Guidelines for Slope Management in Subdivisions

Cardinia Shire Council – Pakenham East Precinct Structure Plan

Prepared by Urban Design & Management Pty Ltd

December 2017

Purpose

These guidelines have been developed to ensure that development of land on the hillsides within the Pakenham East PSP area is appropriately designed to respond to the undulating topography and identified view sheds, and to minimise the amount of disturbance to the natural topography through earthworks associated with building construction, and construction of roads and associated infrastructure.

The more significant areas with a slope of greater than 10% within the PSP area are located on visually prominent hillsides. It is important that the future development within the PSP area responds to the visual and landscape qualities of the area

These guidelines seek to ensure that the design response in these areas allows the retention of existing landscape and amenity values and creates a built environment that is responsive to these conditions.

Where do the guidelines apply?

Any area zoned for residential purposes with a pre-development slope greater than 10% within the Pakenham East Precinct Structure Plan area in the Shire of Cardinia.

When are the guidelines required?

The guidelines require that a Slope Management Plan is submitted with any planning permit application for subdivision on any land that includes an existing pre-development slope of greater than 10%.

What is a Slope Management Plan?

A Slope Management Plan will be used to demonstrate that subdivision, as well as the subsequent development on lots created by the subdivision will respond to and respect the natural topography of the land. A Slope Management Plan will ensure that:

- Earthworks are minimised, and utilised to provide a suitable space for future buildings;
- The use of retaining walls is appropriate to the overall design of the subdivision, and takes into account the potential development on each lot;
- Drainage within the lots is considered and responds to the overall earthworks design of the development;
- Earthwork compaction is minimised to allow appropriate landscaping and allowance is made to ensure there is adequate space for landscaping post-construction, considering the extent of earthworks required;
- Ensures that any erosion from earthworks during construction is managed and mitigated and that the final built form mitigates against erosion;
- Excessive use of retaining walls is avoided, and if they are required, they are appropriately located, designed and respond to the surrounding amenity; and
- The height of free standing retaining walls is limited.

Definition of Sloping Land

The following tables provide assistance in interpreting the definition and categories of slope:

Flat	Land with a slope gradient less than 5%
Moderate Slope	Land with a slope gradient of between 5% and 10%
Steep	Land with a slope gradient of between 10% and 15%
Very Steep	Land with a slope gradient of between 15% and 20%
Extremely Steep	Land with a slope gradient of more than 20%

Slope gradient (rise: run)	Slope Gradient (%)	Slope Angle (Degrees)
1:3	33%	18.43
1:4	25%	14.04
1:5	20%	11.31
1:6.7	15%	8.49
1:10	10%	5.71
1:20	5%	2.86

What should a slope management plan include?

A Slope Management Plan submitted with a planning permit application for subdivision must include:

- A site description and design response. The site description must include a plan of pre-development slope (contours) and categorise the slope into areas of less than 10%, 10-15% and 15-20% and greater than 20% (as applicable). The design response (proposed subdivision) must explain how the design derives from and responds to the slope, proposed neighbourhood character and site description.
- A statement describing how any land with a pre-development slope over 10% will be subdivided and/or developed to complement adjacent land.
- Subdivision that will result in buildings and works on any areas of land with slope over 20% will not be supported. The areas of slope in excess of 20% are limited within the Pakenham East PSP area, and as such, may be able to be suitably dealt with in an overall design response to land with slope of over 10%. Any design response must detail how areas of slope over 20% will be mitigated through the implementation of the Slope Management Plan.
- A statement and/or diagrams detailing the proposed landscape and urban design outcomes that will be achieved to complement the slope and mitigate any impacts of retaining walls and batters.
- A geotechnical report and designs by a suitably qualified engineer to confirm the stability of the natural slope and man-made soil deposits and assess risks posed by the site conditions and proposed earthworks and drainage, unless otherwise approved by the Responsible Authority *(Example: to confirm soil type will support a benched outcome and drainage relating to cut).*
- Proposed road cross sections and long sections to demonstrate how slopes over 10% are being responded to through the design.
- Details of all proposed batters, cut and fill earthworks, retaining walls, driveway crossover locations and drainage solutions required for the subdivision of land that includes an existing pre-development slope of greater than 10%.
- Details of any proposed retaining walls, including overall height, staggering of retaining walls, finished levels, construction materials and associated fencing required.
- Building envelopes (or an alternative design response) to respond to the slope management methods utilised.
- A response to any relevant requirements and guidelines within the *Pakenham East Precinct Structure Plan.*

Slope Management Design Principles

To assist in preparing a Slope Management Plan, the following key principles should be considered when designing subdivision on land that includes an existing pre-development slope of greater than 10%.

