limited to 100mm over 25 years.

1.8.4. Embankment Foundation Treatments

Embankment foundation treatments shall be incorporated into the project earthworks specification to cater for the variety of conditions expected to be encountered during construction. Embankment foundation treatments shall be designed and/or selected to ensure slope stability and settlement criteria are satisfied.

Embankment foundation treatments may include, but not be limited to, adoption of one or a combination of the following:

- Bridging – placing granular material to achieve mechanical interlock directly over the existing ground surface to provide a stable platform on which an earthworks layer can be constructed.
- Rip and Recompact
- Subsurface Drainage, including
    - Embankment Trench and Herringbone Drains; or
    - Cutting Transverse Drains; or
    - Gully Blanket Drains; or
    - Blanket Drains for Cuts
- Benching
- Undercut and Replace
- Shear Key
- Liquefaction Treatments
- Cut / Fill Transitions
- Shallow Embankment Treatment

1.9. Materials Reuse

The Geotechnical design report shall assess the material reuse for construction.

1.9.1. Material Suitability Assessment

A nomenclature shall be developed for consideration in the materials management. The following list presents the material sources assumed at tender:

- Type A – Regolith / Soil with sub groups
    - Type A1 Residual and Completely Weathered Torlesse, including residually to Completely Weathered Conglomerate.
    - Type A2 Granular Alluvium and Colluvium Sourced Materials
- Type B Highly Weathered Torlesse.
- Type C Moderately Weathered Torlesse.
- Type D Slightly Weathered to Fresh Torlesse.
- Type E Fault Crush Material.
- Type F Highly Weathered to Moderately Weathered Conglomerate.
- Type G Slightly Weathered to Fresh Conglomerate.
- Type H Unsuitable Material.

The suitability of materials for reuse shall be developed from that assumed at tender as presented at **Table 11**.

Table 11: Material Suitability Assessment

Material Type	Suitable	Probable	Remarks
Type A1	General Fill		
Type A2	General Fill Bridging	CBR > 10% Subgrade Drainage Material (with processing)	Grading will vary significantly from poorly graded to well graded. Processing may include extracting gravels or blending
Type B	General Fill RSE Fill CBR > 10% Subgrade	Shear Key	
Type C	CBR > 10% Subgrade RSE Fill Bridging Layer Shear Key	MSE Fill	Proportion of Sandstone and Mudstone will affect proposed uses. High proportion of argillite will reduce product quality for reuse
Type D	Rockfill Sub-base (Sandstone) CBR > 10% Subgrade Drainage Material Gabion Rock MSE Fill	Base (Sandstone) Shear Key Scour protection	Argillite may need to be sorted out Wet / Dry strength to be checked
Type E	General Fill	Shear Key CBR > 10% Subgrade	Will likely have high moisture content given groundwater levels at faults May include some Type H
Type F	General Fill Shear Key	CBR > 10% Subgrade	
Type G	General Fill Shear Key MSE Fill CBR > 10% Subgrade		
Type H	Unsuitable	General Fill	Loess may be useable though silt is sensitive Wet material will likely be majority of Type H. May be able to reuse if dried back or lime treated

1.9.2. Earthworks Specification

The designer shall be involved in the development of a method specification that is suitable for construction.

1.10. Geotechnics for Structures

Geotechnical elements associated with structures, including bridges, shall be designed in accordance with the NZTA Bridge Manual.

1.10.1. Mechanically Stabilised Earth (MSE) Bridge Abutment Walls

Design Philosophy

The MSE wall bridge abutments shall be designed in accordance with the requirements of the NZTA Bridge Manual. **Figure 7** presents the design philosophy to be adopted for MSE bridge abutment walls to satisfy the Bridge Manual requirements.

Permanent displacements will be estimated using a single method, for example Jibson (2007) or other methods approved by the NZTA Bridge Manual.

Ultimate Limit State (ULS)

Under ULS seismic loading Clause 6.6.9.b of NZTA Bridge Manual stipulates maximum permanent displacements for retaining structures to be vertical displacement shall not exceed 40mm and longitudinal and transverse horizontal displacements shall not exceed 100mm.

The seismic earth pressure increments may be estimated using the Mononobe-Okabe method (as per Section 3.5.3 of the RRU Bulletin 1990) as the displacement estimation for ULS seismic events indicate displacements sufficiently high for the wall to be considered flexible.

Design Method

The basic design methodology will use static and pseudo-static limit equilibrium methods to ensure an adequate FOS against a range of failure modes. Where the FOS is below acceptable levels, displacement shall be assessed and confirmed as acceptable.

1.11. Geohazard Mitigation

The geotechnical design solution shall consider mitigation of geohazards in accordance with the NZTA Bridge Manual.

1.11.1. Landslides and Debris Flows

Engineering mitigation details

Engineering mitigation measures for unacceptable landslides and debris flow risk may include, but not be limited to, adoption of one or a combination of the following:

- Establishment of Vegetation
- Culverts
- Drainage measures
- Debris Catch Ditch / Niche
- Diversion Channels and Deflection Berms
- Debris Catch Fences
- Debris Deflection Fence (at road verge/cut toe)

1.11.2. Earthquake Effects

The design for earthquakes effects shall be performed in accordance with the NZTA Bridge Manual adopting the site specific seismic study provided by GNS.

1.11.3. Liquefaction

Design for liquefaction shall be performed in accordance with the requirements of the NZTA Bridge Manual.

Liquefaction Design treatment

Areas of potential liquefaction shall be assessed to satisfy the following limit states:

- **ULS PGA response at Peak Strength** (Pre liquefaction behaviour) – Assess critical acceleration and ensure deformation satisfies < 150mm displacement.
- **Static Stability at Post Liquefaction strength** (post liquefaction stability) – Using post liquefaction strength confirm FOS>1.1.

The post liquefied strength may be determined adopting methods published by Robinson and Stark considering a range of strengths assessed.

1.12. Geotechnical Monitoring

1.12.1. Observational Methods and Instrumentation

The detailed design of geotechnical elements shall consider a monitoring regime, where applicable, that shall be developed to define:

- Where and for what purpose monitoring is required
- Purpose of monitoring
- Role and responsibilities
- Monitoring triggers (where applicable)
- Reporting requirements
- Relationship with construction plans (where applicable)

Monitoring Instrumentation may include, but not be limited to, adoption of one or a combination of the following:

- Settlement Plates
- Inclinometer
- Vibrating Wire Piezometer (VWP)
- Standpipe
- Extensometer
- Survey Markers
- Settlement Plates

1.13. Risk and Opportunity

The Geotechnical Design report shall present key risks and opportunities considered in design including those required to be considered during construction and future operation and maintenance of the alignment.

1.14. Detailed Design Stage

1.14.1. Site Investigations Scope

The detailed design shall include supplementary investigation scope, including laboratory testing, to inform the development of the geotechnical model from that presented within the Preliminary Geotechnical design report.

Appendix 6: Pavement Design Philosophy Statement

See document #16619067, entitled “Pavement and Surfacing Design Philosophy Statement”.

Design Philosophy Statement Pavements and Surfacings

Revision E

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Table of Contents

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1. Introduction

1.1. Specific Technical Response

The Specific Technical Response with Respect to Pavements and Surfacings requires a design philosophy statement.

1.2. Pavement Types

The philosophy used in the offered pavement design has been to make use of locally available materials to provide robust pavements that will be tolerant of traffic loadings and of moisture.

Following consideration of flexible and rigid pavement options after consideration of the TG operating requirements and lessons learned from similar projects in New Zealand, and after careful analysis by the WGP D&C and O&M teams the designs selected include:

- Main alignment, Kenepuru Link Road and SH1 (at Kenepuru and MacKays):
  - Cement modified NZTA M/4 basecourse over a cement or cement and lime modified GAP65 subbase with a chipseal surfacing (OGPA in southern section at Kenepuru and SMA in Kenepuru Link Road);
- Interchanges:
  - Structural asphalt over a cement bound GAP65 subbase with an SMA surfacing; and
- Access Roads:
  - Unbound granular pavement with chipseal surfacing.

The pavement designs include three pavement types and four surfacings, with an additional four surfacing treatments for the bridges. There are a total of seven surfacing/pavement combinations (excluding the bridge surfacing treatments).

1.3. Adopted Design Standards

The design for the pavements and surfacings will be undertaken in accordance with the following documents:

- Austroads Pavement Design Guide (APDG) 2004 and the NZ Supplement (2007)
- NZTA specification T/10: 2013
  - State highway skid resistance management, and where applicable,
- Porirua City Council (PCC)
  - Code of Land Development and Subdivision Engineering.
- Kapiti Coast District Council (KCDC)
  - Subdivision and Development Principles and Requirements.

1.4. Pavement Design Criteria

All designs will be developed with focus on performance, constructability, whole-of-life, and value for money. Pavement performance will be optimised not only by the design methodology, but by also ensuring the design assumptions and parameters are achieved during construction.

The main alignment and ramp pavements will be designed for a minimum 25 year life. The interchange pavements will be designed for a minimum 40 year life.

All surfacings will be designed to ensure full compliance with the service requirements of Schedule 12 of the RFP.

Pavement design and construction for the local road tie-ins will comply with PCC or KCDC (as appropriate) requirements.

A design reliability factor of 95% will be used for all pavements.

2. Design Loadings

2.1. Traffic Modelling

The traffic volume information used for calculation of the design traffic loadings was adapted from a combination of:

- Traffic modelling report '20130513 Traffic Modelling Report, Rev. D 29/5/2013'.
- Allowance for High Productivity Motor Vehicles.

2.2. Traffic Loadings

The presumptive axle groups per heavy vehicle and ESA per axle groups from the 2007 NZ Supplement have been used to calculate Design Equivalent Standard Axle (DESA) and Design Standard Axle Repetitions (DSAR).

Table 1 below gives the minimum DESA and highest cumulative damage factor for design of each of the road sections.

Table 1: Traffic Loading

Section of Highway	Traffic Loading (DESA per lane)	Highest Cumulative Damage Factor to be Not Greater Than
Transmission Gully		
MacKays Interchange	22.2×10^6	0.50
MacKays to SH58	22.2×10^6	0.60
SH58 Interchange	27.2×10^6	0.80
SH58 to James Cook	19.9×10^6	0.60
James Cook Interchange	13.4×10^6	0.40
James Cook to Kenepuru	17.7×10^6	0.50
Kenepuru Interchange	15.9×10^6	0.40
Kenepuru Link Road	8.8×10^6	1.00
Existing SH1		
SH1 – South of MacKays Interchange – Link to Coastal Route	10.6×10^6	0.30
SH1 – South of Kenepuru	37.9×10^6	0.40

SH1 – North of Kenepuru	25.1×10^6	0.70
Access Roads		
Van Cruchten	4.6×10^6	1.00
Flighty	4.6×10^6	1.00
Other	4.6×10^6	1.00

Note: The DESA per lane values and the Highest Cumulative Damage Factors in the above table are exclusive of any allowance for construction phase trafficking where the pavement is used as a haul road and/or for construction traffic.

3. Geotechnical Information

3.1. Subgrade Characterisation

It is acknowledged that subgrade conditions are variable along the main alignment and the soil characteristics range from competent greywackes, through moderate to high strength weathered greywackes, to relatively low strength completely weathered greywackes and residual soils.

Any zones with completely weathered greywacke or residual soils will be undercut and replaced with competent subgrade material similar to that used in the engineered fills. The subgrade fill material and improvement layers will be tested and controlled to ensure compliance with the requirements of the earthworks management and pavement design specifications.

Earthworks methodologies will be developed with ground improvement treatments to provide a robust, durable, and stable working platform of California Bearing Ratio (CBR) 10% for construction of the overlying pavement layers.

Fills will be constructed from selected subgrade material and will be monitored for settlement for the required period to avoid any differential settlement at the interface with cuttings and bridge abutments.

4. Pavement Materials and Properties

4.1. Pavement for Mainline Carriageways

The mainline carriageway pavement treatment applies to the Transmission Gully (TG) mainline, interchange ramps, SH58, Kenepuru Link Road, the existing SH1 (at the Kenepuru and MacKays interchanges) and the general area of the weigh facilities.

Based on the analysis of the various pavement options, the Cement Modified Basecourse (CMB) over Cement or Cement and Lime Modified Subbase (CMSB) option was considered to be the optimal solution. This option gave the lowest whole-of-life cost while providing a robust and durable pavement with acceptable maintenance requirements. The integrity of the modified basecourse and subbase layers will be supported through the construction of a robust subgrade formation. This will be achieved by providing well controlled fill layers and working platforms which will reduce the strains experienced by the modified subbase and modified basecourse layers.

