4 Project-wide design principles

4.1 Urban and landscape design concept

The overall concept underpinning the urban and landscape design of the Transmission Gully Project is to:

- Create an 'open sky' highway with expansive views of the surrounding landscape unobstructed by structures - a result of the main alignment sitting above all interchanges and local roads;
- Emphasise the linear character of the highway as a landscape 'fault line' – a reflection of underlying geomorphology and reinforcement of the road as a continuous landscape element and experience in its own right;
- Emphasise the existing landscape patterns perpendicular to the highway – a reflection of existing natural landscape patterns and sense of place, and reinforcement of the road as providing connection with the broader landscape;
- Emphasise the interchange with SH58 with a landscape treatment incorporating new wetlands and tree planting; and
- Celebrate the threshold between the hill country and the urban area at the southern end of the route through sculptured earth form and a gateway underpass design.

The concept is supported by a number of design principles which are presented in the following sections.

4.2 Landscape design principles

Highway Principles

- Design the highway and associated elements to emphasise the highway's linear character, horizontal lines and sharp edges;
- Minimise the overall construction and final footprint of the road;
- Select a coherent suite of highway furniture, using a common language and consistent scale, form, materials, colours and spatial arrangements; and
- Minimise visual clutter of highway furniture elements:
  - Limit the variety for each type of element (for instance by limiting types of safety barrier);
  - Limit the materials and colours for the range of elements;
  - Use recessive colours;
  - Avoid ornamentation;
  - Configure elements to a consistent spatial pattern (for instance the location of sign posts relative to the carriageway); and
  - Use earth contouring and clear zones where practicable in order to reduce the extent of barriers.

Landscape Principles

- Restore vegetation in a bold manner using limited species palettes and broad spatial patterns in order to fit the scale of the landscape;
- Design re-vegetation to be contiguous with vegetation patterns beyond the corridor;
- Emphasise the underlying topography, for instance by establishing riparian vegetation along streams and retaining intervening spurs in pasture; and
- Reinforce the experience of the landscape traversed by road users:
  - Emphasise the contrasting character areas through vegetation selection and response to the topography and adjacent land uses;
  - Create a pattern of enclosure or openness that reflects the adjacent landscape character;
  - Highlight local materials such as greywacke rock and native vegetation;
  - Ensure that the opportunities to provide key landscape views for road users are not lost by poor detailing; and
  - Maintain where practicable adjacent landscape patterns across the highway.

Connection between Highway and Landscape

- Limit the 'in-between' space between the highway and adjacent landscape, and strengthen the extent to which the highway sits within the landscape;
- Create a hard / sharp edge between the shoulder and adjacent vegetation, bringing the existing and re-instated vegetation right up to the road where practicable (i.e. avoiding an in-between strip of ground) and reducing the need for herbicide maintenance;
- Extend adjacent land use and vegetation patterns as close to the highway shoulder as possible consistent with safety requirements; and
- Continue underlying landscape patterns on both sides of the highway so that the highway is not a boundary between different landscape patterns.

-

4.3 Earthworks design principles

General principles

The design of earthworks should:

- Minimise the overall footprint of the road;
- Minimise the visual effects of earthworks;
- Avoid or minimise encroachment into water courses and bodies and areas of indigenous vegetation; and
- Seek to respond to, and reinforce the adjacent natural landscape and landform taking into consideration soil and rock types, fault lines, route security and existing services.

Cut batters – Steep Topography (sections 2,3,7,8 and 9)

The cut batters are a significant design issue because of their size in some locations, (particularly at Te Puka Stream / Horokiri Stream in the north and Porirua East / Linden in the south), and the fact that benching is required in order to maintain route security. The underlying rock is not stable enough to enable steep rock faces and benching is also considered beneficial in arresting rock fall onto the road. Alternatively, to avoid benching by adopting a shallower batter slope angle is not desirable given the very steep hill faces in parts of the route.

The following design principles are recommended to reduce the visual impact of the batters:

- Minimise the number of benches;
- Maximise the height from the road to the lowest bench (for instance >15m);
- Maximise the height between the top bench and the top of the cutting (for instance by grading top batter into adjoining slope and/or extending the top batter to >15m in order to avoid short terraces near the top of the cutting);
- Round the perimeter of the cutting (top and sides) to avoid sharp angles and avoid frittering of soil from the edges;
- Round the front edges of benches;
- Align the benches horizontally rather than parallel to the carriageway surface; and
- Promote re-vegetation of batters with techniques including hydro-moss and hydro-seeding in order to reduce prominence and geometric appearance of benches and to assist in mitigating potential stability and rock fall issues. Where appropriate implement a staged re-vegetation by establishing a grass cover initially, followed by longer term plants once a biological layer is established.

Cut Batters – Rolling topography (sections 1,4,5 and 6)

Where terrain is rolling with reduced batter heights, the best landscape option is to flatten the batter slope so that earthworks merge with adjacent terrain and so that cut batters can be re-topsoiled and re-vegetated:

- Grade batters to a slope of 20-30 degrees in rolling terrain where the batter height does not exceed 20m;
- Scarify cut face to assist retention of topsoil; and
- Re-spread topsoil and re-vegetate as appropriate in order to match adjacent land use.