1. Street design

1A Design the street network to utilise the natural slope of the land, and consider how the street design will impact on the need for earthworks on lots accessing the street (Council will consider up to 20% grade for a driveway). In addition to this consideration, the design of the streets should also consider how the lots will be best designed to retain view lines to and from the ridgelines.

Figure 1: Street design principles

1B Streets should be designed to respond to the natural landform, and this means they will either be located:

- Following the contour line; or
- Directly up/down the slope.
- Alternative solutions, such as a split level divided carriageway can provide site specific solutions to grade issues where appropriate.

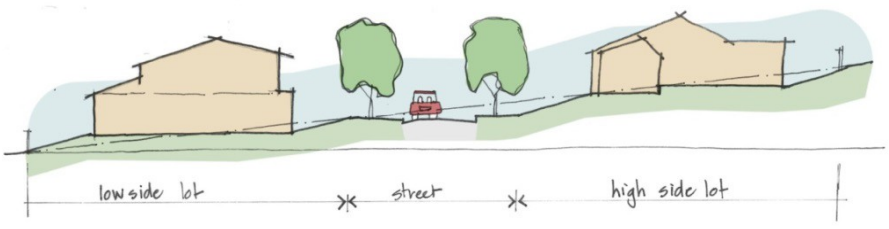


Figure 2: Cross-section view, Streets running along the contour

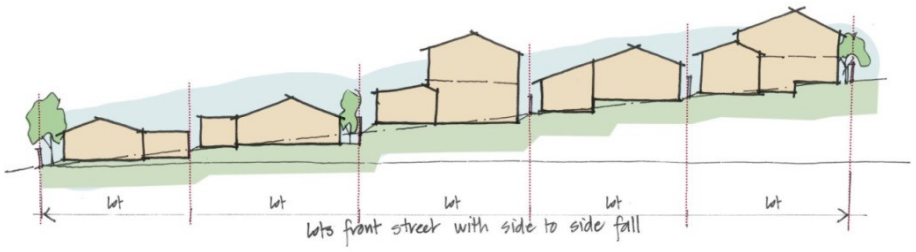


Figure 3: Cross-section view, Streets running up/down the contour

1C In street design, the following key design criteria must be considered when deciding where to locate the streets:

- Streets following the contour: cross fall grade must be 10% or less unless interfacing open space to the satisfaction of Council.
- Streets up/down the slope: Preferred maximum longitudinal grade is 10%.

2. Lot layout and design

2A Based on a street design solution that responds to the design criteria above, the lot and building solutions should be developed in conjunction with the earthworks design. This will enable a lot design solution that responds specifically to the topography, and allows for the most appropriate slope management methods to be used.

2B Lot design should respond to the street network design, and the topography of the land along the street:

- Where streets are running up the slope, lot shapes should allow for building designs to manage the side to side fall of the lot through the minimsation of retaining wall height and benching between lots. This could involve wider frontages to allow for building separation and landscaping between lots, or could involve narrower lot frontages to minimise retaining wall heights and overall fencing heights on boundaries.