Modification of the basecourse and subbase layers will also reduce the sensitivity of the material to moisture variations, resulting in lower maintenance requirements to that of an unbound pavement. Prime and membrane seals will be provided where OGPA and SMA surfacings are required, to ensure that water does not penetrate into the CMB layer. Polymer Modified Binder (PMB) and Polymer Modified Emulsion (PME) have also been specified for surfacings in areas of high stress to provide greater resilience and durability.

4.2. Pavement for Interchanges

Based on the analysis of the various pavement options, the Structural Asphaltic Concrete (SAC) over Cement Bound Subbase (CBSB) option was considered to be the optimal solution for the SH58, James Cook, and Kenepuru Interchanges. This option gave the lowest whole-of-life cost while providing a robust and durable pavement with very low maintenance requirements. The integrity of the cement bound subbase layer will be supported through the construction of a robust subgrade formation. This will be achieved by providing well controlled fill layers and working platforms which will reduce the strains experienced by both the cement bound subbase and structural asphalt layers. Heavy cementing (≥ 4.0%) of the subbase layer will also reduce the sensitivity of the material to erosion and to moisture variations while taking full advantage of the CBR ≥ 10% subgrade, and will provide a robust anvil for construction of the overlaying SAC layers.

A Stress Alleviating Membrane Interlayer (SAMI) will be provided to reduce the risk of any cracking, which may develop in the CBSB, from migrating through the AC10HF asphalt layer. The SAMI will also add extra moisture protection for the CBSB.

The combined thickness of the structural asphalt layers will be at least 130mm.

4.3. Pavement for Local Access Roads

The pavement design for the local access roads will be carried out in accordance with the Porirua City or Kapiti Coast District Councils' standards, whichever is applicable. Designs will be carried out as per the Austroads Pavement Design Guide (2004) and the New Zealand Supplement (2007).

The pavement type will comprise an unbound Wellington Regional M/4 basecourse and an unbound AP65 subbase over a subgrade of CBR ≥ 10. The surfacing will be a chipseal, with a two coat first coat seal.

4.4. Pavement Layers

4.4.1. Modified Aggregates

Modified subbase and basecourse will be used for the main alignment, ramps, and the Kenepuru Link Road. The basecourse to be modified will comply with NZTA specification M/4: 2006, Table 4, Wellington Greywacke, AP40. Modification of the basecourse will be by cement stabilisation. Modification of the GAP65 (Type 1) subbase will be by cement stabilisation or by cement and lime stabilisation.

4.4.2. Bound Subbase

A cement bound subbase (CBSB) will be used beneath the structural asphalt on the interchanges. The aggregate for the CBSB will comply with NZTA specification M/4: 2006 Table 4, Wellington Greywacke, except the particle size distribution will be as per the AUS2 specification for a GAP65 material. Construction of the bound subbase will be in accordance with the NZTA B/6 or B/8 specifications as appropriate (if B/8 the bound subbase to be constructed in one lift).

4.4.3. Structural Asphalt

The structural asphalt (SAC) for the interchanges will comprise polymer modified asphaltic concrete. The SAC will use mix designs that have been developed by Higgins for use in the Auckland Motorways. From extensive laboratory and field testing elastic moduli of 2000MPa and 1500MPa, when corrected for temperature and voids and to 10km/h design traffic speed for the interchange areas, is considered appropriate for this application for the AC14 and AC10 mixes respectively.

The dense graded asphaltic concrete and the SMA will comply with the draft NZTA M/10: 2013 specification and subsequent amendments.

Polymer modified binder will be specified for both intermediate and base layers to provide durability and superior resistance to both rutting and reflective cracking from the underlying cemented subbase layer. The base layer of the SAC will be designed as a high binder mix to provide further reflective crack resistance, ie one of the design functions of the AC10HF is to act as a SAMI layer.

4.4.4. Surfacings

Surfacings for the main alignment and ramps will be prime then three-coat chip seals. Polymer modified binders will be used in the three-coat chip seals where grades are ≥ 5% and on the ramps. Polymer modified OGPA will be paved on top of the chip seals for the main alignment south of chainage 25,500.

Polymer modified SMA10 will be paved on top of the chip seals in areas where road noise suppression is required and the surfacing is subject to high traffic stresses, such as the interchanges and parts of the Kenepuru Link Road.

PSV requirements for all pavements (state highways and local roads) will be calculated using the NZTA T/10:2013 specification and will meet the criteria in Schedule II of the RFP.

A bitumen emulsion trackless tack coat will be specified on the finished concrete bridge decks. The bitumen emulsion prevents delamination of the overlying asphalt and chipseal layers by creating an effective bond with the unpolished concrete deck surface (where no curing compound has been used).

A polymer modified OGPA surfacing will be used on the southern section of the main alignment and the existing SH1 at Kenepuru.

A polymer modified SMA10 surfacing will be used on the interchanges and Kenepuru Link Road.

4.4.5. Maximum Properties for Analysis

The values used in CIRCLY will not exceed those in Table 2 below.

Table 2: Maximum Moduli and Performance Constants for Design

Material	Maximum Moduli	Maximum Performance Constant	Performance Exponent
Modified basecourse	600 MPa vertical modulus, anisotropic and sublayered.		
PMB OGPA	500 MPa, isotropic		
PMB SMA	1,500 MPa(1), isotropic	0.0063(1)	5th power
Cement Bound Subbase (CBSB)	≤ 3,500 MPa	From Austroads 2004 Section 6.4.5 for modulus up to 3,500 MPa	12th power

Subgrade CBR ≥ 10 but less than 15	100 MPa		
Subgrade CBR ≥ 15	150 MPa		

Note:

1) Values shown are default values. These values may be revised with results obtained from laboratory testing and the performance constant shall be derived in accordance with Austroads.
2) No values are shown for the AC14 and AC10HF. At detailed design laboratory tests on these asphalts coupled with Austroads 2004 will provide moduli. Then the fatigue performance constants will be calculated using Austroads 2004, equation 6.8.

5. Design Life and Maintenance Considerations

5.1. Design Life

The adopted design lives for the TG pavements will be 25 years for the main alignment and 40 years for the interchanges.

5.2. Whole of Life Considerations

Pavement deterioration and the associated maintenance requirements for each of the pavement treatment options were determined using the HDM4 pavement performance modelling program.

5.3. Other Maintenance Considerations

In the event of an earthquake the adopted mainline pavement could be repaired quickly using bitumen treated sand re-levelling and resurfacing.

6. Subsurface Drainage

Pavement drainage will be achieved by installing longitudinal subsoil drains at the edge of the pavement on each side of the carriageway and in the central median for the full extents of the project.

There are areas, particularly cuttings, where supplementary subsurface drainage devices will be provided to prevent water infiltration into the pavement. The drainage devices will include herringbone trench drains and a drainage blanket.

Boxed construction is proposed for most of the pavements. Recognising the cautions of Austroads 2004, subgrade design will be based on soaked specimens.

7. Quality Assurance Testing

An extensive and thorough testing schedule will be developed along with material specifications to provide a high level of quality assurance in the source and production properties of the materials utilised in the pavement and founding layers. The material specifications and testing schedule will also ensure a high level of control is exercised in the processing and placement of those materials. The testing schedule and specification are provided in **Attachment 8c** and **Attachment 8d**.

Attachments

8c – Schedule of Testing

8d – Specification

Attachment 8c – Schedule of Testing

Pavement Layer	Test Frequency
Subgrade	
Subgrade - In-situ Clays/Silts/Sands	
Materials Testing (NZS 4407)	
Soaked CBR (Lab)	1/3000m2
Construction Control Testing (applicable NZTA specification)	
Scala	1/20m of each traffic lane and shoulder
Proof Roll	100% area
Benkleman Beam (where feasible and Scala inferred CBR ≥ 10%)	1/20 m each traffic lane and shoulder, alternating wheel paths
Surface shape	1/20m
Subgrade - In-situ Granular Material (rip & recompacted rock or working platform)	
Materials Testing (NZS 4407)	
Soaked CBR (Lab)	1/3000m2
Particle Size Distribution[(1)]	1/3000m2
Sand Equivalent[(1)]	1/3000m2
Construction Control Testing (applicable NZTA specification)	
Proof Roll	100% area
Benkleman Beam	1/20 m each traffic lane and shoulder, alternating wheel paths
OWC / MDD to determine target density	3 initially (with at least 1/stockpile), then 1/5000m2
NDM Density (NZS 4402)	5/1000m2
Plateau Density	1/10000m2 and for any visible change in material
Surface shape	1/20m
Stabilised Subgrade	
Materials Testing (NZS 4407)	
Soaked CBR (Lab)	5 per material/additive combination initially, then 1/3000m2 from behind the hoe samples
OWC / MDD to determine target density	3 per material/additive combination initially, then 1/5000m2 from behind the hoe samples
Construction Control Testing (applicable NZTA specification)	
Benkelman Beam	1/20 m each traffic lane and shoulder, alternating wheel paths
Proof Roll	100% area
NDM Density (NZS 4402)	5/1000m2
Scala	1/20m of each traffic lane and shoulder
Surface shape	1/20m
Granular Fill (top 1m beneath pavement)	
Materials Testing (NZS 4407)	
Crushing Resistance	1/10000m3
Weathering Quality Index	1/10000m3
Soaked CBR	1/10000m3
Particle Size Distribution[(1)]	1/5000m3
Sand Equivalent[(1)]	1/5000m3
Clay Index[(1)]	1/5000m3
Permeability	1/5000m3
OWC / MDD to determine target density	3 initially (with at least 1/stockpile), then 1/5000m2
Construction Control Testing (applicable NZTA specification)	
Proof Roll	100% area
Benkleman Beam	1/20 m each traffic lane and shoulder, alternating wheel paths
NDM Density (NZS 4402)	5/1000m2
Plateau Density	1/10000m2 and for any visible change in material
Surface shape	1/20m

Pavement Layer	Test Frequency
Unbound Subbase	
Materials Testing (NZS 4402 & 4407)	
Crushing Resistance	1/10000m3
Weathering Quality Index (or LA Abrasion [ASTM 535-09])	1/10000m3
Soaked CBR	1/10000m3
Particle Size Distribution	1/1000m3
Sand Equivalent	1/1000m3
Clay Index	1/1000m3
Permeability	1/1000m3
Broken Faces (where appropriate)	1/1000m3
OWC / MDD to determine target density	3 initially (with at least 1/stockpile), then 1/1000m3
Solid Density	1/aggregate variation
Construction Control Testing (applicable NZTA specification)	
Benkelman Beam	1/20 m each traffic lane and shoulder, alternating wheel paths
Proof Roll	100% area
NDM Density (NZS 4402)	1/20 m each traffic lane and shoulder, alternating wheel paths
Plateau Density	1/10000m2 and for any visible change in material
Layer thickness	1/20m
Surface shape	1/20m
Modified Subbase / Bound Subbase	
Materials Testing (NZS 4402 & 4407)	
Crushing Resistance	1/10000m3
Weathering Quality Index (or LA Abrasion [ASTM 535-09])	1/10000m3
Soaked CBR	1/10000m3
Particle Size Distribution	1/1000m3
Sand Equivalent	1/1000m3
Clay Index	1/1000m3
Permeability (where appropriate)	1/1000m3
Broken Faces (where appropriate)	1/1000m3
Mix Design ITS (NZS 4402)	6 per stockpile, then 1 ITS test per day of stabilisation from behind the hoe samples
Mix Design UCS (NZS 4402)	1 per stockpile, then 1 UCS test for every 6 ITS tests from behind the hoe samples
Repeat Load Triaxial (RLT) (NZTA T/15)[(1)]	3
Fatigue Beams (Austroads (2008))[(1)]	3
OWC / MDD to determine target density	3 initially (with at least 1/stockpile), then 1/1000m3 (needs to cover all material variations)
Solid Density (behind the hoe sample)	3 initially (with at least 1/stockpile), then 1/5000m2 (needs to cover all material variations)
Construction Control Testing (applicable NZTA specification)	
Benkelman Beam	1/20 m each traffic lane and shoulder, alternating wheel paths
Proof Roll	100% area
NDM Density (NZS 4402)	1/20 m each traffic lane and shoulder, alternating wheel paths
Plateau Density	1/10000m2 and for any visible change in material
Layer thickness	1/20m
Surface shape	1/20m
Cement Modified Base	
Materials Testing (NZS 4402 & 4407)	
Crushing Resistance	1/10000m3
Weathering Quality Index	1/10000m3
Soaked CBR	1/10000m3
Particle Size Distribution	1/1000m3
Sand Equivalent	1/1000m3
Clay Index	1/1000m3
Broken Faces (where appropriate)	1/1000m3
Mix Design ITS (NZS 4402)	6 per stockpile, then 1 ITS test per day of stabilisation from behind the hoe samples
Mix Design UCS (NZS 4402)	1 per stockpile, then 1 UCS test for every 6 ITS tests from behind the hoe samples
Repeat Load Triaxial (RLT) (NZTA T/15)[(1)]	3
Fatigue Beams (Austroads (2008))[(1)]	3
OWC / MDD to determine target density	3 initially (with at least 1/stockpile), then 1/1000m3 (needs to cover all material variations)
Solid Density (behind the hoe sample)	3 initially (with at least 1/stockpile), then 1/5000m2 (needs to cover all material variations)
Construction Control Testing (applicable NZTA specification)	
Additive dosage checks, stab layer checks etc	Refer NZTA B/5 Spec
Benkelman Beam	1/20 m each traffic lane and shoulder, alternating wheel paths
Proof Roll	100% area
NDM Density (NZS 4402)	1/20 m each traffic lane and shoulder, alternating wheel paths
Plateau Density	1/10000m2 and for any visible change in material
Presealing degree of saturation (NDM)	1/20 m each traffic lane and shoulder, alternating wheel paths
Surface shape	100% of area
NAASRA roughness (before sealing)	each traffic lane and shoulder
Layer thickness	1/20m
Surface shape	1/20m

