5.0 OPPORTUNITIES AND CONSTRAINTS

As an existing road corridor, within a developed suburban setting, there are a number of constraints which will influence the final design outcome. These constraints also provide opportunities to improve the character and identity of the road corridor within the context of the upgrade works.

Key Site Constraints include:

- Property boundaries with immediately adjacent noise walls which restrict road widening;
- Extent of space available for landscaping and screening of noise walls and retaining walls;
- Scope of project constrained to upgraded areas only;
- Devlins Creek which runs across and immediately parallel to the motorway;
- Topography in proximity to Norfolk Road Tunnel; and
- Heritage homestead curtilage on Windsor Road.

Constraints also exist in terms of the existing fabric of the road.

The upgrade works are constrained in scope to only those required to implement the upgrade. The urban design challenge is therefore to address the way the current fabric is changed where upgraded and how this relates to the existing structures. Whilst the existing built form is an unsuccessful urban design outcome which fails to meet current RTA standards, it is important that the relationship between the old and new is considered in the design process and not exacerbated by the new works. Design solutions therefore need to address the character of the existing Motorway built elements and provide solutions which compliment and improve the visual outcome of the Motorway built form.

Opportunities exist to improve:

- pedestrian, cyclist and vehicular connections across the Motorway corridor;
- open space networks;
- the travel experience along the motorway;
- the appearance of cuttings stabilised with shotcrete;
- the appearance of bridge and noise wall structures;
- the landscape design of the Motorway to respond the differing contexts;
- maintenance access;
- weed levels through the adoption of appropriate plant densities and treatments; and
- visual amenity through increased vegetation coverage in front of noise walls and on embankments.

The upgrade of the Motorway and the expansion of the existing carriageways brings with it the opportunity of addressing some of the shortcomings or failings of the present urban design. In addressing these issues the objective would be to unify the corridor and improve the appearance of the road thereby creating a stronger identity to the corridor. Elements where improved urban design outcomes can be implemented include:

- Noise walls (Refer to Section 5.1)
- Cuttings (Refer to Section 5.2)
- Bridges (Refer to Section 5.3)
- Retaining walls (Refer to Section 5.4)

5.1 Noise Walls

An opportunity exists to significantly improve the urban design of the existing noise walls along M2 Motorway corridor. The following design issues related to the different noise wall types are discussed:

- Location of the walls in relation to the Motorway and topography;
- Material selection - type, colour, texture;
- Use of planting to respond to context and create an improved visual outcome;
- Architectural detailing.

5.1.1 Noise Wall Location in Relation to the Road

Noise walls should either provide a sufficient setback for landscape screening or be a defined hard urban edge, closely coupled to the road.

Close Coupled Noise Wall

The close coupled noise wall can create a clean hard edge to the road that can reduce maintenance if detailed correctly (refer to Figure 5.1 and Photo 5.1). If a gap is left it may be affected by weed growth and become a collection point for debris.

In designing a close coupled noise wall the support structure, panel fixing and colour need to be carefully considered.

Noise Wall Relationship to Cutting and/or Retaining Walls

The alignment of noise walls on road cuttings can accentuate the verticality of the cutting.

Refer to Photo 5.2.

The scale of the wall may be reduced by providing additional revegetation in front of walls and/or increasing the setback of noise walls from the motorway.

Care needs to be taken so that the built element relates to and complements the character of the natural geology or the underlying retaining wall panel design.

Alignment of Noise Walls

Walls must use a consistent methodology to define their relationship to the road. Consideration of the noise wall alignment in plan and elevation is critical in achieving an integrated outcome, particularly in relation to retaining walls.

Refer to Photo 5.3.

Irregular and random setbacks can provide a profile which is distracting and provides poor visual amenity.

The profile of the walls should be as streamlined as possible. Random stepping to accommodate a slope should be avoided.

Refer to Photo 5.4.

Photo 5.1 Noise wall directly adjacent to concrete traffic barrier.

Photo 5.2 Sandstone cutting with shotcrete top edge and noisewall.