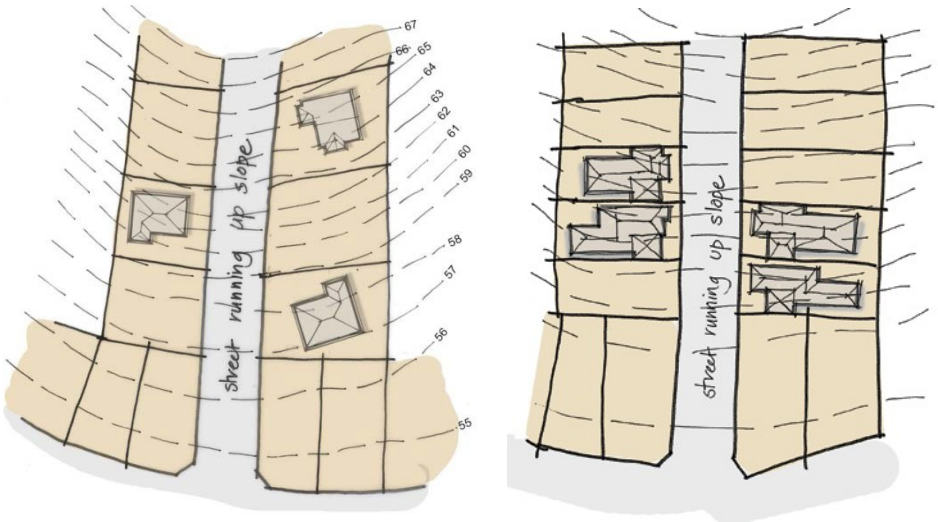


Figure 4: Lots could be wider to accommodate cross fall on lots with larger side setbacks where streets run up/down slope, or alternatively narrower to minimise the heights of retaining walls on side boundaries between smaller lots with minimal side setbacks

- Where streets run across the slope, lot shapes could be narrower and deeper, so that the fall from the street can be taken up across the length of the building and the lot.

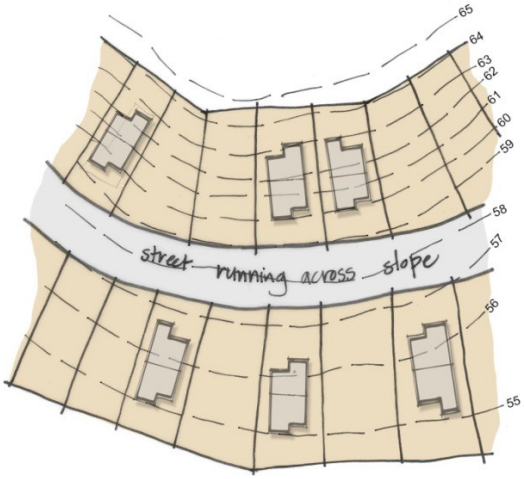


Figure 5: Lots designed to be narrower and deeper to accommodate fall from front to rear/rear to front of lot

This should assist in minimising the amount of excavation and retaining walls required.

2C Depending on the extent of slope, the direction of the fall and the location of adjoining development, different lot and building options should be considered in addition to conventional slab on ground construction.

Some lot design and building considerations that may address slope more effectively than mass earthworks include solutions such as:

- Split level designs;
- Providing for larger lots to ensure adequate space to cater for slope management and effective landscaping around buildings;
- Including single and double storey components to the building design, to address a sloping site; and if cutting and filling deeper than 1.0 metre is required, retaining walls should be staggered with a minimum of 1.0 metres between each stagger to allow for the inclusion of landscaping.

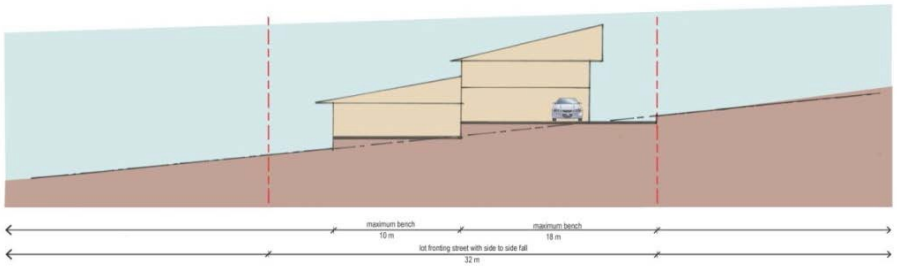


Figure 6: Examples of site response - Natural Grade 10-15% (road up/down contour)