Pavement Layer	Test Frequency
Chipseal Wearing Courses	
Binder	Refer NZTA M/1 Spec
Sealing Chip	Refer NZTA M/6 Spec
Adhesion Agents	Refer NZTA M/13 Spec
Design	Refer Chipsealing in New Zealand manual
Construction	Refer TNZ P/3 Spec
NAASRA Roughness (excluding bridges)	each traffic lane and shoulder
Structural AC Mixes	
AC10HF	
As per NZTA M/10: 2013 (and subsequent amendments)	See NZTA M/10: 2013 (and subsequent amendments)
Refusal density of high fatigue mixes	1/mix design
Matta ITS test	each mix type
Fatigue beams (only required if CBSB post-cracking life considered)	1/mix design
AC14	
As per NZTA M/10: 2013 (and subsequent amendments)	See NZTA M/10: 2013 (and subsequent amendments)
Refusal density of all structural mixes	1/mix design
Wheel track testing of all structural mixes	1/mix design
Matta ITS test on all structural mixes	1/mix design
NAASRA Roughness	each traffic lane and shoulder
Fatigue beams (only required if CBSB post-cracking life considered)	1/mix design
AC Wearing Courses	
SMA / AC14	
As per NZTA M/10: 2013 (and subsequent amendments)	See NZTA M/10: 2013 (and subsequent amendments)
Refusal density on AC14 wearing courses	1/mix design
Matta ITS test on all SMA and AC14 surface mixes	1/mix design
Wheel track testing of all SMA and AC14 surface mixes	1/mix design
Surface shape	1/20m
Surface texture	each traffic lane
FWD	1/20m each traffic lane and shoulder, alternating wheel tracks
NAASRA Roughness (excluding bridges)	each traffic lane and shoulder
OGPA	
As per Transit NZ P/11	See NZTA P/11
Surface shape	1/20m
Surface texture	each traffic lane
FWD	1/20m each traffic lane and shoulder, alternating wheel tracks
NAASRA Roughness (excluding bridges)	each traffic lane and shoulder
Main Alignment Trial Pavement	
Three 50m trial pavement sections of Treatment M1a utilising varying additive dosages in the granular subbase and basecourse layers. - To be trafficked by construction traffic - Shall not form part of the final subbase or basecourse layers for the main alignment	
<u>Testing required:</u>	
Benkelman Beam	1/10m alternating wheel paths
Cores	1/10m
NDM Density	1/10m
Trenches	2/trial pavement section

<u>Note:</u>

1) Items to be confirmed in detailed design stage.

Attachment 8d – Specification

Pavement Layer	Specification Requirement
Earthworks	
Constructed in accordance with the requirements of NZTA F/1 and TG Testing Schedule - where applicable to formation subgrade preparation prior to pavement works - refer to foundation treatment specification for subgrade formation requirements	Refer NZTA F/1 specification
Benkelman Beam target deflections on prepared subgrade formation layer: - Treatment M1 (a, b, c & d), M2 & M3	1.0mm / 1.3mm (90th percentile / Maximum)[1]
Unbound Subbase	
GAP 65 (Type 1)[2] Particle Size Distribution	See grading table GAP 65 (Type 1) below
Crushing Resistance	100kN min
Weathering Resistance	CA or better
Sand Equivalent	25 min
GAP 65 (Type 2)	Refer NZTA M/4 Regional Wellington Greywacke specification with the following grading: see grading table GAP 65 (Type 2) below
Constructed in accordance with the requirements of NZTA B/2 and TG Testing Schedule	Refer NZTA B/2
Benkelman Beam target deflections on prepared unbound subbase layer: - Treatment M3	0.9mm / 1.1mm (90th percentile / Maximum)[1]
Modified Subbase / Bound Subbase	
Constructed in accordance with the requirements of NZTA B/5 and TG Testing Schedule	Refer NZTA B/5 specification
Benkelman target deflections on prepared modified/bound subbase layer: - Treatment M1 (a, b, c & d) - Treatment M2	 0.9mm / 1.1mm (90th percentile / Maximum)[1] 0.6mm / 0.8mm (90th percentile / Maximum)[1]

GAP 65 (Type 1) grading:

Test Sieve Aperture (mm)	Percentage Passing
65	100
37 5	80 - 90
19 0	50 - 70
9.5	30 - 55
4.75	20 - 40
2 38	15 - 30
1.18	10 - 22
0.600	6 - 18
0.300	4 - 14
0.150	2 - 10
0.075	0 - 7

GAP 65 (Type 2) grading:

Test Sieve Aperture (mm)	Percentage Passing
65	100
37.5	80 - 90
19.0	52 - 65
9.5	32 - 48
4.75	20 - 35
2.38	12 - 25
1.18	7 - 18
0.300	3 - 10
0.075	1 - 5

Pavement Layer	Specification Requirement
Unbound Basecourse	
NZTA M/4 AP40	Refer NZTA M/4 Regional Wellington Greywacke specification
Constructed in accordance with the requirements of NZTA B/2 and TG Testing Schedule	Refer NZTA B/2 specification
Benkelman Beam target deflections on unbound basecourse layer: - Treatment M3	 0.8mm / 1.0mm (90th percentile / Maximum)( )
Cement Modified Base	
Constructed in accordance with the requirements of NZTA B/5 and TG Testing Schedule	Refer NZTA B/5 specification
Benkelman target deflections on prepared modified basecourse layer: - Treatment M1 (a, b, c & d)	 0.7mm / 0.9mm (90th percentile / Maximum)( )
Chipseal Wearing Courses	
Binder Sealing Chip Adhesion Agents Design Construction NAASRA Roughness (excluding bridges)	Refer NZTA M/1 specification Refer NZTA M/6 specification Refer NZTA M/13 specification Refer Chipsealing in New Zealand manual Refer TNZ P/3 specification ≤ 60 NAASRA (each traffic lane and shoulder)
Structural AC Mixes	
Designed and constructed in accordance with the requirements of NZTA M/10: 2013 (and subsequent amendments) and TG Testing Schedule	Refer NZTA M/10: 2013 (and subsequent amendments)
AC Wearing Courses	
SMA / AC14 As per NZTA M/10: 2013 (and subsequent amendments) NAASRA Roughness (excluding bridges)	 Refer NZTA M/10: 2013 (and subsequent amendments) ≤ 50 NAASRA (each traffic lane and shoulder)
OGPA As per Transit NZ P/11 NAASRA Roughness (excluding bridges)	 Refer NZTA P/11 specification ≤ 50 NAASRA (each traffic lane and shoulder)

Note:

1) Deflection targets to be finalised at the detailed design stage.
2) A GAP65 aggregate that does not comply with the GAP65 (Type 1) specification will be deemed acceptable where the Sand Equivalent is greater than 20, and Repeat Load Triaxial testing on the modified material as specified in NZTA T/15:2013 confirms that the resilient modulus, measured in the wet and dry, is at least 40% greater than the design modulus and confirms an appropriate rut resistance.

Appendix 7: Bridge Schedule

The location coordinates and the length dimension values provided below are indicative and may be subjected to a reasonable amount of change during the development of the detailed design without a Non-Material Change or a Change first being required to be approved by the Transport Agency.

Bridge	Bridge Northing (m) *(bridge centre)*	Bridge Easting (m) *(bridge centre)*	Obstacle Crossed	WGP Design	Spans	Minimum internal dimensions (m) for underpasses	Length (m) *(back of abutment to back of abutment)*	Width (m) *(overall width to outside face of barriers)*
1A	5462778	1766916	Northbound entrance ramp over NIMT rail line	[redacted]	1		16.6	16.0
1B	5462638	1766803	Northbound entrance ramp over stream	[redacted]	n/a		8.8	12.0
2	5461285	1765710	TG over local road	[redacted]	1		18.0	26.6
3	5460690	1765354	TG over stream	[redacted]	1		57.5	26.1
4	5455086	1764159	TG over Horokiri stream	[redacted]	1		22.0	25.0
5	5454326	1764118	TG over vehicle access	[redacted]	1	5.0m high x 6.0m wide		27.6
6	5453906	1764009	TG over stream	[redacted]	1		27.0	25.0
7	5453216	1763687	TG over vehicle access	[redacted]	1	5.0m high x 5.0m wide		28.1
8	5452025	1763254	TG over Horokiri stream & 2 vehicle access tracks	[redacted]	1		32.0	24.0
9			Farm access over Horokiri stream	[redacted]	1		10.0	7.5
10	5451225	1763147	TG over vehicle access	[redacted]	1	3.0m high x 3.0m wide		30.0

Bridge	Bridge Northing (m) *(bridge centre)*	Bridge Easting (m) *(bridge centre)*	Obstacle Crossed	WGP Design	Spans	Minimum internal dimensions (m) for underpasses	Length (m) *(back of abutment to back of abutment)*	Width (m) *(overall width to outside face of barriers)*
11	5451030	1763147	TG over vehicle access	[redacted]	1	5.0m high x 6.0m wide		27.6
12	5449692	1762742	TG over vehicle access	[redacted]	1	5.0m high x 6.0m wide		28.7
13	5446957	1761051	TG over SH58	[redacted]	1		37.0	26.0
13A				[redacted]				
14	5446876	1760930	Northbound exit Ramp over stream	[redacted]	1		32.0	7.6
14A	5446821	1761000	Southbound entrance Ramp over stream	[redacted]	1		32.0	7.7
15	5446851	1760962	TG over stream	[redacted]	1		32.0	26.0
16	5444828	1759501	Link road over TG	[redacted]	1		32.0	16.0
17	5443654	1758788	TG over stream	[redacted]	1		12.0	88.1
17A				[redacted]				
18	5443475	1758587	TG over stream	[redacted]	1		12.0	117.5
18A	5443552	1758664	TG over access track	[redacted]	1	5.0m high x 5.0m wide		29.6
19	5442655	1758029	TG over stream	[redacted]	2		152.0	25.0

Bridge	Bridge Northing (m) *(bridge centre)*	Bridge Easting (m) *(bridge centre)*	Obstacle Crossed	WGP Design	Spans	Minimum internal dimensions (m) for underpasses	Length (m) *(back of abutment to back of abutment)*	Width (m) *(overall width to outside face of barriers)*
20	5442303	1757303	TG over Cannons Creek	[redacted]	3		249.0	24.4
21			TG over stream	[redacted]	n/a		n/a	n/a
22			TG over stream	[redacted]	n/a		n/a	n/a
23				[redacted]				
24	5442737	1754706	TG over Kenepuru Link Road	[redacted]	1		29.0	25.0
25	5442449	1754353	TG northbound link over SH1	[redacted]	4		132.0	14.7
26	5441963	1754136	TG/SH1 over Collins Ave	[redacted]	1		28.4	36.0
27	5442925	1754477	Kenepuru Link Road over SH1	[redacted]	4		132.0	12.9
28	5443112	1754500	Kenepuru Link Road over stream and NIMT rail line	[redacted]	2		76.0	13.9

Appendix 8: Utility mitigation measures

The following measures are proposed by the Contractor based on the preliminary design submitted as part of the [redacted]. Instances may arise however where Design Development necessitates amendments to these measures. It is also recognised that the final measures implemented are subject to consultation with utility owners and the Transport Agency and that these consultations and agreements may also lead to amendments to these measures.