Photo 5.3 Noisewall on top of shotcrete wall at Pennant Hills Road Interchange.

Photo 5.4 Noisewalls with irregular stepping and offset from the road edge.

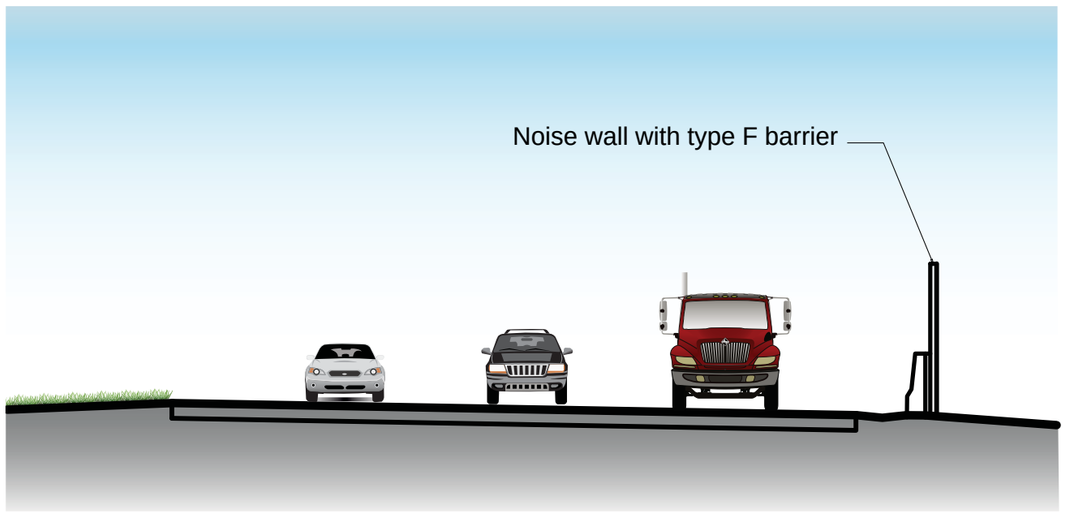

Figure 5.1 Close Coupled Noise Wall.

5.1.2 Noise Wall Materials Selection

Noise wall materials should be designed as part of a coordinated palette of materials, colours and textures. The profile of the walls should be as streamlined as possible. The following palette of noise wall materials should be considered.

Precast Concrete Panels

Precast concrete is useful and cost efficient when creating long lengths of repetitive panels. The material is strong, durable, versatile and a high quality finish can be achieved. Panel lengths can be determined to maximised post spacings and to suit the desired proportions and length of the individual wall. The detailing is important and looks attractive when the steel support structure is concealed. Contextually appropriate patterns can be applied to add interest and establish linear identity. (Refer to Photo 5.5)

Hebel Lightweight Concrete Panels

Hebel lightweight concrete panels are currently used for all walls on the M2 Motorway. This cost effective material is useful for matching with existing walls that require additional length or height. Care should be taken to achieve clean lines and a controlled top edge to the wall alignment. (Refer to Photo 5.6)

Transparent Panels

Best practice urban design utilises transparent panels to allow views of the surrounding context, specifically at bridge crossings. This provides the motorist with a visually pleasing journey experience and landmarks for orientation and way-finding. The panels can be acrylic or glass however, consideration must be given to the risk of vandalism. It is noted that other project priorities may also effect the choice of transparent versus solid panels. (Refer to Photo 5.8)

Absorptive Panels

Absorptive panels are used where higher acoustic performance is required. Absorptive surfaces have been applied at several locations along the Motorway and may be required to integrate into existing absorptive walls. Even when painted the same colour as typical walls, their visual appearance can differ markedly due to their rough texture and over time tend to collect more grime. (Refer to Photo 5.9)

Colour

As previously mentioned, the noise walls, despite efforts to camouflage the structures by painting them green, are a visually dominant element. There is an opportunity to provide a better colour palette which complements the existing green walls, references the surrounding bushland context and visually recedes into the context. Photos 5.7 and 5.10 illustrate the existing colour scheme versus use of a more blue/grey colour. Adopting a better grafitti managment policy, such as painting the whole panel rather than patching, may also improve the appearance.