Fill Batters – Steep topography (sections 2,3,7,8 and 9)

Apply the following principles in areas such as the Duck Creek section of the route, and/or where there are other environmental constraints, for instance in order to avoid encroaching into Te Puka and Horokiri Streams:

- Maximise the fill batter slope in order to reduce the footprint of earthworks and to reflect the steepness of adjacent natural slopes. For instance 1H:1V fill batter slopes achieved by use of reinforced earth batters;
- Re-grass or re-plant fill batter slopes to match adjacent landuse; and
- Install special engineering to further steepen batter faces where necessary to avoid encroaching into natural stream beds or significant vegetation.

Fill Batters – Rolling topography (sections 1,4,5 and 6)

In locations where fill batters do not extend into streams or ephemeral watercourses:

- Minimise fill batter slope in order to merge with surrounding terrain, and to facilitate re-vegetation to merge with surrounding land use.

Photo 4.1: Steep mono-slope without bench

Photo 4.2: Benching

Spoil Disposal Sites

- Locate spoil disposal on areas near watersheds such as broad spur summits, plateaux and natural benches, and shallow basins at the heads of catchments. Avoid locating spoil disposal sites in stream or ephemeral watercourse valleys;
- Locate spoil disposal preferably on areas of pasture so as to avoid areas of native bush or other significant vegetation as much as possible;
- Maintain low profile by restricting spoil disposal to a maximum 3m depth with rounded edges. It is preferable to occupy a larger footprint with low profile landforms on less sensitive sites than to create deep disposal sites in sensitive areas; and
- Strip, stockpile and re-spread topsoil over completed spoil disposal sites and re-plant with species that reflect original vegetation patterns and merge with adjacent land-use.

Slope Stabilisation

Given variations in geology along the length of the Project route there may be instances where localised slope stabilisation measures are required. Such measures may include (but not be limited to) reinforced soil embankments, rock bolts and anchors; soil nails; shotcrete; dental concrete and mesh.

- Limit the use of these measures and ensure they are as visually recessive as possible;
- Avoid a high number of interventions creating visual anomalies along the route. Large sections of visually prominent stabilisation structure should also be avoided if alternatives that satisfy both structural and visual parameters are practicable;
- The use of shotcrete should be avoided if other practicable alternatives exist. Where shotcrete is required then methods such as pigmentation and surface treatment should seek to mimic adjacent natural material;
- Where mesh, wire baskets, hydroseed and other materials can be used to provide medium for plant growth on stabilised slopes, they should be preferred over concrete finishes.

Rock Fall Protection

The primary focus is to achieve passive rock fall protection through cut face configuration and vegetation in the longer term. There will be instances along the Project route where localised rock fall structures will be required to ensure safety and route security issues are addressed.

- In the first instance draped netting should be used to address rock fall, allowing the surface profile of the cut face to be retained and becoming visually recessive over time through the inclusion of vegetation;
- Where rock fall fences are required at road level they should be:
  - incorporated into any safety barrier;
  - located on the same alignment as other furniture such as light poles or signs;
  - constructed of similar materials to adjacent road elements; and
- Where rock fall fences are required on benches they should be constructed out of 'light' materials and set back from the front edge of the bench to reduce visual prominence. The focus should be on visual continuity and rock fall fences being part of a suite of road side furniture that promote visual continuity along the route.

4.4 Structures design principles

4.4.1 Bridges

Bridge designs conform with the Structure Design Philosophy which is influenced by a number of key factors including:

- Cost efficiency with consideration for whole of life cost: Wherever possible bridges have been avoided in preference to embankments due to the disproportionate cost of structures when compared to earthworks;
- Regional network security in the event of a large earthquake: Highly redundant bridge forms and seismically proven MSE retaining walls and 45 degree reinforced soil slopes have been selected for the Project;
- Environmental and social considerations: In some locations bridges have been selected instead of culverts to minimise the structure's footprint, sediment movement and flow velocity and to maintain fish passage. Aesthetics considerations have informed bridge designs. The number of construction tracks has been minimised through careful choice of structural form;
- Durability and maintenance: High durability, long lasting coating systems (up to 40 years to first maintenance) have been assumed in the costing of steel bridges. Concrete elements in bridges and retaining walls will be designed for a 100 year design life and will require little if any maintenance; and
- Aesthetics and visual effects: Clear structural lines and unadorned, neat concrete finishes have been selected. Bridges with fewer larger piers have been selected over solutions with many smaller elements to minimise the visual and physical effect of the bridges on the landscape. Superstructures which provide elegant uncluttered solutions have been selected in highly visible or landscape sensitive locations. A consistent treatment of abutment wrapped with MSE walls is the preferred approach to provide continuity of design through the Project.

More detailed bridge design principles are listed below.