Vector Gas

Table 1 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1a	Ch 0000	ALL-UT-1002	Vector Gas 1a Approximately 170m of the DN200/100 line is affected. The northbound entry Ramp to SH1 crosses the DN200/100 line north of Ch 0000, with maximum of 4m of fill. ***Proposal:*** *This is a non motorway entry ramp and maintenance access can be provided within the shoulder. FEED to determine mitigation measures for this pipeline.*
1b	Ch 1200-1550	ALL-UT-1005	Vector Gas 1b Approximately 400m of DN200/100Line is affected. TG Main Alignment crosses the DN200/100Line at Ch 1200 with approx. 1 to 3m of fill and the realigned 'old' SH1 crosses the DN200/100Line from Ch1120 to Ch1470 at an oblique angle with minimal cut or fill. ***Proposal****: Realignment of the pipeline along the western boundary of the proposed SH1, from the existing 30 degree (to perpendicular) crossing of TG Main Alignment at Ch1200, and a tie-in to the existing pipeline at Ch1470.*
2a	Ch 11500-11600	ALL-UT-1026	Vector Gas 2a A total of approximately 60m of the DN300/605Line is affected. The batter cross the DN300/605Line from Ch 11520 to 11580 with a deep fill. ***Proposal****: Realignment approximately 80 LM along the western boundary of the Designation, away from the batter zones'.*
2b	Ch 11820	ALL-UT-1026	Vector (gas) 2b Total of 25 LM of pipeline conflicts with the alignment. FEED to determine mitigation measures.
3a	Ch 12820	ALL-UT-1028	Vector Gas 3a A total of approximately 80 LM of the DN300/605Line is affected with the TG Main Alignment crossing at an oblique angle with maximum of 8m of fill. ***Proposal****:* FEED to determine mitigation measures.

Zone	Chainage	Sheet	Impact & Proposal
3b	Ch 13340-13440	ALL-UT-1029	Vector Gas 3b A total of approximately 120 m of the DN300/605Line is affected with the TG Main Alignment crossing at an oblique angle at Ch 13370. ***Proposal****: Realignment (150LM) with a perpendicular crossing at approx. Ch 13380 in an area of moderate fill and join to existing within designation.*
4	Ch 14700-14900	ALL-UT-1032	Vector Gas 4 A total of approximately 150m of the DN300/605 Line crosses under the TG Main Alignment at an oblique angle from Ch 14730 to Ch 14860 with a deep fill. ***Proposal****: Realignment near or along the western boundary of the designation, with a perpendicular crossing of TG Main Alignment at approx. Ch 14850.*
5	Ch 15900-15960	ALL-UT-1034	Vector Gas 5 Approximately 90m of the DN300/605Line is affected where the TG Main Alignment crosses the pipeline between Ch 15900 and Ch 15960 at an oblique angle in a substantial cut. ***Proposal****: Realignment 200 LM with a perpendicular crossing of proposed TG Main Alignment at approximately Ch 15990.*
6a	Ch 17150-17300 SH58 I/C	ALL-UT-1037	Vector Gas 6a SH58 interchange and Bridge Structures are adjacent to the DN300/605Line with a deep fill. ***Proposal****: Realign the DN300/605Line with near perpendicular crossings of both the TG Main Alignment and the SH58 interchange ramps between Ch 17150 and Ch 17300. Relocation could follow several potential alignments subject to detailed design.*
6b	Ch 17700-18100	ALL-UT-1038	Vector Gas 6b The TG Main Alignment obliquely crosses and then parallels the DN200/100Line between Ch 17900 and Ch 17980 with a substantial cut. ***Proposal****: Realign the DN200/100Line with a deepened crossing of the TG Main Alignment at or near Ch 17970.*
6c	Ch 18030 to Ch 18130	ALL-UT-1040	Vector Gas 6c Approximately 100m of the DN200/100Line and 80 LM of the DN300/605Line runs along the top of a deep cut embankment. ***Proposal****: This area will be reconsidered during detailed design and if the conflict remains, an engineered solution developed.*
6d	Ch 18600	ALL-UT-1041	Vector Gas 6d Approximately 20m of the DN300/605 line and approx 70 DN200/100Line is along the top of a deep cut embankment. ***Proposal****: Both pipelines will require diversion (DN300/605 for 100LM; DN200/100 for 130LM) to run parallel to the*

Zone	Chainage	Sheet	Impact & Proposal
			existing, but further to the east. This area will be reconsidered during Detailed Design and if possible, an engineered solution developed. If work on the gas mains is to be undertaken within the adjusted easement, Vector will be notified at preferred bidder stage to allow sufficient time to obtain the new easement.
7a	Ch 19230-19450	ALL-UT-1042	Vector Gas 7a Approximately 220m of the DN300/605Line runs along the top of a deep cut embankment. ***Proposal****: This area will be reconsidered during detailed design and if the conflict remains, approx 200m of this pipeline will relocated.* *The existing DN200/100Line shown on the drawing will be relocated (see Zone 7b below).*
7b	Ch 19240-19780 (Waitangirua Link Rd Ch 1650)	ALL-UT-1043 LNK-UT-1014	Vector Gas 7b There are a number of potential conflicts with the DN200/100Line from construction of the James Cook interchange and Waitangirua link road. ***Proposal****: Realign 1,050 m of the DN200/100Line from just north of the proposed interchange, parallel and adjacent to the DN300/600Line from Ch 19300 to Ch 19650, then routing 90 degree westward allowing for a near perpendicular crossing of the TG Main Alignment under a fill. The line would then eventually merge with the existing DN200/100Line route west of Bridge 29 at Ch 1650 on Waitangirua Link Road.*
8	Ch 21450	ALL-UT-1046	Vector Gas 8 The TG Main Alignment crosses the DN200/110 Hutt Valley Lateral near Ch 21520 under a deep fill. ***Proposal****: This area will be reconsidered during detailed design.*
9	Ch 23350-23800	ALL-UT-1050-51	Vector Gas 9 TG Main Alignment Bridge 20 crosses the DN200/100Line at Ch 23360 and the pier foundations potentially conflict with the pipeline. The southbound shoulder is adjacent and parallel to the DN200/100Line between Ch 23550 and Ch 23700 at the top of an embankment in an area of deep cut. ***Proposal****: 9a) The pipeline will be diverted under Bridge 20 to remove any conflict with the foundations.* *9b) The DN200/100line runs along the top of the east cut embankment for a distance of 90m (Ch 23620 to 23700). The pipeline will be diverted to run further away from the embankment (or an engineered solution developed e.g. steepened batters).*

Transpower 110 kV Electricity Transmission Lines

Table 2 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1	Tower 1- 48		**Transpower 1** Demolition of the 110kV transmission line foundations on land that is required as part of the Contractor's design proposal. We note that the earliest available start date for the demolition of the foundations is July 2015 and we have identified this as a critical date in our programme. We have had discussions with Transpower on prioritising the tower removal to remove impact to the programme. ***Proposal:*** *The foundations will be removed as follows:* *For any land not required by the LHJV during the Operating Term (and included in the TG Project Lease), we propose to demolish all of the foundations and make good.* *For any land that forms the TG Project Lease, we propose to demolish the foundations to not less than 800mm below finished ground level.*
2a	Ch 17100	ALL-UT-1039	**Transpower 2a** The existing 110kV lines cross the SH58 link road from the Pauatahanui Substation. ***Proposal:*** *The lines cross the proposed SH58 with sufficient clearance, so no relocation is planned.*
2b	Ch 1470 Waitangirua Link Rd	LNK-UT-1013	**Transpower 2b** The existing 110kV lines cross the Waitangirua Link Road between the Pauatahanui and Takapu Substations. ***Proposal:*** *The lines cross the proposed Waitangirua Link Road with sufficient clearance, so no relocation is planned.*
3	Ch 22900	ALL-UT-1049	**Transpower 3** Tower 297 is at the top of a cut batter. Preliminary survey and design shows the outer edge of the tower footings are outside the required 12m influence zone. ***Proposal:*** *Further survey and design will validate the above conclusion. Final design will maintain this clearance, or will provide an acceptable engineered solution.*
4	Ch 23340	ALL-UT-1050	**Transpower 4** The existing 110kV line crosses the TG Main Alignment at Bridge 20 to reach the Takapu Substation. ***Proposal:*** *Preliminary survey and design shows that clearance at this Bridge is marginal. If final design supports this, construction of an extra tower on the southern side will provide a shorter span and a more perpendicular crossing of the Bridge, or raising one of the existing towers.*

Wellington Electricity Lines Company

Table 3 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1a	Ch 12550	ALL-UT-1028	**WE 1a** An 11kV distribution line crosses the proposed TG Main Alignment. ***Proposal:*** *Re-align the line to follow the minor road crossing under the TG Main Alignment at Bridge 11.*
1b	Ch 13320 to 14000	ALL-UT-1029,30,31	**WE 1b** Two instances of 11kV overhead line crossing the proposed TG Main Alignment including two (2) pole mounted substations. ***Proposal:*** *Re-align the 11kV line to the eastern side of Flighty's Rd. The existing crossing at Ch 14000 will be relocated to cross the TG Main Alignment under Bridge 12.*
2	Ch 17300	ALL-UT-1039	**WE 2** Vicinity of SH58 Interchange where there are two instances where lines cross the proposed re-aligned SH58 and one instance of a line crossing the TG Main Alignment. The 11kV underground cable with an associated termination pole does not cross the proposed SH58 alignment. ***Proposal:*** *The 11kV lines will be re-aligned with new pole spacing where necessary to cross the Ramp fills and the SH58 exit Ramp.*
3a	Whitby Link Road Ch 0000	LNK-UT-1001	**WE 3a** At the proposed connection of the Whitby Link Road connection to Navigation Drive there is a ground mounted substation and a crossing of 11kV and 400V underground cables on the Whitby Link Road. ***Proposal:*** *As the link rd joins Navigation Dr at existing grade, neither the underground 11kV and 400V lines nor the position of the ground mounted substation will need to be relocated.*
3b	Waitangirua Link Road Ch 0000	ALL-UT-1011	**WE 3b** At the proposed connection of the Waitangirua Link Road connection to Warspite Avenue there is a ground mounted substation (adjacent to the Plunket Rooms which will be relocated) and several instances of 11kV underground cables that cross the intersection. ***Proposal:*** *The substation will not require to be moved under the designed alignment of Waitangirua Link Road. The Waitangirua Link Road joins the existing Warspite Ave at grade. And therefore will not need relocating (assuming an existing minimum cover of 750mm).*
4	Ch 23500 to 23800	ALL-UT-1051	**WE 4** In this vicinity there are two instances of twin circuit 33kV overhead line crossing the TG Main Alignment (Waitangirua and Porirua Zone circuits).

Zone	Chainage	Sheet	Impact & Proposal
			Proposal: *Both instances cross in an area of sidling cut and there will sufficient clearance to the TG Main Alignment. However, the western-most line will need to be relocated to the west to cross the TG Main Alignment perpendicularly (extra pole) to clear construction equipment.*
5a	Ch 26350	ALL-UT-1056	**WE 5a** One instance of 33kV underground cables including overhead termination structures, crossing under the existing Johnsonville Motorway. ***Proposal:*** *No move or extra protection required.*
5b	Ch 26350	ALL-UT-1056	**WE 5b** One instance of twin circuit 33kV overhead lines (Kenepuru Zone circuit) crossing at the proposed TG interchange. ***Proposal:*** *Subject to final design, the lines will be undergrounded under the motorway interchange.*
5c	Ch 1000	ALL-UT-1060	**WE 5c** One instance of 11kV underground cables crossing under the proposed Kenepuru Link Road. ***Proposal****: No move required.*
5d	Ch 1000	ALL-UT-1060	**WE 5d** One instance of 11kV lines crossing over the proposed Kenepuru Link Road. ***Proposal:*** *The link pole (2 lines joining) will need to be repositioned away from the alignment, to allow crossing with sufficient clearance.*
5e	Kenepuru Dr	ALL-UT-2002	**WE 5e** At the proposed connection of the Kenepuru Link Road connection to Kenepuru Drive there is an 11kV underground cable passing along the south east shoulder of Kenepuru Rd. ***Proposal:*** *Subject to final design, this cable will be ducted under the fill.*

Electra 33kV Line

Table 4 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1	Ch 1500 to 1790	ALL-UT-1006	**Electra 1** This 33kV line (includes a transformer and overhead switch gear) runs along the existing SH1 north of Paekakariki and crosses both the TG Main Alignment and the proposed SH1 alignment. ***Proposal:*** *A realignment which parallels the new SH1 to the east with a perpendicular crossing of TG Main Alignment and SH1 at 1700 and 1470 respectively.*

Zone	Chainage	Sheet	Impact & Proposal
2	Ch 2050	ALL-UT-1007	**Electra 2** Single line crosses alignment, feeding local properties. ***Proposal:*** *Relocate line to across alignment at low point.*
3	Ch 00	ALL-UT-1003	**Electra 3** An underground line crosses under the eastern arm to the rotary feeding 3 No street lights. ***Proposal:*** *Proposed road is at grade where it crosses the existing line. 2 No street lights and cables will need relocating. The depth and protection of the remainder will be checked during refurbishment of the pavement.*