Photo 5.5 Patterned precast concrete panels on the Pacific Highway.

Photo 5.6 Hebel wall with clean lines and top edge.

Photo 5.7 Existing colour scheme palette.

Photo 5.8 Transparent panels on a Pacific Highway bridge.

Photo 5.9 Absorptive panels adjacent to smooth panels.

Photo 5.10 Proposed blue/grey alternative colour palette.

5.1.3 Use of Planting in Front of Noise Walls

Landscape planting can be used to improve amenity and create landscape character. Where a wider space exists, the insertion of landscape in front of the wall can provide a heightened user experience along the corridor and better visual connection to the adjoining context. The following describes the different type of setbacks.

Wide Setback

This is where the setback behind a barrier is greater than 3 metres and can accommodate trees, shrubs or ground covers. The provision of a wide setback can dramatically improve the visual amenity in front of noise walls. The scale of the revegetation relates well with the built form as shown in Figure 5.2. Wide areas of planting provide amenity and soften the road corridor (refer to Photo 5.9), however, consideration needs to be given to additional maintenance requirements and their associated costs.

Narrow Setback

When the setback behind a barrier is greater than 1.5 metres and less than 3 metres it can accommodate shrubs and ground covers only. The use of ground covers only to the base of the noise wall can provide separation between the road pavement and the noise wall strengthening the architectural qualities of the noise wall.

The design of the traffic barrier needs to be considered in the adoption of the minimum setback. The present road alignment predominantly uses W-beam barrier or Type F barrier. These barrier types will be continued. When using a Type F barrier in association with planting consideration to filling behind the barrier is recommended.

Refer to Figures 5.3 and 5.4.

Where a minimal setback is adopted, planting needs to consider the environmental constraints (physical and micro-climatic). When the setback is too narrow, the success of the planting can be sporadic (refer to Photo 5.10). Three areas influence the success of this zone:

1) Ground preparation is critical for the plants establishment and long term survival.
2) Plant selection needs to be cognisant of the environmental constraints to achieve a successful and robust outcome.
3) Maintenance – landscape is a "living finish" and so will need some level of maintenance input.

When deciding on a treatment it should be remembered that sometimes having planting can be a worse response than to not have planting, due to the haphazard appearance of the planting and the difficulty of maintenance. In such instances it may be better to consider the whole of life cost and adopt a close coupled noise wall and barrier approach with no planting that relies on a well detailed wall for a more consistent and durable outcome.

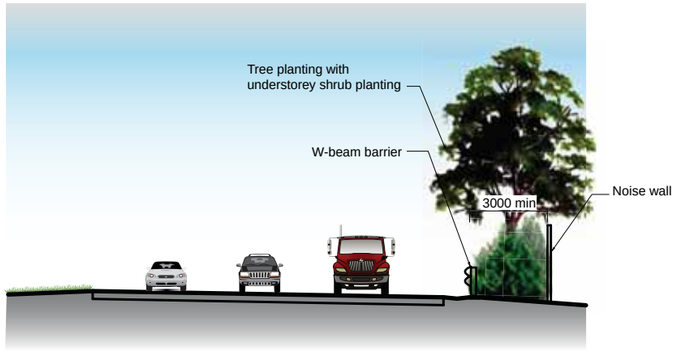

Figure 5.2 Planting - wide setback (greater than 3m width)

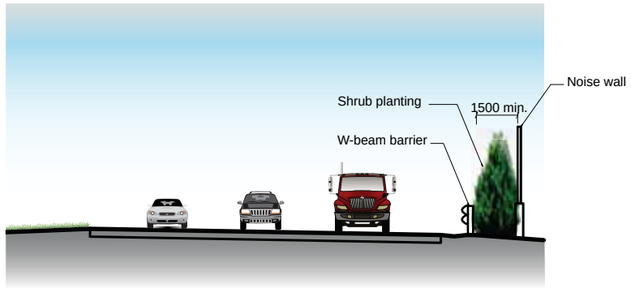

Figure 5.3 Minimal setback with W-Beam barrier (1.5m to 3m width)