Where bridges are visible from surrounding communities, regional parks or the highway itself, the following design principles apply:

- Bridges should complement their context. This means considering factors such as, but not limited to, the topography, location of watercourses, the rural or urban setting, the bridge visibility, presence of valuable vegetation or ecology features, proximity to houses or open spaces and the presence of pedestrian or cycle paths across or in the vicinity of the bridge;
- Design bridges to be recognisable as part of the Transmission Gully Project 'family', with individual variations reflecting the requirements of their specific setting;
- The relative proportion of structural elements should be carefully considered to minimise the bridge profile, achieve balance, and create a simple, elegant whole. Seek to equalise or balance spans;
- A play of light and shadow on a bridge can reduce the apparent mass and bulk of the structure and balance its vertical and horizontal proportions. Sloping all or part of the outer face of the side barrier inwards to catch the sunlight, extending the barrier down past the deck and recessing beams to create a shadow line, will reinforce the horizontal lines of the bridge;
- Barriers depth should be carefully proportioned in relation to the deck and superstructure. Barriers should be extended well past abutments to anchor the bridge in the landscape. Sloping the top of the barrier inwards towards the deck will minimise water staining on the outer face of the barrier. Barriers should have minimum embellishments, with any surface treatment used only to reinforce the clean lines of the bridge;
- Design bridge barriers with a skirt to conceal the full depth of the deck (girder and rc slab deck) and drainage pipes;
- Where the road corridor is constrained, closed (vertical) abutments should be carefully designed and detailed to present a high quality finished appearance. Along Collins Avenue, where the abutments will be seen at close range by pedestrians, cyclists and motorists, their design should incorporate finer grain details, textures, artwork or colour scheme;
- Structures that eliminate the need for cap beams (headstocks) and enable simple, elegant girder to pier connection are preferred. Where cap beams are required, minimise length of cap beam beyond last girder;
- Where practicable, the preference is to drop the pile to column connection to be fully below ground;
- Where a bridge crosses over a local road or pedestrian / cycle path, to provide a light well in the median if practicable;
- Any bridge lighting and drainage should be integrated with the structure, leaving the external surfaces of the bridge free of drainage pipes or services. Lighting design and selection should incorporate protection against vandalism;
- Locate highway lighting columns to respect the visual rhythm of the bridge. This can be achieved by aligning the columns with bridge piers or laying them out symmetrically on either side of the piers;
- Select durable materials and finishes that do not significantly degrade in appearance over time; and
- If required, a clear, matte anti-graffiti coating should be applied to the full extent of piers, MSE walls and barriers at the bridge construction phase to prevent patchy application and appearance at later stages.

All the bridges within this Project were assessed early on to determine the appropriate level of aesthetic treatment required, if any. The bridges were classified based on their visibility for road users and the local community. Those bridges which will be visible from the surrounding communities, Regional Park tracks or the highway itself are subject to aesthetic considerations as outlined in this Framework. The considerations are of two types:

- The bridges which will be visible from a long distance are subject to design principles relating to their overall form.
- The bridges which will be visible at close range by pedestrians, cyclists, residents and road users are subject to design principles relating to their detailed design and finishes.

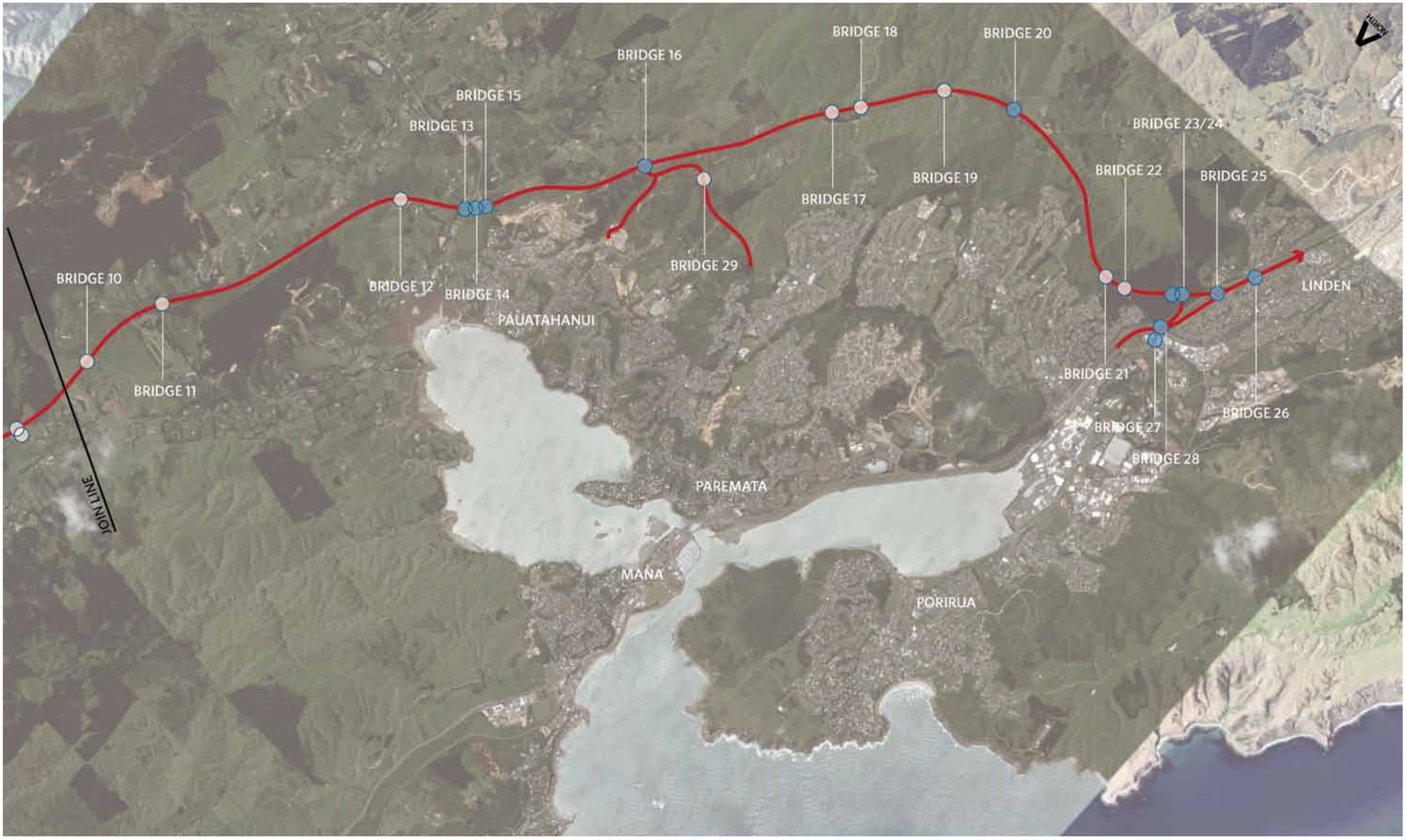
The bridges which are subject to aesthetic considerations are highlighed on Figure 4.2.