Greater Wellington Regional Council (GWRC) Bulk Water Supply

Table 5 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1	Ch 18700	ALL-UT-1041	**GWRC 1** Brady Reservoir Branch. The current crossing is a 180mm OD polyethylene pipe enclosed in a 450mm diameter concrete pipe, which was laid to be lower than the proposed formation level. However, subsequent design changes necessitate relocation of the pipeline. ***Proposal:*** *Install a similar sleeved pipeline crossing approximately 110LM southwards along the alignment.*
2	Ch 19200	ALL-UT-1042	**GWRC 2** Porirua Branch. The current crossing is two pipes, a 450mm ID steel pipe and a 375mm ID cast iron pipe. Both pipes need to be carried across the TG Main Alignment for future operational requirements. ***Proposal:*** *Two new pipeline lengths (sleeved) will pass under the TG Main Alignment. They will also pass through the embankment under the northbound on-ramp after diversion from their existing route adjacent to the eastern edge of the designation and then rejoining at the Whitby Link Road embankment.*
3a	Ch 20580	ALL-UT-1045	**GWRC 3a** Silverwood Forests. This crossing as designed is in a fill area. ***Proposal:*** *Proposal is to encase existing pipeline in a 2.4 x 2.0 Culvert as suggested by GWRC.*
3b	Ch 20900	ALL-UT-1045	**GWRC 3b** Subject to final design confirmation, the edge of the embankment fill could encroach on the pipeline where it parallels the TG Main Alignment. ***Proposal:*** *A design check will be undertaken to ensure that no undue transverse pressure is transferred to the pipeline.*

Zone	Chainage	Sheet	Impact & Proposal
4	Ch 22730 to Ch 23000	ALL-UT-1049	**GWRC 4** Tunnel No 3 is an existing pipe in an existing 2.5m x 2.0m box Culvert. ***Proposal:*** *The proposed TG Main Alignment road profile will cross the existing pipeline and Culvert with adequate cover. A suitably qualified geotechnical engineer will confirm that the earthworks are clear of northern tunnel portal and that the proposed excavation will have no deleterious or injurious effect on the GWRC tunnel.*

KiwiRail

Table 6 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1	Ch 0000	ALL-UT-1003	**KiwiRail 1** The northbound on-ramp to the existing SH1 crosses the NIMT at the existing overpass at MacKay's Crossing which will be lengthened to the southwest. ***Proposal:*** *Lengthening of the overpass will include constructing an extension of the existing walls within the rail corridor. This will not impinge on existing utilities within the rail corridor with the exception of the overhead traction supply which will be lengthened. All works will be in agreement with KiwiRail operating conditions.*
2	Kenepuru Link Road Ch 100	ALL-UT-1060	**KiwiRail 2** Bridge 28 across the NIMT. The proposed design has a piled pier outside of the rail corridor adjacent to the stream. ***Proposal:*** *Discussions with KiwiRail show that there is no impact on their services apart from the overhead traction power supply. This will need to be reconfigured with fixtures to the underside of the Bridge. All works will be in agreement with KiwiRail operating conditions.*

Powerco

Table 7 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage)	Sheet	Impact & Proposal
1	Ch 1700	ALL-UT-1006	**Powerco 1** This distribution gas line does not conflict with the proposed TG Main Alignment. ***Proposal:*** *Not required.*
2	Ch 1800	ALL-UT-1006	**Powerco 2** This spur line has been disconnected. ***Proposal:*** *Not required.*
3	Ch 17900	ALL-UT-1038	**Powerco 3** This line does not conflict with the TG Main Alignment. ***Proposal:*** *None required.*
4a	TG Ch 19200 Whitby Link Rd, Ch 00	LNK-UT-1001	**Powerco 4a** Whitby Link Rd: An 80NB line crosses the proposed intersection at the entrance to the Navigation Dr/James Cook Dr/Link Road intersection. ***Proposal:*** *The pipe is required to be set back from the intersection.*
4b	TG Ch 19200 Waitangirua Link Rd, Ch 00	LNK-UT-1011	**Powerco 4b** Waitangirua Link Rd: A strategic 100NB line crosses the Warspite Ave/Niagara St/Link Road intersection at the entrance to the Waitangirua Link Road. ***Proposal:*** *The pipe is required to be set back from the intersection and the junction and meter moved to the south footpath.*
5	Kenepuru Link Road, Ch 00	ALL-UT-2002	**Powerco 5** Kenepuru Link Road: A strategic 80NB pipeline crosses under the fill on the south side of Kenepuru Drive. ***Proposal:*** *Line is under the existing carriageway, and under the proposed fill. It will therefore not require lowering or diverting*.
6	Collins Ave	ALL-UT-1058	**Powerco 6** A 100NB Steel LMP line passes under the TG Main Alignment at the Collins Rd Bridge with a spur line on Little Collins Rd. ***Proposal:*** *The Collins Rd line will be relocated to the north berm and the Little Collins Ave spur line will be relocated to the east berm to allow construction of the retaining wall.*

Kāpiti Coast District Council (KCDC)

Table 8 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1	Ch 1800	ALL-UT-1006	**KCDC 1** ***Proposal***: *The proposed TG Main Alignment will not affect the pumping station and other facilities. It is proposed to relocate (renew subject to design and program) the existing sand filters to a position adjacent to the existing pump station. KCDC have confirmed the position of the new bore (Bore No 2) and LHJV will provide a sleeved connection under the alignment fill to the relocated sand filters. These will be connected into the existing pipework system upstream from the pump house. Suitable access to the pump station and associated equipment will be from the existing SH1*.

Chorus Telecommunications Assets

Table 9 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1a	Ch0050	ALL-UT-1006	**Chorus 1a** Chorus underground cables in the eastern shoulder (Ch 0040) and under the rotary. ***Proposal:*** *Relocate underground cables (180LM) where required and protect where crossing roads (100LM) at rotary.*
1b	Ch 1800	ALL-UT-1006	**Chorus 1b** Chorus underground fibre in the southern shoulder following the existing SH1 (eight ducts in the same trench), which will cross under the proposed TG Main Alignment. There is also fibre in the northern shoulder which joins the eastern shoulder ducts before crossing under the proposed TG Main Alignment. ***Proposal:*** *Leave ducts on the existing southern shoulder alignment, lowering where necessary and protecting.*
2	Ch 13330 to Ch 14200	ALL-UT-1029, 30, 31	**Chorus 2** At Ch 14250 where investigation show that these are predominately on the eastern side of Flighty's Road. ***Proposal:*** *Prove location, mark and relocate/protect where necessary.*
3	Ch 17180	ALL-UT-1037	**Chorus 3** Chorus underground fibre and copper lines are in the eastern shoulder of the existing SH58. ***Proposal:*** *These will not be affected in the proposed SH58 layout. However, where the proposed meets the existing, lines will be located, marked and protected.*

Zone	Chainage	Sheet	Impact & Proposal
4	Ch 23780 – Ch 24000	ALL-UT-1007	**Chorus 4** Underground copper lines service the Takapu Road Substation and local residents. ***Proposal:*** *As the existing cross the TG Main Alignment in a cut, it is proposed to reroute along the northern embankment to cross under the TG Main Alignment at approx. Ch 23780.*
5	Ch 26600 – Ch 27200	ALL-UT-1057,8	**Chorus 5** Ch 27,000 where the TG Main Alignment merges with SH1 at Linden (main underground fibre in shoulder on western side of SH1, eight ducts in the same trench). ***Proposal:*** *Relocate cable to follow north-western shoulder of the Johnsonville-Porirua Motorway.*
6	Kenepuru Link Road Ch 1100	ALL-UT-2002	**Chorus 6** Where the Kenepuru Link Road merges with Kenepuru Drive (underground fibre and copper in 37 Kenepuru Dr property and the Kenepuru Drive southern shoulder). ***Proposal:*** *Relocate all ducts to ducted crossing under the fill.*

Vodafone Telecommunications Assets

Table 10 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1	Ch 17150	ALL-UT-1037	**Vodafone 1** Single (mixed aerial and underground) fibre which runs along SH58. This is a 'backbone' line providing a connection between the Hutt Valley and the Kāpiti Coast, but does not have laterals along its length. ***Proposal:*** *Run fibre underground (conduit) from Pauatahanui substation to rejoin SH58 north of rotary.*
2	Ch1150 (Kenepuru Link Rd)	ALL-UT-2002	**Vodafone 2** A single fibre cable runs underground along Kenepuru Dr to Kenepuru Hospital. From north of No 37 Kenepuru Dr, this fibre optic has no lateral connections or access pits/pillars along its length. ***Proposal:*** *Fibre rerouted in new ducts under fill, with connection pit moved to outside fill area.*
3	Ch 26760	ALL-UT-1057	**Vodafone 3** Cell Tower to be moved at their cost (a requirement of Transport Agency's licence). Liaison required for programme. Vodafone have advised their relocation could take up to 12 months depending on obtaining consent. Their preference is to remain on Transport Agency property in the vicinity but Transport Agency / WGP are not obligated to accommodate this.

City Council Utilities

Table 11 - Identified Impacts and Proposed Mitigation Measures

Zone	Chainage	Sheet	Impact & Proposal
1	Whitby Link Rd Ch 00	LNK-UT-1001	**PCC 1** At the intersection of the Whitby Link Road with Navigation and James Cook Drive. ***Proposal:*** *PCC-Water: A 200mm diameter uPVC crosses the intersection to serve a hydrant on the Link Road berm.* *PCC-Wastewater: A 150mm diameter uPVC crosses the intersection with a manhole in the footpath.* *PCC-Stormwater: Stormwater pipes service the catchpits at the corner of the Link road. Subject to final design of the Link Road, stormwater at the intersection will require reconfiguration from the manhole on the eastern corner.* *Chorus: Copper / fibre underground cable. No relocation needed.* *PCC Street Lights (WE asset): No light poles need relocating (see proposed Link Road lighting design).*
2	Waitangirua Link Rd Ch 00	LNK-UT-1011	**PCC 2** At the intersection of the Waitangirua Link Road with Warspite Ave and Niagara Street. ***Proposal:*** *PCC-Water: A 375mm and a 100mm diameter AC pipe cross the intersection on the Niagara side of Warspite Ave. There is no requirement to relocate.* *PCC-Wastewater: A 150mm diameter AC sewer pipe terminates at a manhole within the intersection. The manhole will be relocated away from the intersection.* *PCC-Stormwater: There are no stormwater assets in conflict with the intersection. Subject to final design of the Link Road, stormwater will flow away from the intersection along the link road.* *Chorus: Copper / fibre underground chamber in roadway to be relocated to south berm (approx. 20LM).* *PCC Street Lights (WE asset): One light pole needs relocating (see proposed Link Road lighting design).*
3	Ch 1150 (Kenepuru Link Rd)	ALL-UT-2002	**PCC 3 (Kenepuru Drive)** Existing underground services at the Kenepuru Link Road Intersection with Kenepuru Drive. ***Proposal:*** *PCC-Water: duct under fill.*

Zone	Chainage	Sheet	Impact & Proposal
			PCC-Wastewater: duct under fill. *PCC-Stormwater: will need reconstruction.* *PCC-Lighting: see proposed TG lighting design.*
4	TG Ch 27460	ALL-UT-2001	**WCC 4 (Collins Rd)** Existing underground services along Collins Rd under motorway Bridge (BR26). (Assume Bridge underpass is widened with piles outside of Collins Rd footpath)(note WCC = Wellington City Council). ***Proposal:*** *WCC-Water: no impact.* *WCC-Waste water: no expected conflict.* *WCC-Stormwater: will need reconstruction (see Little Collins St below).* *Powerco Gas: (included here for completeness) no impact.* *WE Electricity: (included here for completeness) no impact.* *Chorus: (included here for convenience): no impact.*
5	TG Ch 27460	ALL-UT-2001	**WCC 5 (Little Collins St)** Existing underground services along Little Collins St (from intersection with Collins Rd to avoid conflict with retaining wall). ***Proposal:*** *WCC-Water: realign pipe to east in new street berm.* *WCC-Wastewater: no expected conflict.* *WCC-Stormwater: pipeline to be relocated further to east in new berm, including renewed surge chamber in NW quadrant.* *Powerco Gas: (included here for completeness) DN50 MDPE pie servicing local properties. Relocate further to east in new berm.* *WE Electricity: (included here for convenience) assume underground cable to be relocated further to east in new berm. (street light in cul-de-sac to be moved).* *Chorus: (included here for convenience): realign underground cable for 30 metres to east in new street berm.*
6	TG Ch 27300	ALL-UT-1058	**WCC 6 (Rangatira Ave)** Retaining wall impacts driveway. ***Proposal:*** *WCC Water: 175 LM realignment.* *WCC Wastewater: 175 LM realignment.* *WCC Stormwater: 85 LM realignment.* *Powerco Gas: 175 LM DN40 realignment.*

Zone	Chainage	Sheet	Impact & Proposal
			Chorus: 175 LM underground fibre and copper realignment. *WE Electricity: 210 LM of 400V line underground and 175 LM overhead 11kV line realignment.*

Appendix 9: Drainage Design Philosophy Statement

See document #16673676, entitled “Drainage Design Philosophy Statement”.