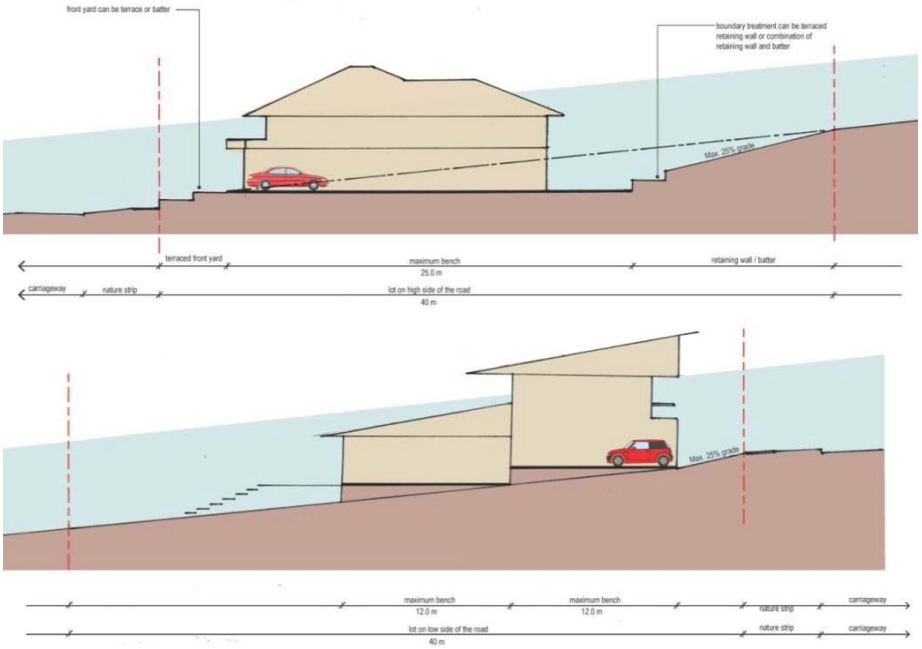


Figure 7: Examples of site response - Natural Grade 10% -15% (road along contour)

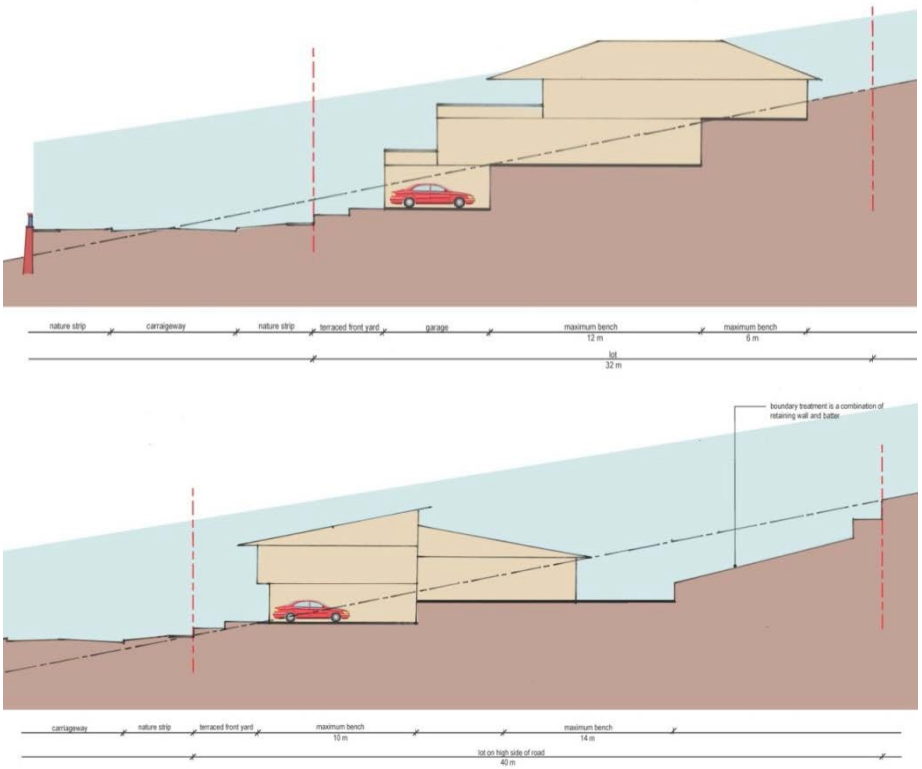


Figure 8: Example of site response - 15-20% Natural Grade (street along contour)

- Innovative medium-high density design solutions that integrate the design with the topography and landscape. These could include split level townhouses with under croft garaging, interlocking apartments/townhouses (ie. designed as one building, accessed independently from either the low or high side adjacent streets as separate dwellings). These types of solutions will ensure that the building forms work with the natural slope, have minimal intervention with the natural grade, and can be of a scale that does not dominate the hillside.