Photo 4.3: Feature lighting for gateway location

Photo 4.4: Elegant profile: Twin haunched girder bridges

Photo 4.5: Bridge barrier extends down to conceal girder

Figure 4.1: Location of bridges along the Transmission Gully Route


BRIDGE 10
BRIDGE 11
BRIDGE 12
BRIDGE 13
BRIDGE 14
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BRIDGE 16
BRIDGE 17
BRIDGE 18
BRIDGE 19
BRIDGE 20
BRIDGE 21
BRIDGE 22
BRIDGE 23/24
BRIDGE 25
BRIDGE 26
BRIDGE 27
BRIDGE 28
BRIDGE 29
JOIN LINE
PAUATAHANUI
PAREMATA
MANA
PORIRUA
LINDEN

4.4.2 Underpasses

Where underpasses accommodate public pedestrian and cycle access the following design principles apply:

- Underpasses should offer a straight route so that one end of the underpass is visible from the other. Bends and angles in the underpass should be avoided as they create hidden places which encourage vandalism, crime and anti-social behaviour;
- The walls of the underpass should not have recesses where litter might accumulate or someone might hide;
- Underpasses should be as wide and high as possible to maximise light penetration, visibility and amenity;
- The underpass should have appropriate internal lighting levels. Median skylights should be provided where practicable. Artificial lighting should be provided where natural light is insufficient;
- The underpass should be at grade with the surrounding land. Alternatively, the approach ramps should be gradual enough to accommodate pedestrians and cyclist safely and provide sufficient forward visibility;
- Planting around the underpass entrances should not obscure sightlines to and from the underpass;
- Feature paving, wall and ceiling treatments, lighting and artworks should be considered to create a pleasant environment in the underpass and should complement any external components;
- Robust, long-life, vandal-proof materials and lighting should be used in the underpass to minimise maintenance; and
- Adequate drainage systems should be provided in the underpass to allow for satisfactory disposal of run-off and prevent flooding and pooling.

Photo 4.6: High quality wing wall treatment

Photo 4.7: Feature wall and ceiling treatment

Photo 4.8: Median skylight provides daylighting

4.4.3 Culverts

Where culverts will be visible to the surrounding communities, regional parks visitors or highway users, the following design principles apply:

Headwalls

- Minimise culvert length by maximising fill batter gradient for fill embankments across streams and ephemeral watercourses. Preferable gradients are 1H:1V achieved by reinforced earth techniques;
- Construct sloping culvert portals to the same gradient as adjacent fill batters; and
- Where armoring is required use local materials where practicable, and techniques that blend in with the surrounding landscape. Preference is for a natural finish.

Energy Dissipation and Fish Passage

Construct culverts to 'fish friendly' principles: [in accordance with ecological report]

- Set culvert as shallow gradient;
- Install below natural bed of stream to enable natural material to build up on base of culvert;
- Insert natural durable rock within base of culvert to assist build up of natural material and to provide fish passage following storms;
- Construct rock ladders below downstream portal to prevent scouring and to avoid perched culverts; and
- Use sprat thread where appropriate.

4.4.4 Retaining walls

- As a first preference in rural sections of the alignment, use engineered fill vegetated to match adjacent land-use instead of retaining wall;
- Where vertical structures are required use concrete slabs (MSE panels) with exposed greywacke rock surfacing;
- The top of individual MSE panel units should be cast with former inserts to follow the slope of the bridge deck above or soil behind and achieve a neat straight line. Avoid stepping top of MSE wall down or cutting units on site to achieve a consistent slope as this rarely results in a neat finish. Avoid bulky edging units;
- When wrapping an MSE retaining wall around a bridge abutment, the gap between the structure and MSE wall should be minimised, subject to constructability and cost considerations; and
- When wrapping an MSE retaining wall around a bridge abutment, the top of the MSE wall should line up with the top of the abutment cap.