WELLINGTON GATEWAY PARTNERSHIP

Design Philosophy Statement Drainage

Revision D

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1. Introduction

This Drainage Design Philosophy Statement (DDPS) has been prepared to inform the detailed drainage design for the Transmission Gully Design and Construct (D&C) phase of the project which includes the main alignment and all link roads.

The Philosophy Statement provides a summary of the overall approach, design parameters, standards and other reference documents. It also details constraints on the design and assumptions upon which the development of the detailed design will be based.

The DDPS is intended as a guidance document for reference during the detailed design development and is subject to alteration as required to achieve agreed project outcomes. Any alterations will be first agreed with the NZTA to ensure a collaborative approach is achieved.

This Design Philosophy Statement may be subjected to modification during detailed design development to cater for the following potential scenarios:

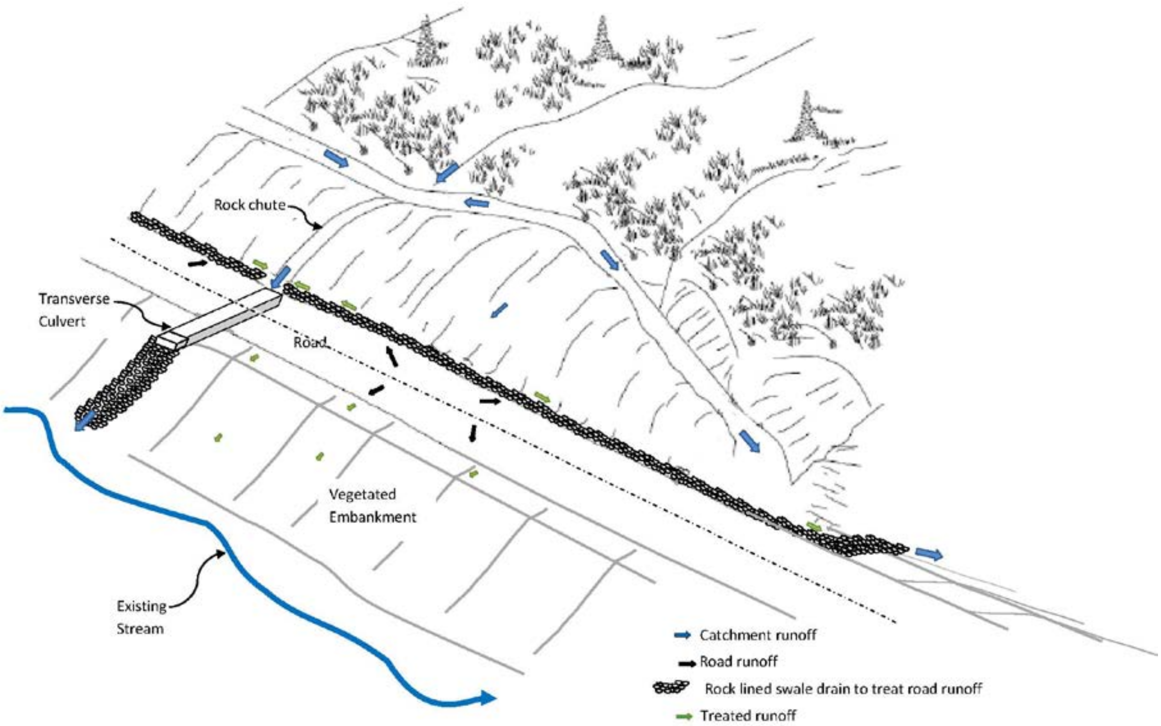
- Variation in ground conditions from that known at tender – which may impact on the final geotechnical arrangements and their impact on the drainage design
- Enhancement of the engineering function or durability of the design solution
- Enhanced value for money of the design solution considering the whole of life of the asset
- Safety in Design considerations

1.1. Overall Approach

The approach to drainage design for the TG project has requires careful consideration of the system as a whole and its interaction with the surrounding environment, both upstream and downstream. Integration with the other design elements such as the alignment, geotechnical, environment and constructability are also significant influencing factors.

A diagrammatic sketch showing the typical components of the drainage system and runoff treatment process within the road corridor is presented in Figure 1.

Figure 1 - Schematic of stormwater drainage elements within the road corridor



1.2. Design Philosophy

The design philosophy that will guide the design development is based on a simple, self-sufficient and sustainable drainage management solution. The design approach utilises natural drainage processes and vegetated batters with reduced reliance on traditional underground pipe structures. Consideration of safety, extreme weather events, and minimising the impact on drainage infrastructure from seismic activity are foundational to the design approach.

The design is guided by the following statements:

- provide for a safe road by draining the road surface adequately and providing a safe roadside environment;
- embrace environmental and sustainable principles;
- utilise natural processes and materials wherever possible to reduce reliance on hard engineering solutions;
- minimise underground drainage infrastructure to enhance seismic and settlement resilience;
- minimise operational maintenance requirements;
- minimise impacts to the surrounding environment;
- replicate the natural environment in stream diversions (form, shape, gradient etc) to promote fish passage and retain ecological habitat value;

- reduce drainage risk by designing for debris flow through the corridor in accordance with the natural processes rather than trying to engineer containment provisions which are more likely to fail; and
- provide overall whole of life project benefits in terms of minimising upfront capital costs and ongoing long term maintenance costs.

1.3. Design Standards and Software

1.3.1. Design Standards

The Drainage Design will be based on the following guidelines as referenced in Schedule 11 Part 26:

- NZTA's Stormwater Treatment Standard for State Highway Infrastructure (2010)
- Austroads: Guide to Road Design, Part 5, Drainage – General and Hydrology Considerations (May 2013)
- Austroads: Guide to Road Design, Part 5, Drainage – Road Surface, Network, Basins and Subsurface (May 2013)
- Austroads: Guide to Road Design, Part 5, Drainage – Open Channels, Culverts and Floodways (May 2013)
- NZTA Bridge Manual
- Austroads: Waterway Design – A Guide to the Hydraulic Design of Bridges, Culverts and Floodways (1994)
- National Roads Board "Highway Surface Drainage. Design Guide for Highways with a Positive Collection System", November 1977 (NRB 1977); and
- Auckland Regional Council (ARC) Stormwater Treatment Devices: Design Guidelines Manual 2003 (TP10).

In addition, the following standards and guides will be used:

- AS/NZS 3725 – Design for installation of buried concrete pipes
- ASNZS 2566 – Buried Flexible pipelines
- AS/NZS 1100 – Technical Drawings
- Paekakariki – Options assessment of stream sediments (April 2008)
- FISH PASSAGE AT CULVERTS – A review, with possible solutions for New Zealand indigenous species (1999) – National Institute of Water and Atmospheric Research (NIWA)
- Hydraulic Engineering Circular (HEC) 23 Bridge Scour and Stream Instability Countermeasures
- Hydraulic Engineering Circular 14 – "Energy Dissipators"

- High Intensity Rainfall Design System (HIRDS version 3) – National Institute of Water and Atmospheric Research (NIWA).

1.3.2. Design Software

The road drainage system will be sized/ designed using 12D Version 9 (or later), which incorporates an inbuilt drainage analysis module. Culvert hydraulics will be checked using HY-8 or Culvert Master and stream diversion works assessed using HEC-RAS or Mike 11 by DHI.

2. Design Parameters

2.1. Design Parameters

The drainage system will collect, treat and convey surface runoff to the most naturally suitable point and discharge to the receiving environment in a way that mimics the natural hydrologic and hydraulic regime. A Best Practicable Option (BPO) approach will be taken in the determination of stormwater management approaches used for each sub-catchment.

In particular, the design will incorporate the following minimum criteria:

- In accordance with Commentary 9 Austroads AGRD Part 5 (2008) the maximum water film on the road will not exceed 4mm, for a rainfall intensity of 50mm/hr.
- Provision of secondary flow paths shall be provided were practicable or, where they cannot be provided, alternative methods will be used, such as over size culverts or bypassing these flows safely to locations where they can be managed.
- The provision for carriageway surface water drainage will ensure the flow path width does not spread into traffic lanes during a 10% AEP storm event and will not extend more than 1m into a trafficable lane during a 1% AEP storm event. For piped networks conveying flow from low points on the carriageway, where there is no available secondary overland flow path, the network will be designed to collect and convey the 1% AEP critical duration storm.
- A minimum pipe diameter of 300mm for longitudinally placed pipes and a minimum 375mm diameter for any pipe crossing the alignment transversely.
- Pipe classes and cover requirements assessed for buried concrete pipes using the Concrete Pipe Association's "Concrete Pipe Selection and Installation Guide" to be suitable for construction traffic and staging conditions.
- Climate change 2.1 degree increase in temperature.
- The water quality volume (WQV) from the road surface runoff will be directed through the appropriate treatment measures in order to achieve an overall target treatment efficiency rate of 75% TSS removal.
- Settlement velocities by particle size are provided in Table 7.3 Austroads 2010.
- The maximum permissible velocities assumed for various surface vegetation types are in accordance with the nominated standards as referenced in Section 1.3.1.
- Minimisation of erosion and not compromising any structure, and/or surrounding slopes, to ensure there is no impact on strength and stability.
- Culverts (excluding temporary culverts) servicing the Project:
  - are capable of conveying the critical duration 10% Annual Exceedance Probability (AEP) storm event, including an allowance for climate change, without surcharge of the culvert; and

  - do not result in stormwater levels either: being within 500mm of the main carriageway surface level; or being above the underside of the sub-base, for a 1% AEP storm event including an allowance for climate change.
- Fish specific parameters:
  - Standard and Specific fish passage.
  - Depressed invert and full length remains submerged (Standard only).
  - Maximum base flow velocity 0.3m/s. Where this is not possible provision of resting areas (Special / Advanced culvert design), given the fish can achieve a dart speed of 0.7m/s for distances up to 1m.
  - Minimum 15ha contributing area required to provide sufficient flow in a river/stream.
- Water from batters or cut slopes does not flow across the road surface for the proposed design events.
- Stream diversions:
  - the existing channel form, shape, gradient and long term ecological habitat will be replicated as closely as practicable;
  - sufficient floodplain will be provided for flood flows to be conveyed within existing boundaries;
- the banks of a diverted stream will incorporate measures to mitigate any increases in velocities and associated risk of erosion.
- Provision of suitable access for maintenance and operation.
- Upstream and downstream flooding is no greater or of longer duration than that predicted to occur for the design events used in Technical Report #14 (Transmission Gully Project – Assessment of Hydrology and Stormwater Effects).
- Use Low Impact Development (LID) techniques as far as practicable.
- Collected stormwater will be treated and discharged in a distributed fashion as soon as practicable, thereby minimising the risk associated with holding concentrated flows and volumes for extended periods within or under the road corridor.

2.2. TSS Loadings

Based upon a study on behalf of Auckland Regional Council in 2010 (TR2010/004), an estimate of the anticipated TSS by vehicles per day is shown in Table 1.

Table 1 Extract from TR2010/004 (Table 10 Contaminant yields for the source areas)

Vehicles per day	TSS g/m2/year
5,000 to 20,000	53
20,000 to 50,000	96
50,000 to 100,000	158

2.3. Rainfall Run-off Parameters

For the purposes of design a single and conservative location with higher rainfall intensity values will be adopted for the determination of road surface runoff. The parameters in Table 2 and Table 3 will be used to determine the runoff as the basis for detailed design (Reference –Technical Report #14, corroborated using HIRDS version 3).

Table 2- Storm event Intensities (Technical Report #14 Isopleths year 2090 and including a 2.1 degree temperature increase)

AEP	50%	10%	1%
I24hr rainfall depth (mm)	95	140	220

Table 3 –Coefficients for Design

Surface type	Coefficient of Impermeability (C)	Manning's (n)
Paved impermeable areas	0.9	N/A
Exposed cut faces	0.7	N/A
Rock	N/A	0.035
Stream (Natural)	N/A	0.05
Stream (Engineered)	N/A	0.05
Vegetated	N/A	0.03 – 0.05
Concrete	N/A	0.013

3. Low Impact Development

The overall project philosophy and focus of the stormwater management design is to replicate the natural pre-development processes and conditions as much as is practicable. The design will consider and apply Low Impact Development (LID) principals as far as practicable.

The suite of LID techniques and their potential flow control attributes and the stormwater philosophy and solutions proposed for Transmission Gully are substantively aligned. The LID techniques generally being employed include:

- infiltration and evapotranspiration (increased re-vegetation of upper catchment areas and the works corridor),
- increased times of concentration for reduced discharge rates (through flatter slopes, longer flow paths, rougher conveyance channels (rock lined) etc),
- collecting and treating stormwater at the source as it is generated (through sheet flow down vegetated batters or rubble filter drains),
- runoff conveyance through vegetated swales and filter (buffer) strips,
- removal of kerbs, pits and pipes wherever possible,
- flow detention storage at various locations as required (including dedicated on-site detention tanks).