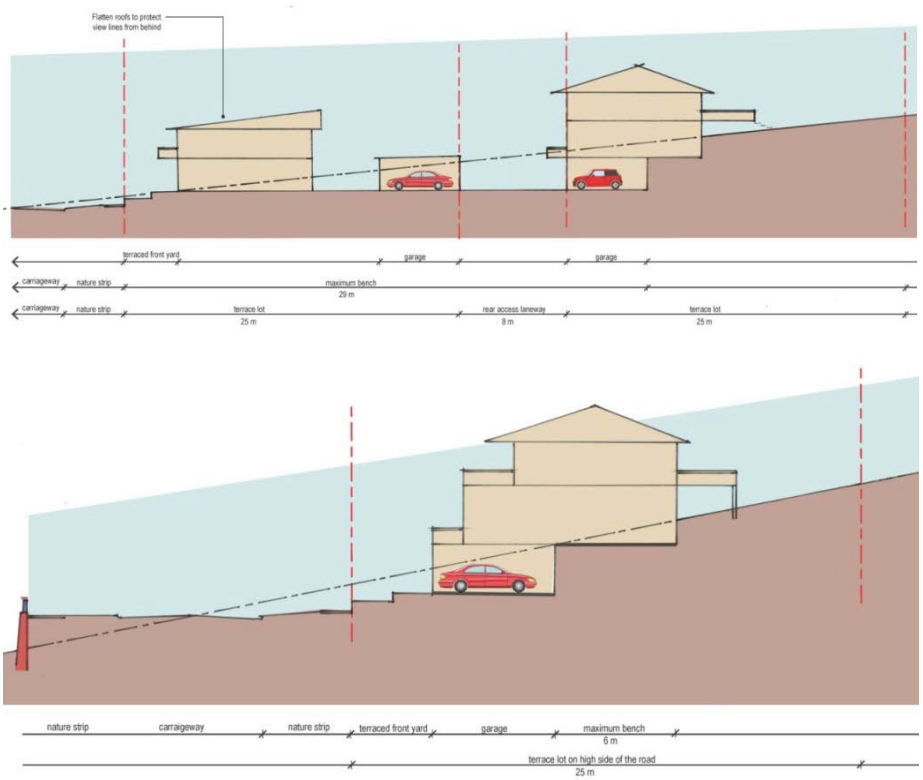


Figure 9: Examples of townhouse design solutions (maximum grade 20%)

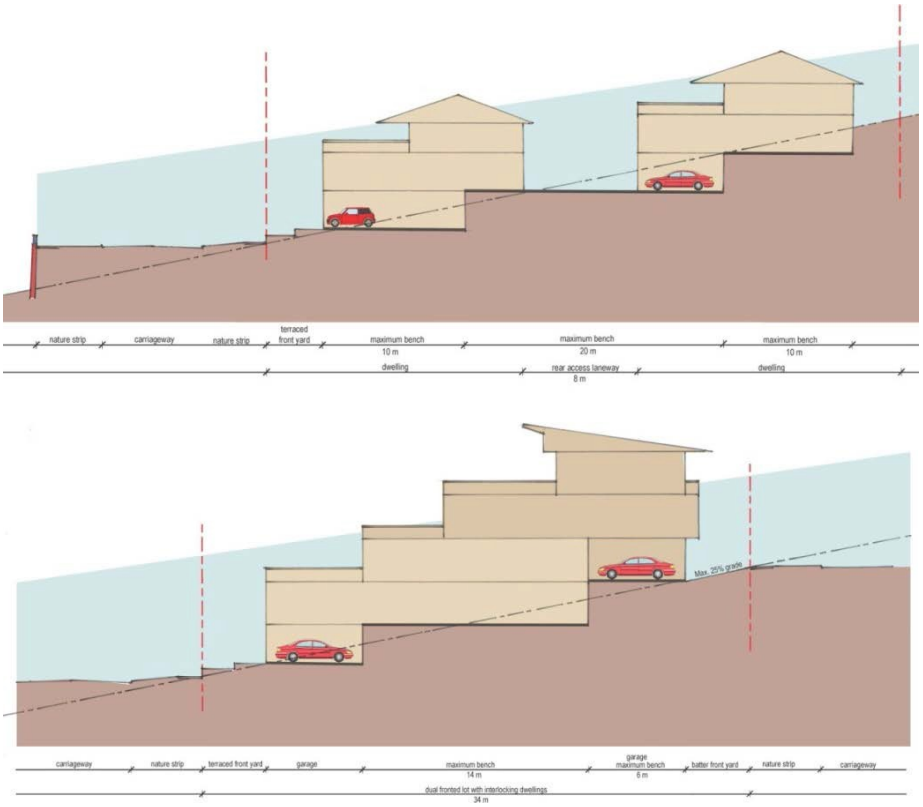


Figure 10: Alternative site responsive medium density solutions to slopes in excess of 15%

The slope management plan should identify any lots that are designated for a non-conventional style of construction (as outlined above), and special design guidelines may be prepared and approved for these lots as a requirement of any planning permit issued for subdivision to ensure the outcomes are a requirement on future purchasers of the lot/s.