Photo 4.9: Vertical MSE retaining wall wrapped around bridge abutment

Photo 4.10: Neat finish of angled top of MSE wall

Photo 4.11: Feature MSE wall panels for high visibility location

4.5 Planting design principles

General

- Design planting to emphasise the underlying landscape and reflect adjacent land use and vegetation patterns;
- Emphasise underlying topography, for instance by establishing riparian planting along margins of streams but leaving spurs in open pasture;
- Plant in a bold manner using restricted species palettes and broad spatial patterns in order to suit the scale of the landscape;
- Design vegetation within the corridor to achieve continuity with vegetation and land use patterns beyond the corridor;
- Replant cut and fill batters with simple palette of pioneer shrubland species;
- Ensure that underlying landscape patterns continue on both sides of the highway. The highway should not create a new boundary between different land uses or vegetation patterns;
- Plant in a way that creates a sequence of enclosure and openness that reflects the surrounding landscape;
- Extend land use and vegetation patterns as close to the carriageway as practicable;
- Design the highway (including storm water infrastructure and highway furniture) and so that there is a sharp edge between highway and adjacent landscape. Avoid in-between space between highway and adjacent land use and vegetation patterns; and
- Design planting to reflect character areas as follows:

Streams

- Re-vegetate margins of all streams crossed by the highway in order to emphasise natural topography, enhance habitat and improve water quality;
- Use riparian and margin species indigenous to the area; and
- Extend planting to the embankment fill batters at all stream crossings. Use species that are appropriate for the conditions on fill batters and that merge with the character of the adjacent stream planting. Use low species at the top of embankments in order to maintain views along stream valley.

Cut Batters

- Re-vegetate cut batters with a simple palette of low-growing pioneer shrubland species where practicable;
- Select species to respond to adjacent landscape character; and
- Establish pasture between top bench and top of cut batter (fence on top bench) where such pasture merges with adjacent land use.

Fill Batters

- Rehabilitate fill batters to merge with surrounding landscape patterns;
- Merge re-vegetation on fill batters with adjacent riparian planting at stream crossings; and
- Overfill and re-grass fill batters where they merge with existing pasture. In such instances the fence-line might be located inside the designation so that the adjacent land use appears to extend as far as the road corridor.

4.6 Noise barriers design principles

The location, type and height of noise barriers required to mitigate the operational noise effects of the Project have been determined in accordance with New Zealand Standard 6806 'Acoustic – Road Traffic Noise – New and Altered Roads'. The standard assists with the determination of best practicable noise mitigation options by adopting a multi-disciplinary approach. Specific urban design, landscape and visual effects criteria were included in the assessment of noise mitigation options as follows:

- Maintenance or enhancement of visual amenity for surrounding residents;
- The extent to which the mitigation option promotes integration and establishes visual coherence and continuity of form, scale and appearance of structures and landscape proposals along the route;
- Road users' views to the surrounding landscape and key features / locations;
- Utilisation of materials that reflect the character of the location and reduce the use of non-renewable materials;
- Maintenance or enhancement of the convenience and attractiveness of pedestrian and cycle networks;
- Maintenance or enhancement of safe routes to school;
- Impact (land take, amenity and usability) on community facilities (reserve, school, playground, playing field, etc);
- Public access to coastal marine areas, streams or lakes; and
- Public safety and security.

In applying the above criteria, consideration was given to the potential for noise walls to over-shadow properties, block sight lines for surveillance purpose or block significant views of the surrounding area both towards and from the road. In selecting the appropriate wall height, the multi-disciplinary team aimed to strike a balance between noise mitigation and the visual impact of the wall. Where appropriate, earth bunds and other noise control methods such as low noise road surfaces and solid safety barriers have been selected in preference to noise walls. Long sections of noise wall on both sides of the road have been kept to a minimum.

The following principles should guide the detailed design of the noise barriers:

- The slope and landscape treatment of noise bunds should integrate with the surrounding landform and landscape character;
- Noise walls should integrate with the corridor-wide landscape concept and complement the road structures, landscape treatment and safety barriers;
- Noise walls should be designed as three-dimensional objects with two faces performing different functions. The road face is viewed at speed by road users. Their perception is fleeting and only bold designs, geometric patterns and the overall shape of the wall will be viewed. The road face should not have intricate detail that could distract drivers. The outer face is viewed from the surrounding area as a static, permanent feature in the environment and depending on the proximity of viewers, construction and design details may be visible and should be a of high quality;
- To minimise the visual impact of noise walls, minimise changes to the horizontal alignment and balance changes to the vertical alignment to create regular steps or a single sloping line joining the tops of the wall units. Separate and overlap walls to accommodate any necessary changes in height, horizontal and vertical alignment, form or material. Consider tapering the ends of walls into adjacent landforms;
- In areas where noise walls are recommended on both sides of the road, both sides should be designed together as an overall composition;
- Planting should be used to deter graffiti, help integrating the wall with the surrounding landscape or provide an attractive interface to nearby properties, reserves (such as Mahoe and Arthur Carman parks in Linden) and paths. Planting should allow for access to the wall for maintenance;
- Materials should be of high quality and long-lasting to minimise on-going maintenance costs; and
- The overall shape of the noise wall, the finer detail of its alignment and the surface colour and texture are the key aspects to be addressed at the detailed design stage.