During the design a full evaluation of the potential hydrologic impacts associated with the project will be completed. This will include a comparison of pre and post works performance conditions for both water quantity and quality. A full hydrological evaluation for the proposed stormwater BMPS, including the LID components, will be prepared as part of the detailed design process.

4. Stormwater Management Design Criteria

4.1. General

Where practicable the use of 'hard' engineering solutions, such as piped networks, for the collection and conveyance of carriageway surface water runoff will be avoided. Low Impact Development techniques will be used such as; flattening slopes, increasing the flow path lengths, inclusion of vegetation and infiltration trenches.

If a piped network is proposed, and there is a probability of ground settlement, additional conveyance capacity will be provided within the drainage system to accommodate the potential loss of grade or waterway in the piped network. This additional conveyance capacity is achieved by increasing pipe grade, where possible, or increasing the pipe diameter.

However, the primary mechanisms proposed for the Design are for the collection and conveyance of stormwater to be above ground solutions. Catch drains, bench drains and swale/table drains will be located and designed in accordance with good drainage design practice and the particular requirements of the variable terrain of the Project.

The drains and channels will be assessed and designed according to the prevailing ground slope and categorised for appropriate lining treatment (vegetated, concrete, rock).

The drainage system will be designed to prevent saturation of the road sub-base either through the use of a sub-soil pavement drain, in accordance with NZTA F/2 and/or NZTA F/6, or a full width drainage blanket layer below the pavement sub-base. Where it is not possible to "daylight" the subsoil drains or drainage blanket, a dedicated collector drain will be provided. In locations where long lengths of subsoil drains are required, "rodding eyes" will be provided clear of the carriageway and at appropriate spacing for maintenance.

Inlets on the alignment will be designed to collect flow from at least the 10% AEP critical duration storm event allowing for bypass flow from upstream inlets. High inlet capacity structures will be adopted at carriageway sag points to cater for the 1% AEP rainfall event runoff assuming loss of inlet capacity in upstream grates.

Inlets for any piped road surface drainage network on the Project will be selected based upon clear zone requirements, Austroads requirements and the inlet capacity required at each location.

4.2. Design Loading Requirements

For buried pipes and culverts installed in trench, the protection and bedding required will be in accordance with the recommendations in AS/NZS 3725 for buried concrete pipes and AS/NZS 2566 for buried flexible pipes.

4.3. Transverse Drainage

The transverse drainage requirements will be influenced by both the horizontal and vertical alignments. The following considerations will be given with respect to transverse drainage:

- rationalisation of the number of culverts crossing the alignment, particularly in the steeper northern areas through the Wainui Saddle. Flows from some of the smaller hanging catchments will be accumulated and directed to the next suitable transverse crossing rather than having culverts at every single possible location;
- specifying standard size culverts for the small to medium catchments in the steeper terrain with flows in the range of 0.5m3/s to 4 m3/s. These culverts will be placed at relatively steep grades to maintain super-critical flow conditions in the areas at greatest risk to debris flow. This oversized and steep arrangement will have excess capacity to cater for the hydraulic and debris flow conditions and thereby minimise the risks of blockage. These culverts are generally servicing catchments that are ephemeral and do not have need of fish passage;
- Re-direction of some of the smaller upper catchment flows to adjoining transverse culverts through a combination of catch drains and berm drains above and within the cuts; and
- Culvert lengths and grades to account for fish passage and minimise energy dissipation requirements where possible.

Transverse culverts will, as far as practicable, be designed to operate in a similar manner to the section of natural stream they replace. The design will assume that debris torrent will be conveyed downstream through the culvert as it would in the natural uninterrupted stream tributary.

Transverse culverts will be either a reinforced concrete pipe/reinforced concrete box or HDPE pipes. A reinforced box is proposed where it is anticipated that the stormwater from the contributing sub-catchment will include a significant degree of debris in suspension or where the design or physical constraints preclude the use of pipes.

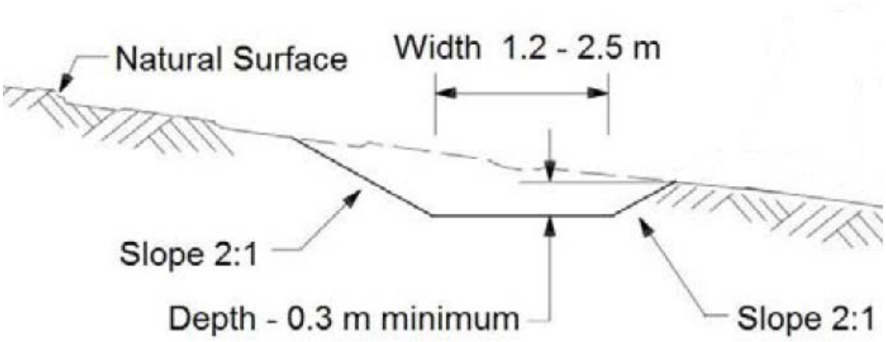
4.4. Drainage – Cut batters

The runoff from the road pavement and the first face of the cut batter above the road surface level will be collected and conveyed in a channel behind any safety barrier and at the toe of the cut batter. The conveyance for the 10% AEP and 1% AEP storm events will be above the treatment surface in the trench.

Where cut batters have intermediate benches, these benches will typically intercept runoff and return it to the natural environment at the nearest practicable point of discharge. The conveyance capacity of the perched benches exceeds the surface runoff from the cut batters up to and including a 1% AEP storm event. In addition, where practicable the benches will be vegetated or concrete lined to minimise any potential erosion of the bench surface.

Catch drains (Figure 2 below) will intercept surface flow from perched natural slopes above cut batters. These are to be proposed where they can be safely constructed and do not introduce an unacceptable safety hazard for the ongoing operation and maintenance of the Project.

Figure 2 - Typical Catchdrain arrangement – Austroads



Due to stability considerations for the underlying material, it is proposed the base and first 300mm depth of side wall will be concrete lined. Where the natural material is considered highly erodible the catch drain and sides are to be fully concrete lined.

4.5. Debris Flow Provisions

Given the nature and geo-morphological conditions of the surrounding steep catchment terrain, the issue of debris load carried within the stream flows is a major concern and risk to the design and operation of the waterway structures (culverts, channels and stream works).

As such, the culverts will be afforded particular consideration over and above the basic hydraulic capacity. A single size culvert laid at a relatively steep slope for supercritical flow conditions will be utilised to encourage the continuous flow of debris through the structure.

This approach is intended to mimic the existing natural conditions as much as possible whereby the debris plug is allowed to continue moving downstream to the stream beds below the alignment. In addition, those culverts will be designed to be flexible so as to provide for seismic resilience.

Figure 3 – Typical Section in Steep Cut

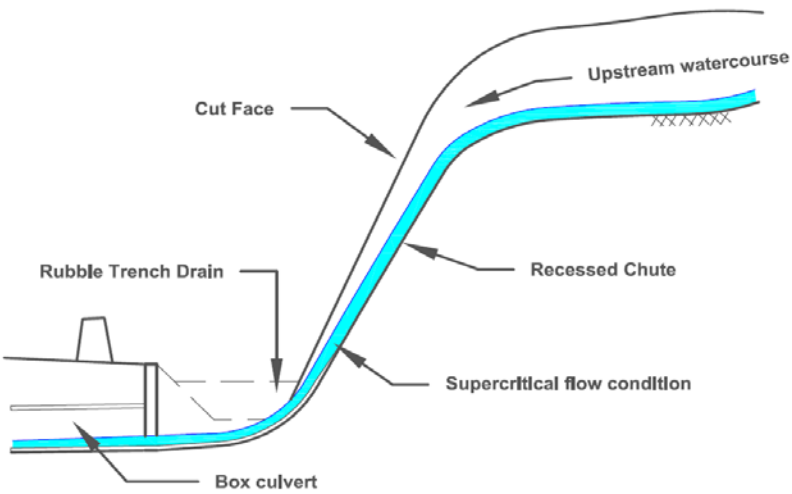


Figure 4 – Typical Stream in Operation Outside Rainfall Event

Provision of a stilling basin for the debris to settle from the flow at culvert inlets, as described in Technical Report#14, is not proposed. A perched stilling basin presents an avoidable risk to the final infrastructure where the volume of material to be allowed for is largely unknown resulting in potential exceedance and/or basin failure. In addition, for the ongoing operation and maintenance, it is considered that such a perched basin would present significant issues regarding health and safety as well as making the periodic removal of accumulated debris very difficult. Where a culvert is expected to experience debris inflow, it will be designed with a steeper slope to allow super-critical flow conditions to develop and encourage the estimated debris to be passed into and through the culvert as far as practicable. It is recognised that such debris will therefore be transferred downstream to the main stream channel, as is the case for the pre-development situation, and dealt with as it would be currently.

4.6. Inlet Blockage Protection

Re-vegetation and management of the stream geo-morphology, directly or in negotiation with adjacent land owners, is the principal means proposed to minimise the risk of transverse culvert inlets becoming blocked by larger boulders or debris.

Where it is identified that such measures are not possible, the mitigation of the risk of inlet blockage will be achieved through appropriate inlet structure design (or other approved methods).

4.7. Stream Diversions

4.7.1. Te Puka Stream

The design through the Wainui Saddle area will adopt a holistic approach giving consideration to construction sequence and methodology, vertical and horizontal alignment, seismic factors and the consequence of seismic events.

A range of other key factors will be considered, including:

- geotechnical requirements for long term embankment stability,
- maintaining the existing groundwater regime,
- replicating the stream ecology in the diverted stream (short and long term),
- the provision of a 'low flow' section within the diverted stream bed to provide suitable fish habitat during dry weather conditions and stream bed widening, whenever practicable, for establishment of ponds, riffles and meanders.

The construction sequence and subsequent diversion of the Te Puka Stream is likely to require significant temporary works. The extent and complexity of the construction is in large part a result of attempting to minimise both the short and longer term impacts upon the stream.

Provision to maintain flow in the natural steam, unaffected by the proposed construction, is to be achieved by the temporary works. The pipework used as part of the temporary works will remain in place after completion of the diversion works and function as a subsoil drain to the engineered fill and stream diversion.

4.7.2. Horokiri Stream

For the Horokiri Stream the floodplain is fairly broad, flows are not large and the stream channel is not well defined or incised. The proposed embankment associated with the new alignment encroaches out into the floodplain and intersects the existing stream channel over a number of segments. The proposed diversion is limited to these areas of encroachment. The approach for the Horokiri stream will not require the same significant temporary work as proposed for the Te Puka stream and can be managed through more typically applied temporary works arrangements. However, careful management and controls will be employed during construction to prevent or minimise the environmental impact. The design of the proposed stream diversion works will incorporate appropriate protection measures to prevent future scour and erosion problems.

4.7.3. Minor Waterways

A number of minor channel works will also be required at the inlet and/or outlet to drainage structures. Such works are typically required for one or more of the following reasons:

- where the proposed upgrade alignment coincides with or interferes with an existing waterway;

- where the grade of the culvert would result in excessive velocities in the culvert and/or the outlet;
- where the required skew of the culvert structure would result in an excessive culvert length;
- to better align the drainage structures with the existing channels , thereby minimising potential scour and erosion issues.

It is proposed that these works will endeavour to replicate or mimic the existing natural channel conditions (waterway area and grade) as far as is practicable, with particular attention afforded to creating a stable and natural stream form. This will involve appropriate landscaping treatment to establish, restore and rehabilitate vegetation to ensure there would not be any significant reduction in habitat availability or water quality.

Permanent Erosion and Sediment Control Mechanisms Erosion management will be achieved by controlling velocities through the following principles:

- Energy dissipation and scour protection – the energy of upper tributaries will be dissipated prior to its discharge to a main stream to prevent scour and erosion of the natural stream.
- The energy of the main stream diversions and associated velocities will, be minimised for the larger storm events whilst maintaining the current flow characteristics for normal flows.

Areas will be “retired” and re-vegetation used along the riparian margin of the stream. The influence and potential use of re-vegetation techniques is dependent upon the land ownership and permissions.

4.7.4. Vegetation Establishment

The establishment of good vegetation cover will be a fundamental defence against erosion. This approach provides a good environmental outcome overall since it binds the soil and, therefore, minimises the initialisation or onset of erosion forces (water and/or wind on batters), reduces water flow velocities (particularly in the stream overbanks) and provides a water quality treatment function of filtering and absorbing sediments and nutrients in a distributed fashion.