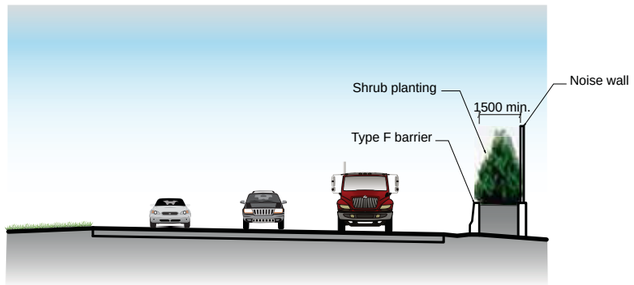

Figure 5.4 Minimal setback with Type F barrier (1.5m to 3m width)

Photo 5.9 Noisewall concealed in wide setback with shrub plantings.

Photo 5.10 Poor and irregular planting between traffic barrier and noise wall.

5.1.4 Architectural Detailing of Noise Walls

The architectural detailing of the noise walls must be considered not only for acoustic performance but also for visual. Details to consider include:

Post Position

Structural noise wall posts concealed from the motorway side create a cleaner line, although care with the off-road side wall appearance must be taken. Photo 5.11 illustrates poor landscaping screening treatment of an off roadside noise wall.

Posts, particularly if visible, should be spaced regularly and any stepping to accommodate slopes should maintain the regular spacing (refer to Photo 5.12). Post spacing should also consider the desired visual proportions of the noise wall. For example, the existing noise walls on the motorway are at spacings of 4 metres and when the walls increase in height, they appear visually taller than the actual height.

Joints and Junctions

The joints and junctions should be fully sealed with no gaps, as this affects the acoustic performance of the noise wall. Joints can be expressed or concealed depending on the directional emphasis of the design and panel sizes should be consistent. The stepped joints between panels on the existing Motorway walls create a horizontal emphasis which can be distracting when the panels step up a slope or the joints are misaligned.

Terminations

The end of each noise wall must be designed to 'fade out' into the landscape or terminate with a design feature. Walls which interact or merge with other structures, such as bridges or retaining walls, must have an integrated design intent. Most existing noise walls on the Motorway simply terminate with no consideration given to the aesthetic appearance of the end panels. (Refer to Photo 5.13)

Bolt Connections

Bolted connections should be designed to fit with the style or theme of the noise wall and appear simple and robust. Connections are to be as simple in appearance as possible, vandal proof, durable and not left up to the contractor to solve on site. Photo 5.14 shows the current poor resolution of this detail on the motorway.

Photo 5.11 Noise wall posts viewed from the off-road side.

Photo 5.12 Tree trunks echo the regular panel joint spacings.

Photo 5.13 Poor noise wall termination viewed from the local road.

Photo 5.14 Noise wall post connection to a bridge parapet.

5.2 Cuttings

An opportunity exists to significantly improve the urban design of the existing cuttings along M2 Motorway corridor. The following design issues related to the different cutting profiles are discussed:

- Profile
- Stabilisation - use of rock bolts, architectural shotcrete or cladding
- Revegetation.

Sandstone cuttings are a strong and repetitive element within the current M2 corridor. These cuttings have a positive visual impact on the M2 Motorway however retention in their natural state is dictated by their structural strength.

5.2.1 Cutting Profile

The current M2 has adopted a benched profile for a number of cuttings.

The benching relates to the transition between the strong and weak sandstone, with the weaker stone laid back at 1 in 2 slope or flatter and the higher strength rock set near vertical (refer to Figures 5.5 and 5.6). This strategy has enabled vegetation to establish along the top of the embankment. This is a successful approach that should be carried forward into the design of the upgrade works.