Photo 4.12: Noise bund planted with native species

Photo 4.13: Simple wall profile through sloped area

Photo 4.14: Amenity planting in front of noise wall

4.7 Pedestrian and cycle links design principles

The Transmission Gully Project Main Alignment will be a motorway under section 71 of the Government Roading Powers Act 1989 (GRPA). Consequently, no pedestrian or cycle path will be provided alongside the Main Alignment. Some pedestrian and cycle links will however be provided in areas where the Project crosses or joins the local road network, as may be appropriate.

Shared and cycle paths

- Shared paths are for use by pedestrians and low speed recreational cyclists. Path gradients will be consistent with NZ accessibility standards where possible;
- Cycle path gradients should be 10% or less where possible;
- Shared and cycle paths should be continuous and link with existing and planned open space and pedestrian / cycle networks;
- Shared and cycle paths should be direct and convenient to use, with vertical and horizontal alignment variations 'smoothed out';
- Shared and cycle paths should provide good amenity with adequate path width and separation from carriageways. The berm should be wide enough to accommodate landscape treatment;
- Locate and design paths and adjacent landscape treatment to allow informal surveillance between the path and adjacent road or land use activity;
- Design paths to maximise forward visibility and minimise the potential for pedestrian-cyclist conflicts; and
- Any drainage grates should be designed and located to minimise hazard risk to cyclists and pedestrians.

Cycle lanes

Any cycle lane proposed as part of the Transmission Gully Project should follow NZTA's guidelines for cycle lanes. As a minimum they should comply with the following:

- The width of the cycle lane will vary with the speed limit of the adjoining road. GTEP Part 14 NZ Supplement states minimum widths of 1.5m, 1.9m and 2.5m for speed limits of 50kph, 70kph and 100kph respectively;
- Cycle lanes should have an even and continuous sealed surface;
- Cycle lanes should be identified by cycle pavement marking symbols. Other distinguishing features such as coloured surface may also be used; and
- Audio-tactile pavement marking should be used to make the edge of the carriageway unless this is precluded because of proximity to adjacent residential properties.

Tramping tracks

The Project provides opportunities for new tramping tracks to be provided by other organisations along or across the Project corridor to connect existing tracks and create a continuous route. A potential track spanning the entire Project corridor is illustrated on Figures 4.2 and 4.3. The following design principles would apply:

- Tramping tracks generally follow the lie of the land. The detailed alignment of the track will preferably follow the less steep grounds along ridges and spurs and provide adequate visual and physical separation from the highway;
- Tracks surfaces will generally be the natural ground;
- Some vegetation can be cleared to ensure there are clear passage and a clear view of track markers. Native vegetation removal will be avoided or, if unavoidable, minimised;
- Direction signs are to be placed at all track entrances, and at junctions or crossings point where there is a risk of getting lost; and
- Watercourses should be bridged where no reasonable alternative safe wet weather track exists.