3. Lot Access

3A Driveway grades can often become an issue due to the street design grade and lot gradient and retaining wall/benching design. A maximum driveway grade of 20% (1 in 5) is allowable.

3B Depending on whether the street runs up/down the slope or follows the contour, there can be challenges with the driveway grade, and also the relationship of the driveway to road cross fall. The Slope Management Plan will need to demonstrate how lot access will be provided to enable safe access to lots from the street.

3C In particular, where streets are designed to run up/down the slope, in most cases it will be preferable to locate the driveway crossover on the low side of the lot, to ensure the driveway can be constructed with a minimal grade.

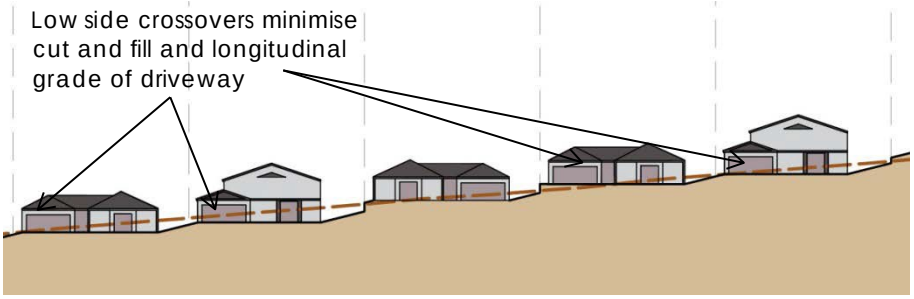


Figure 11: Up slope streets, crossovers preferred on low side of lot

4. Drainage

4A The Slope Management Plan must consider the implications of any proposed benching and retaining walls on the drainage requirements for all lots. The Plan must indicate how drainage is going to be provided for given the proposed earthworks, to Council standards.

5. Retaining walls

5A Retaining walls are often used to assist in managing the grade change across an area of residential development, and are generally proposed along lot boundaries to provide for a suitable buildable area on each residential lot. The Slope Management Plan must indicate the location, height and proposed materials for all retaining walls.

5B Retaining walls should be designed and located based on the following key principles. Any retaining structures should be:

- No more than 1.0 metres in height between a building and a public space (ie. street open space or pathway), or where visible from a public space;
- Where constructed on a boundary between two lots, either set back at least 1.0m from a building envelope, or designed to be integral to the overall building design;

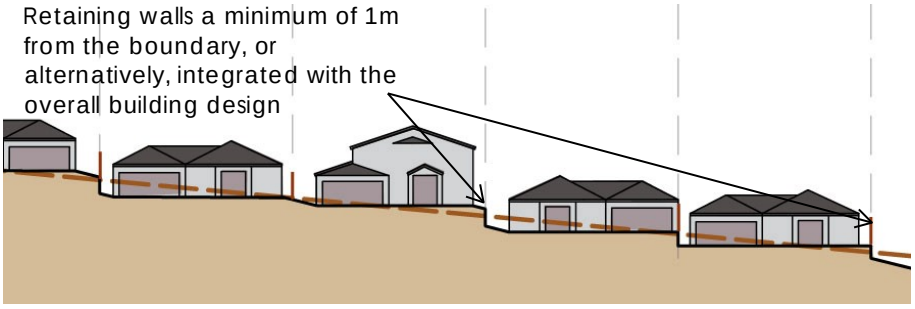


Figure 12: Retaining wall setbacks

- Staggered with a minimum of 1.0 distance between each stagger to allow for the inclusion of landscaping, where cutting and filling is deeper than 1.0 metres and a retaining wall higher than 1.0m would otherwise be required;

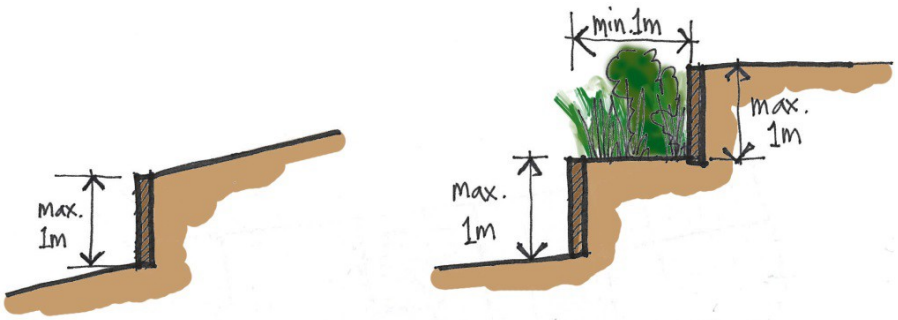


Figure 13: Possible retaining wall solutions

- Positioned so that associated drainage infrastructure and structural foundations are fully located within the same lot; and
- A maximum overall height for a staggered wall of no more than 2.0 metres, to avoid unreasonable impacts from overshadowing of adjacent development.