Near vertical cuttings have also been used without benching (refer to Photo 5.15). Where vertical cuttings occur in association with built elements such as noise walls, care needs to be taken to ensure an integrated interface between the two elements.

Where a weaker seam occurs within the near vertical cut profiles shotcrete has been used to stabilise the face of the wall. In such instances a flatter slope would have been more successful outcome as illustrated in Photo 5.16.

Where weaker rock has been exposed cuttings have been generally laid back at 1in 2 or flatter. For weak rock embankments, revegetation is most successful on slopes flatter than 1in 3. Slopes steeper than 1:2 are not able to be effectively revegetated in the short term. Over time vegetation may establish in the weaker plans of such rock as can be seen in photo 5.15, this process is slow and uneven and best left to nature.

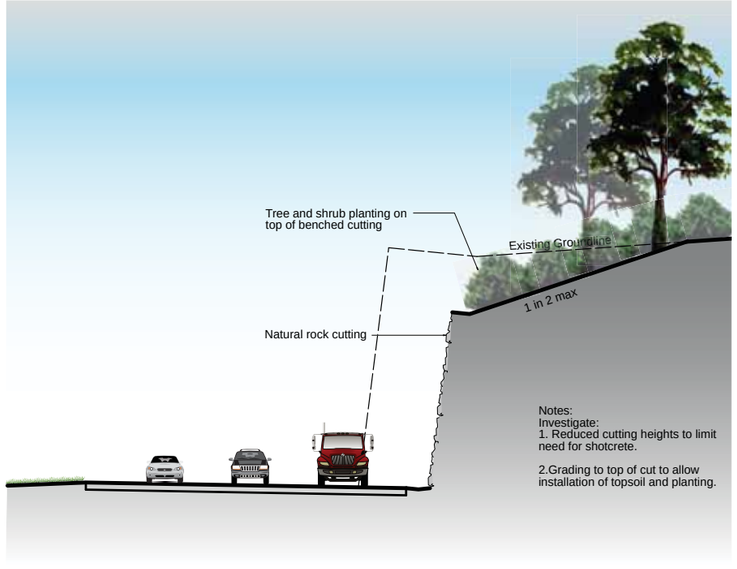

Figure 5.5 Cut slope – Option to reduce scale of vertical cut and avoid use of shotcrete.

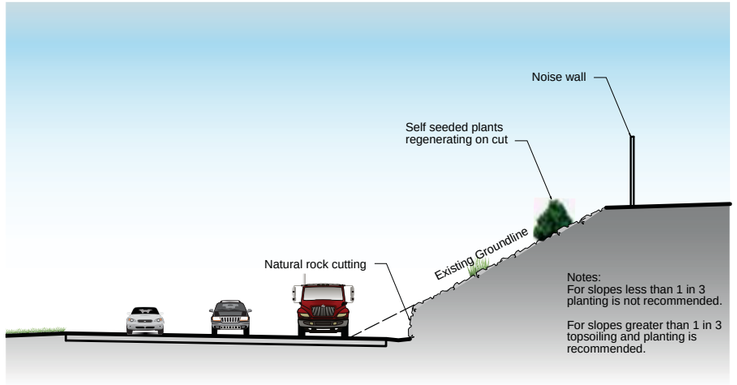

Figure 5.6 Cut slope - Option to minimise change in slope profile by standing vertical.

Photo 5.15 A near vertical cutting without benching.

Photo 5.16 Shotcrete stabilisation applied to a near vertical cutting.

5.2.2 Cutting Stabilisation

The use of rock bolts with shotcrete on the cutting face creates a visually unappealing finish along the corridor (refer to Photo 5.17). Where large expanses of shotcrete have been applied, an improvement in the wall could be provided by either treatment of the shotcrete, the application of concrete cladding panels or a redesign of the wall treatment to improve its visual amenity such as texture, colour or patterning subject to other project priorities.

Problems experienced with the use of shotcrete are:

- Large uniform textures which do not relate to the geology or context;
- Colours need to reflect the material to which they are being applied; and
- Extent needs to be focused and overspray avoided.