4.7.5. Scour and Erosion Protection

Scour protection is to be provided at bridge crossings, pavement system outlets, upstream and downstream of transverse culverts and all other areas which may be susceptible to high velocities and therefore causing scour. Appropriate protection will be provided where required to prevent scour of the embankment, such as along the toe of batters adjacent to the main streams. During design the detailed requirements will be confirmed and designed to be environmentally and fish friendly, in consultation with qualified soil conservationist and the relevant authorities.

4.7.6. Culvert Outlets

Where exit velocities from drainage culverts would potentially induce scour of the permanent works or existing receiving watercourses, protective measures will be included. For example, discharge from concrete channels and outlets where the Froude number does not exceed 3 and outlet areas would not be prone to damage caused by debris, rip-rap, gabion baskets and/or rock-mattress will be used as required to suit the particular constraints. In general, for small culvert outlets, a headwall with batter drain and rock protection at the toe will control the predicted velocities and prevent downstream erosion.

4.7.7. Scour

Scour is also possible at the culvert inlets if the water has to contract and thus accelerate to enter the structure or where the channel approaching the culvert is steepened to meet the culvert invert; for example, if the culvert entrance has been placed below the existing ground level (standard fish passage design). These potential scour problems can be controlled at most locations using conventional culvert inlet arrangements.

However, where it is considered that these measures will not be sufficient, additional protection may be required in the form of extending channel invert protection with rip-rap. For a Froude number less than 3, then rip-rap or a rock-mattress arrangement is considered suitable. As a result of the road alignment transecting existing catchments there are several culverts where the use of a drop outlet arrangement will be utilised to dissipate the energy, prior to and where the flow discharges to the natural environment.

4.8. Energy Dissipaters

Energy dissipaters will be provided on the outlets to drainage culverts that have high Froude values (typically greater than 2) with the potential to cause significant scour.

Where it is practicable and the Froude number is less than 3, the more typical arrangement will use a rock rip-rap dissipater pool with a rip-rap downstream apron.

4.9. Aquaplaning

As accepted and agreed with NZTA, surface water can flow across the lower carriageway for specific situations. Those situations relate to the surface water depth compliance and the requirement for single grading point and super elevation to be fully developed.

This approach, in accordance with TM-2502, is based on 50mm/hr rainfall intensity and the water film depth does not exceed the recommended maximum 4mm.

Through reducing the extent of buried infrastructure in these areas, a lesser overall environmental footprint is incurred and a better seismic resilience outcome is achieved. The maintenance burden will also be reduced along with the disruption to traffic associated with the operational risks of maintaining drainage systems in the median.

4.10. Secondary Flow Paths

4.10.1. Transverse Culverts

For some of the transverse culverts an alternative overland flow path will not be available. In these situations, the culverts will be sized for the estimated 90 percentile debris size and provision made to prevent larger debris particles causing potential blockage of the culvert.

Typically, the transverse culverts will be designed, as far as practicable, to maintain similar flow characteristics to those of the existing stream which is bisected by the proposed road alignment. This includes the conveyance of debris within the stream flow to be carried as it would have for the undisturbed stream condition.

5. Stormwater Treatment

5.1. Introduction

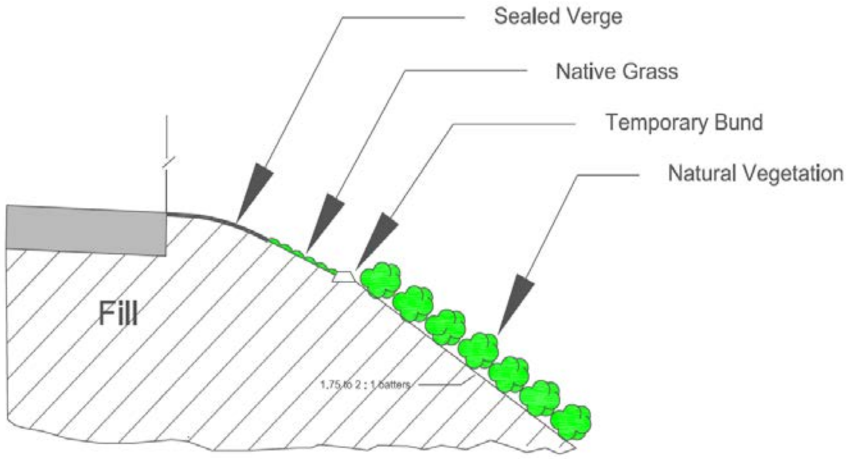
The proposed treatment measures are required to achieve a target of 75% removal of the total suspended solids (TSS) conveyed within stormwater runoff from the pavement surface of the highway during operation.

In New Zealand, guidance generally targets removal of 75% of Total Suspended Solids (TSS). Within ARC (2003) there is a suggested method for re-calculating the efficiency where 100% of the required water quality volume is either exceeded, or cannot be met.

Where possible the full 100% WQV will be provided however, in some instances this may not be achievable. Similarly, there will be instances where more than the 100% WQV can be achieved. An average, minimum removal efficiency of 75% will be targeted for each of the eight catchments within the project extents. The overall drainage strategy adopted for the project has utilised natural materials and processes wherever possible to create a more sustainable approach to stormwater management. The longitudinal system allows runoff to generally discharge from the road surface as sheet flow down vegetated fill batters (buffer zones – refer Figure 5 and Figure 6) or into rock-filled table drains (which also serve a geotechnical function). The combination of these measures therefore provides for the required drainage capacity as well as forming part of the treatment train process to remove suspended sediments (TSS).

Figure 5 - Recently constructed vegetated batter in sensitive environment

Figure 6 - Typical detail for establishing vegetated batter



5.2. Summary of Treatment Devices

The alternative design measures which will be implemented as appropriate to provide stormwater quality treatment are summarised below:

- Swales
- Vegetated Buffer Strips
- Rock-filled channel drains
- Wetlands
- Proprietary devices
- Level spreaders

It is noted that the above devices are often used as a treatment 'train', for example, a rock-filled channel followed by a proprietary device / level spreader; or a buffer strip followed by a vegetated swale.

Details around each type of approach are provided in the following sections.

5.3. Vegetated Swales

Vegetated swales convey accumulated road runoff to the transverse drainage or receiving environment. Treatment is provided as water passes through the vegetation of the swale. Vegetated swales receive runoff from the pavement surface only. The efficiency of removal is determined from the height and thickness/density of the vegetation - the minimum vegetation height being 50mm. It is proposed that where treatment swales are to be used, these will be vegetated in co-ordination with the landscaping proposed.

Where swales are steeper than 5%, check dams will be introduced to slow velocities and encourage treatment.

5.4. Vegetated Batters (Buffer Strips)

Maintaining the batter with permanent vegetation (a buffer strip) is an acknowledged means of helping to control water quality. Buffer strips trap sediment and enhance filtration of nutrients and other contaminants by slowing down runoff that could otherwise directly enter the local receiving waters. The root systems of the planted vegetation in these buffers hold soil particles together, which alleviate the loss of soil through erosion (water and/or wind) and stabilize stream banks providing protection against substantial erosion and landslides.

Buffer strips can have several different configurations of vegetation on them, varying from simply grass to combinations of grasses, trees, and shrubs. Areas with diverse vegetation provide more protection from nutrient and contaminant flow and at the same time provide better biodiversity among plants.

In fill embankment areas, the pavement runoff will be generally discharged as sheet flow from the road surface and flow directly down the vegetated batter surface. Where practical or feasible, vegetated swale drains will also be provided at the toe of the batter to convey and provide further opportunity to treat pavement runoff before its discharge to the receiving natural environment.

Where a fill embankment creates a valley then the resultant vegetated channel will provide additional treatment at the toe of the embankment.

Research indicates that for a runoff of 0.028m3/s, a prescribed minimum 4m long vegetated strip is required to achieve 75% TSS removal. Where the flow for treatment exceeds the 0.028m3/s value then a proportional and additional length of vegetated strip is required. Alternatively, where this is not practicable, it is proposed to use a swale at the toe of the batter. Sections of these swale elements will also provide volume storage to achieve extended detention requirements.

5.5. Rock Filled Trench

A rock-filled trench operates much like an infiltration trench but rather than the water seeping into permeable ground the first flush stormwater is conveyed along the length of the trench to the point of outlet with a rate of discharge similar to a rate of infiltration.

These will function as a hybrid with the combined characteristics of a sedimentation basin and gravel filter. They will also serve an important function to collect rocks which fall from the cut slopes. The rock-filled drains receive runoff from the road and in some areas, will receive runoff from lower faces of the cut batters. Sediment removal occurs as water slows, passing through the rock causing heavy particles to settle from solution and larger particles are screened by the narrow pores of the in-situ gravel.

5.6. Wetlands

Wetlands, where required, will be designed as off-line devices. Wetlands detain flows to allow sediments to settle, and also remove a significant proportion of contaminants by adhesion to vegetation and aerobic decomposition. Vegetation is an integral component of the wetland system and assists each of the treatment mechanisms. It reduces velocities and turbulence, provides significant surface area for silt adhesion and reduces dissolved metals and nutrients through biological uptake. Wetlands can also provide peak flow attenuation and provision of extended detention if it is determined to be required.

5.7. Proprietary Devices

These are typically underground filtration devices that treat stormwater and remove contaminants. They are useful in constrained areas where more natural forms of treatment are not possible. For this project, they will be considered in a number of locations where the grades are steep, space is constrained and to supplement the treatment provided by other devices.

5.8. Level Spreader

This is a feature at the end of a linear treatment device (eg swale or rock-filled channel), used to turn out the concentrated flow and direct it along a contour, and thereby allow sheet flow to ‘spill’ down a vegetated embankment. These are designed to receive only the water quality flow, with larger peak flows bypassing down a protected channel to a discharge point. The level spreader provides an additional degree of treatment over and above the primary treatment device, in a similar manner to a buffer strip.

5.9. Untreated Stormwater Discharge

There are no locations of surface water runoff from the proposed carriageways being discharged to the environment without pre-treatment.

6. Catchment Flooding

The drainage design will allow the project to comply with the conditions of the Resource Consents. The design will be informed by appropriate hydrologic and hydraulic modelling. The hydrologic and hydraulic design criteria to be adopted for the TG Project are outlined below.

6.1. Hydrology

A hydrologic analysis of the rainfall – runoff process will be undertaken to quantify flows of varying storm event magnitudes. Catchment areas for the various stream systems within the vicinity of the designated project corridor will be defined using the available topographic contour information and site survey. Detailed hydrologic models will be established for the purposes of estimating design flows within the streams traversed by the alignment.

6.2. Hydraulics

Hydraulic modelling of the Te Puka and Horokiri Streams will be undertaken using HEC-RAS or other appropriate software to assist with the assessment of the stream diversions and bridge waterways. A detailed two dimensional (2D) model of the Pauatahanui Stream has been established and will be updated as necessary to inform the design development around the SH58 interchange.

6.3. Flood Levels

For all bridge structures, the top flood level has been confirmed to not be greater than 1.2m below the bridge soffit during a 1% AEP event. For the proposed works at SH58 intersection, the predicted impact of flooding is within the limits presented during the project's consenting process.

7. Operations and Maintenance Considerations

Access and the on-going maintenance requirements must be considered in conjunction the O&M teams who will be responsible for maintaining the infrastructure over the operating term.

Maintenance of the planting provided as part of the Project, and specifically that provided for water quality treatment will require, approximately, monthly inspections until it is considered the vegetation is establishing.

Maintenance check sheets and any residual health and safety matters relating to the drainage infrastructure, which could not be eliminated during either design or construction, will be provided post construction.

8. Glossary of Terms and Abbreviations

Term/Abbreviation	Definition	Reference / Source
Major Culvert	Defined as a culvert with a waterway area greater than 3.4m^2	NZTA Bridge Manual Section 1 Design Statement (June 2003)
Treatment Trench	A trench with single size aggregate filled to a depth based upon the water quality volume required and with a nominated void ratio	
Catch Drain	Typically small size drains formed above the cut face batter to intercept and divert 'clean' runoff and minimise erosion issues	
Bench Drain	Benches formed as part of the cut batter intercepting 'clean' runoff	
Swale Drain	Shallow drains to convey runoff to the downstream receiving environment. Functions to slow down stormwater flows and provide further treatment opportunity to remove coarse to medium sediments	
Debris Torrent	A stormwater flow with rock / solid debris in suspension	
Main Stream	A river / stream geographically referenced	Technical Report #14
AEP	Annual Exceedance Probability	
ARI	Average Recurrence Interval	
PE	Polyethylene Pipe	
RCRRJ	Reinforce Concrete Rubber Ring Joint	
HEC	Hydraulic Engineering Circular	
NIWA	National Institute of Water and Atmospheric Research	
HIRDS	High Intensity Rainfall Design Systems	
TSS	Total Suspended Solids	
NZTA	New Zealand Transport Agency	

Appendix 10: [redacted]

[redacted]