5C Design of retaining walls will need to be cognisant of the implications on other lot infrastructure (physical services locations, fencing, and lot access). The design will need to also consider the impacts the retaining wall location will have on the buildable area on a lot, as well as how it impacts the buildable area on adjacent lots.

Figure 14: Examples of stone retaining walls (ideal for street boundaries and public space edges) and concrete sleeper walls (most suitable for retaining walls at side or rear boundaries)

6. Lot Benching

6A Lot Benching is an earthworks construction method used in sloping areas to provide relatively flat pads for building on, avoiding the need for retaining walls (or in conjunction with retaining walls where a combination of methods are considered the more desirable outcome). Benching may be used so that slope can be taken up in the front and rear of lots, so that a flat building pad can be provided.

Figure 15: Lot has been graded or benched with a combination of retaining walls and lot grading to ensure a flat building pad is provided

6B Lot benching must be planned across the whole 'street block' to ensure that it provides a manageable outcome for all future allotments. Issues arise when an area has been benched, and subsequently individual lot purchasers significantly change the earth forms, thereby creating detrimental impacts on adjoining properties as a result of their individual earthworks.

6C Slope of batters to benches on lots must be no more than 1:4 (25%).

6D The Slope Management Plan must show the location of all batters and benched areas, and the gradient and dimensions of benched areas so that the buildable area of individual lots can be considered. Details of who is responsible for these works (land subdivider or lot purchaser) must be provided.

7. Buildable Areas/ Building Envelopes

7A Subject to the design of any proposed retaining walls and /or lot benching, and through the lot design process, buildable areas of lots should be shown on the Slope Management Plan to indicate the area and dimensions of each lot available for building. This will (once approved) need to be included in information provided to lot purchasers, so that they are aware of the area of the lot available for building.

Reference Documents

March 2013, *Pakenham East PSP – Slope Analysis and Design Principles for development on sloping land*, SMEC Urban

Draft Pakenham East Precinct Structure Plan

Attachments

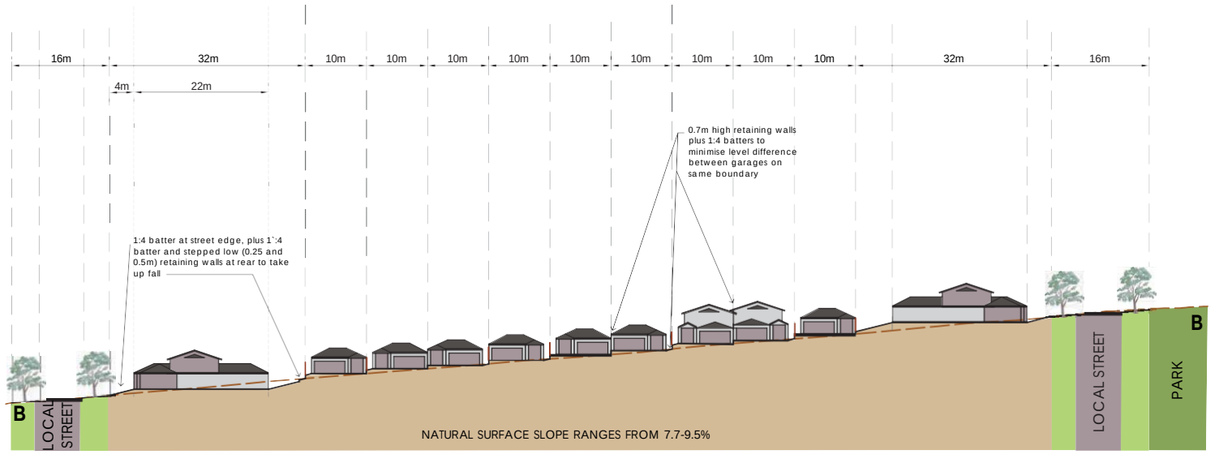
1. Cross Sections showing analysis of possible slope responses, Pakenham East PSP
2. Photographs of poor examples of retaining wall design responses
3. Slope Analysis Plan – Pakenham East PSP