Photo 4.15: Informal shared pedestrian and cycle path

Photo 4.16: Shared walking and horse riding track

Photo 4.17: Footpath separated from road by grassed berm

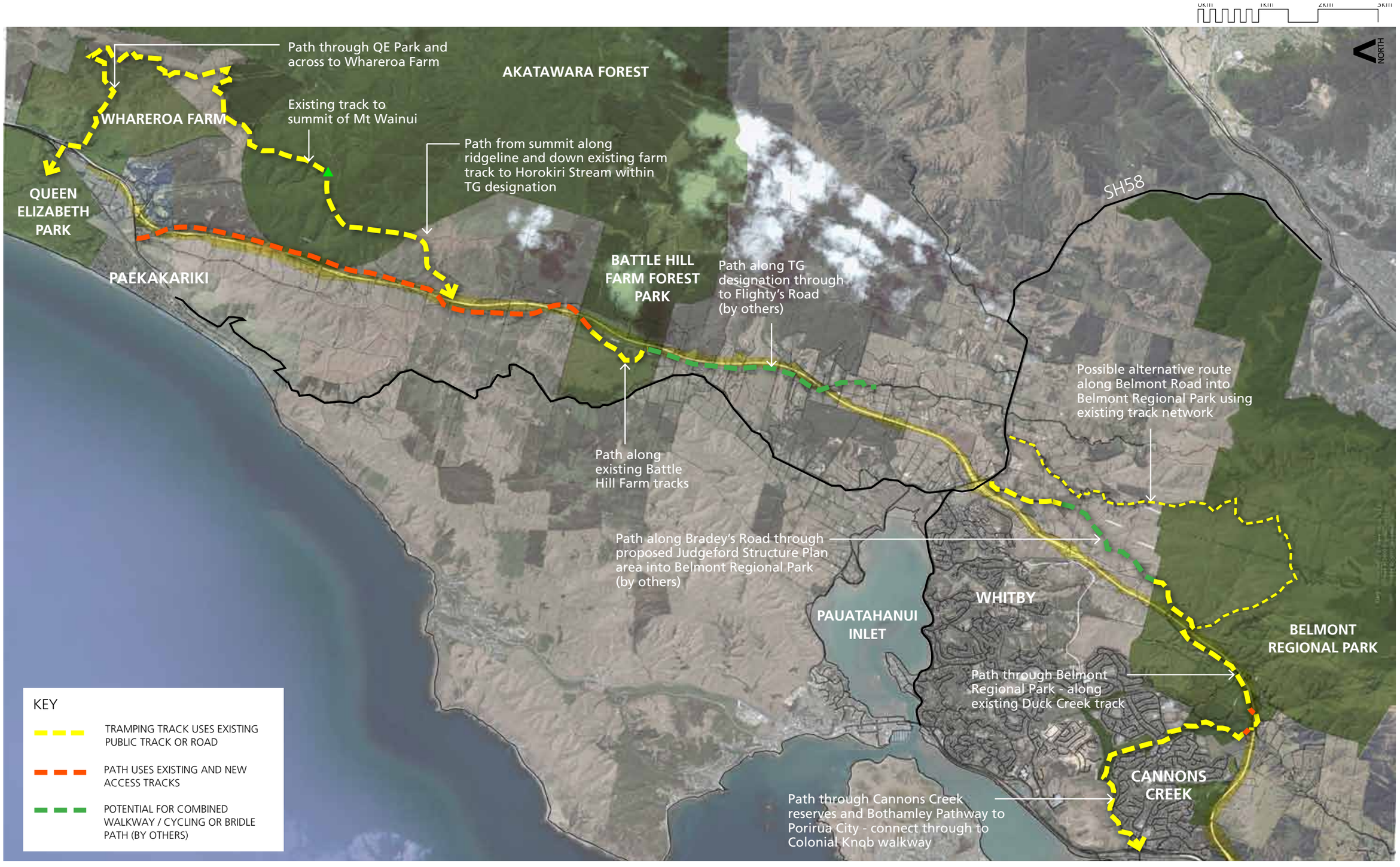

Figure 4.2: Route of possible tramping track - Overall route from Queen Elizabeth Park to Belmont Regional Park

Figure 4.3: Route of possible tramping track between Mt Wainui, Battle Hill and SH58

4.8 Stormwater devices design principles

Stormwater 'treatment trains' combine the functions of two or more different stormwater treatment methods to provide improved treatment capabilities, to reduce the risk of environmental impacts if one part of the system fails or is being maintained and to achieve other objectives such as flood mitigation and aquatic ecosystem protection. A common treatment train combines sumps (to trap gross pollutants) swales and wetlands. Treatment trains including swales and wetlands have been recommended along this alignment wherever the site conditions (primarily topography and soil type) are suitable. The location of wetlands and swales is shown on Figure 4.4.

Wetlands

- Wetlands are preferred over deeper ponds as they minimise drowning hazards and have better overall water quality treatment;
- Wetlands should be designed with the multiple roles of stormwater treatment, landscape amenity feature and ecological habitat;
- Optimise the natural character of wetlands through their shape, edge profile and landscape treatment;
- Integrate recommended wetlands with the surrounding pedestrian and cycle networks;
- Design the edge of wetlands to be shallow and vegetated so as to prevent accidental access whilst reducing the need for fencing; and
- Integrate recommended wetlands with natural stream environments to connect them visually and ecologically, if not hydrologically.

Roadside drainage

- Swales will need to include vegetation to assist with storm water treatment and should utilise concrete beam adjacent to the edge of the carriageway and greywacke armouring where appropriate. Vegetation within swales will create a backdrop to side barriers and emphasise the horizontal line of the highway; and
- Use kerb and channel in locations where space is constrained.

Photo 4.18: Boardwalk along wetland

Photo 4.19: Wetland at MacKays Crossing

Photo 4.20: Wetland at MacKays Crossing

Figure 4.4: Road catchment suitable for treatment by wetland and swales

4.9 Highway furniture principles

4.9.1 Side barriers

The use of side barriers should, in the first instance, be avoided through the overfilling of fill batters.

Where side barriers are required (excl. bridges) for safety reasons either low earth mounds or steel (w-section and or thrie-beam) barriers should preferably be used:

- The height of all barriers should be kept to a minimum to retain views beyond the carriageway;
- Where short sections of barrier are required (i.e. between cut faces) earth mounds are the preferred option. Short sections of steel barrier should be avoided;
- Where barriers are required on both sides of carriageway they should be the same;
- The profile and surface treatment (e.g. vegetation or grass) of earth mounds should be consistent with adjacent land forms and treatments (e.g. cut batters) and should transition smoothly into these features or finished ground level. Abrupt and hard ends to barriers should be avoided; and
- Where both noise mitigation structures and safety barriers are required they should be integrated so they appear as a common element ensuring visual coherency and limiting visual clutter.