The use of shotcrete on the top edges of sandstone cuttings is not always a successful solution. An enhancement of the visual character of the cutting may be more effectively achieved by using:

- Stone pitching;
- Creating a benched profile with reduced upper slope, that is 1 in 4 slope enabling revegetation; or
- Shotcrete to achieve a texture, colour and patterning that reflects that of the underlying stone.

5.2.3 Revegetation on Cuttings

Revegetation on road cuttings creates an improvement to the visual amenity of the road corridor. The benching also allows a higher success rate of reseeding of native species and a safer environment for maintenance. (Refer to Photos 5.18 and 5.19)

The design of cuttings should consider the potential to apply top soil to flatter slopes for revegetation, softening the impacts of cuts and providing better integration with the adjacent landscape.

Photo 5.17 External rock bolts beneath shotcrete stabilisation.

Photo 5.18 Revegetation of a cutting conceals the noise wall.

Photo 5.19 Shotcrete stabilisation and vegetation on top of a cutting.

5.3 Bridges

An opportunity exists to significantly improve the urban design of the existing bridges along the M2 Motorway corridor. The following design issues related to the bridges are discussed:

- Structural form
- Pier, headstock and parapet design
- Bridge furniture.

5.3.1 Structural Bridge Form

The choice of bridge structure is fundamental to the aesthetic outcome of the Motorway. The complexity of the structure should be minimised to create a simple and elegant bridge. Form, proportion, symmetry, and detailing are all important factors.

The structural from of a new bridge should reflect the context within which it is located and the nature and type of load that is being carried. The superstructure must be well proportioned and simple in its design. It is generally accepted that a bridge with a slender girder depth is more elegant. Symmetry in a bridge structure assists in creating an harmonious whole.

Most overbridges on the current M2 Motorway are Super-T girder structures as shown in Photos 5.20 and 5.25. Any bridge expansions required in the motorway upgrade works should be a straightforward repetition of the existing bridge structure. Any new works should attempt to enhance the appearance of the bridge and integrate cleanly with the existing form.

5.3.2 Pier, Headstock and Parapet Design on Bridges

The piers and headstocks should be integrated with the bridge. Headstocks are more successful if they are integrated with the pier design and their ends not exposed past the edge of the bridge structure (refer to Photos 5.22 and 5.23). This allows the superstructure to dominate the appearance of the bridge.

Piers should be evenly spaced along the length of the bridge. On road bridges, the piers should be located to facilitate clear spans for the passing of traffic beneath. Piers can be tapered, elliptical, round or rectangular and the shape is selected to reflect the natural transfer of loads to the ground.

The outer face of the parapet is often the most dominant feature when the bridge is viewed from below. The parapet should be as slender as possible and appear as a continuous element. The thinner this leading edge, the more elegant the bridge. (Refer to Photo 5.24)

The parapet should be a single clean plane and be angled to control staining from rain water runoff. Transparency through the parapet, utilising single or double rail steel barriers maintains a slender edge profile and allows views for the motorist.

The bridge extension works of the M2 upgrade will match new piers, headstocks and parapets to the existing bridge language on the road.

Photo 5.20 Lane Cove Road double span overbridge.

Photo 5.21 "Bebo" arch bridge over Busaco Road.

Photo 5.22 Bridge at Beecroft Road with exposed piers and headstocks.

Photo 5.23 Piers and headstocks beneath Christie Road overbridge.

Photo 5.24 Noisewall adds extra depth to the structure over Khartoum Road.

Photo 5.25 Single span Super-T girder bridge over Wicks Road.

Photo 5.26 Pedestrian bridge over the M2 Motorway.

Photo 5.27 Double motorway bridge over bushland and Devlins Creek.

5.3.3 Bridge Furniture

Noise barriers on bridges increase the visual depth of the structure and transparent acrylic panels may be considered to offset this effect (subject to other project priorities). The bolted post connections must be set out evenly across the bridge parapet as shown on Photo 5.28.