Where side barriers are required on bridges, the preference is that these should:

- Be concrete.
- If TL5 standard is required use Texas HT profile with elliptical top rail, as per RoNS Guidelines;
- The barrier length should be at least as long as the bridge span;
- Where earth mounds or cut faces are located adjacent to the end(s) of a bridge the concrete side barrier may extend a short distance beyond the bridge footprint and tie back to finished ground level to provide a smooth transition;
- Where steel barriers are located adjacent to the end(s) of a bridge the transition should be concrete/ thrie bean/ w-section tying into finished ground level; and
- Whilst coloration of concrete barriers is acceptable it should be subdued. Other surface decoration such as application of motifs etc should be avoided.

Where side barriers are required on underpasses and culverts, the preference is that these should:

- Be steel (w-section and or thrie-beam);
- Where barriers need to extend beyond the footprint of the underpass/ culvert they should be kept to a minimum and tie into finished ground level; and
- Where the underpass/ culvert is of a suitable span a thrie-beam barrier should be used transitioning into a w-section beyond the footprint and tying into natural ground level.

4.9.2 Median barriers

- It is not proposed to provide a grassed central median, as this would require widening the footprint and would result in much greater earthworks given the steep topography;
- Preference is for a consistent concrete barrier along the length of the highway (incl bridges, overpasses and culverts). Wire rope should be avoided, except where viable alternatives do not exist; and
- Whilst coloration of concrete barriers is acceptable it should be subdued. Other surface decoration such as application of motifs etc should be avoided.

Photo 4.21: Neat transition from steel barrier to concrete

Photo 4.22: Concrete median barrier

Photo 4.23: Lightweight steel barrier supports

Photo 4.24: Railing on top of concrete barrier

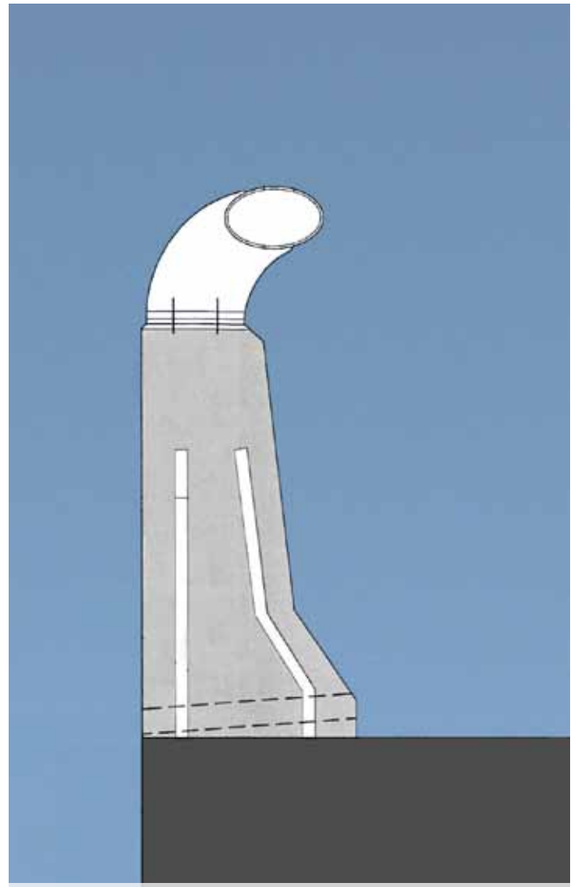

Photo 4.25: TL5 bridge barrier with elliptical top rail

4.9.3 Lighting Columns

Lights are not required for the majority of the Main Alignment, which will reduce the potential visual clutter and night-time light effects. Lights are only recommended in the vicinity of the interchanges and the short section of the Main Alignment between the SH58 and James Cook Interchanges. In these areas:

- Design light standards as part of a coherent suite of highway furniture, and to be visually recessive;
- Adopt steel light standards with a plain galvanised finish;
- Preference is for light standards with either a sharp angle between pole and arm, or fix fittings directly to the pole;
- Use consistent heights within each group of light standards (for instance within each interchange) in order to reduce visual clutter; and
- Adopt consistent column design for CCTV cameras.

4.9.4 Protection of Roadside Furniture

- Configure edge barriers in such a way to avoid the need for additional protection of structures or utilities adjacent to the highway; and
- Use frangible elements in any locations where there are no edge barriers to provide protection.

4.9.5 CCTV

- Adopt design for CCTV camera standards that is either combined or consistent with light standards.

4.9.6 Sign Gantries and Signage Posts

- Construct gantries so that beams and pillars join at right angles. Preference is for square box section, I beams and flat steel components.
- Construct pillars to prevent unauthorised access without the need for such secondary fittings as barbed wire;
- Use simple steel posts for smaller signs installed adjacent to highway;
- Paint gantries a metallic colour that complements weathered galvanised steel;
- Where possible, signage should be visually contained within the depth of the spanning girder, through integrated design of girders and signage panels.
- Signage for road users is not permitted to be mounted on pedestrian overbridges (if present).

Photo 4.26: Simple orthogonal light standards

Photo 4.27: Orthogonal signage gantry

Photo 4.28: Orthogonal signage post

Photo 4.29: Single support signage at off-ramp

Photo 4.30: Well integrated girder and signage panels

Photo 4.31: Light columns mounted to side of bridge