The safety screen should be an integral part of the bridge design. The detailing of safety screens on bridges should be simple, safe, robust and complementary to the surrounding setting (refer to Photo 5.30). Screens that curve or splay outwards provide a less enclosed experience on top of the bridge. The handrails and throw screens on bridges should be integrated as one element to simplify the design.

Steel traffic barriers, handrails and cyclist rails should be integrated with each other, as shown in Photo 5.30 and extend to the very ends of the bridge parapet to create a clean, elongated visual line. The elements should be simple in their design yet meet all the safety requirements without becoming oversized.

Drainage pipes should be concealed between girders or behind precast concrete parapet extensions. The pipes should not be exposed (see Photo 5.31).

Bridge furniture on any new or expanded bridges, as part of the M2 Motorway upgrade, will endeavour to integrate with the existing style of bridge furniture, maintain the existing character and improve the appearance of the bridges.

Photo 5.28 Solid noisewalls fixed to the bridge parapets at Khartoum Road.

Photo 5.29 Simple, well defined safety screens on Christie Road overbridge.

Photo 5.30 Well integrated handrails on the pedestrian bridge at Kent Road.

Photo 5.31 Exposed drainage pipes on Watkins Road overbridge.

5.4 Retaining Walls

An opportunity exists to significantly improve the urban design of the existing retaining walls along M2 Motorway corridor. The following design issues related to the different retaining wall types are discussed:

- Location and profile in relation to other structures;
- Materials selection - type, colour, texture;
- Use of planting - screening, contextual response and identity.

5.4.1 Location and Profile

Retaining walls should be well integrated with the structures they are supporting and be designed to enhance the character of a precinct. Ideally, retaining walls should be setback from the edge of the road to provide space for planting. Where this is not possible the wall should be designed as a feature, possibly with a pattern or colour to match the setting.

Walls facing motorways and major local roads may be more urban in their style whereas walls around reserves, creeks and parklands should use natural materials and be as recessive as possible.

The top edges of retaining walls should be designed to create a smooth, flowing line, despite local deviations in the adjacent topography.

Retaining walls which are integrated with bridge abutments should have clean, lines and not distract from the clarity of the bridge structure.

5.4.2 Material Selection

Retaining walls can be built out of many materials creating a variety of appearances ranging from very urban to more rural in character. Existing retaining wall types comprise:

- Precast concrete panels - with relief patterns to create visual interest (refer to Photo 5.32).
- In-situ concrete walls, where a high quality of finish is not required (refer to Photo 5.33 and 5.34).
- Gabion baskets - colour and type of stone should match the local types (refer to Photo 5.35).

Shotcrete should be minimised in highly visible locations (as far as practicable). (Refer to Photo 5.36 and 5.37)

Photo 5.32 Precast concrete panel wall bridge abutment at Khartoum Road.

Photo 5.33 In-situ concrete walls along Devlins Creek at Kirkham Street.

Photo 5.34 Precast concrete walls at Beecroft Road bus ramps.

Photo 5.35 Low gabion basket walls near Khartoum Road bridge.

Photo 5.36 Shotcrete retaining wall at Pennant Hills Road Interchange.

Photo 5.37 Shotcreted abutment cutting at Watkins Road overbridge.

5.4.4 Use of Planting with Retaining Walls

Planting can be used to screen, break up or provide a setting for a retaining wall.

Planting strategies include:

- the use of trailing plants to spill over the retaining wall;
- climbing plants to cover the face of the retaining wall;
- garden beds to the front of walls to assist in reducing the scale (refer to Photo 5.38);
- where a gabion or crib lock wall is used, planting could be integrated into the wall structure creating a living wall (refer to Photo 5.39).

New retaining walls or those which require alterations as part of the M2 Motorway upgrade will be designed to be in keeping with the identified existing character precincts and to improve the overall appearance of the motorway.

Photo 5.38 Planting in front of the existing precast concrete walls along Junction Road.

Photo 5.39 Stacked sandstone boulders retain earth at Busaco Road bridge.

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