Attachment 1

Cross Sections showing analysis of possible slope responses - Pakenham East PSP

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

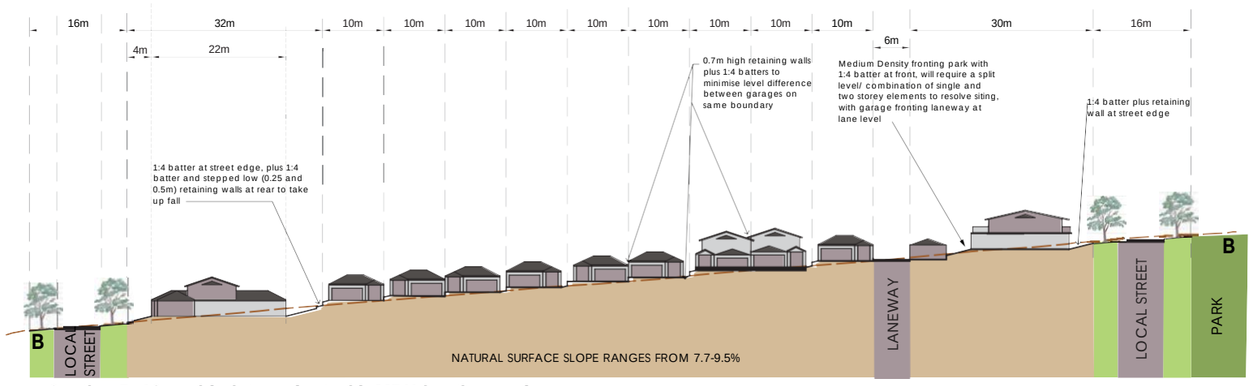
10 x 32m Lot product:
Lots fronting park and streets require 1:4 batters at front and rear.
All side boundaries require retaining to keep walls at less than 1m high (generally range from 0.7 - 0.9m, or stepped if necessary).
Minimal side setbacks (1m on one boundary, 0m on other) provide limited landscaping opportunity.
Integrated design required to achieve built to boundary solutions given need for retaining walls (which limits product selection on narrower lots unless they are built together).



Section B: 10m wide lot product

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

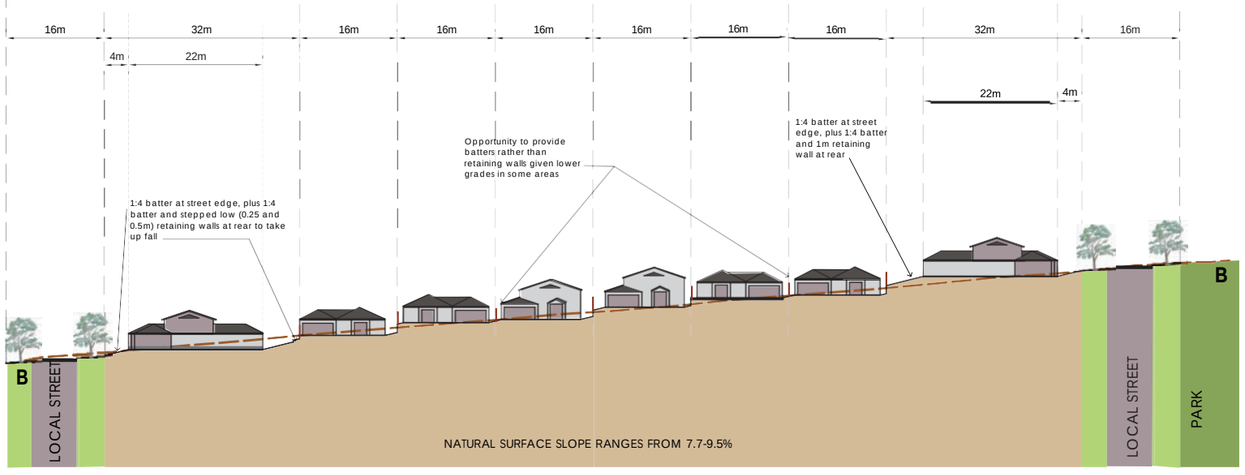
10 x 32m Lot product and Medium Density:
All side boundaries require retaining to keep walls at less than 1m high (generally range from 0.7 - 0.9m).
Minimal side setbacks (1m on one boundary, 0m on other) provide limited landscaping opportunity.
Medium Density fronting park will sit beow street level to achieve suitable batters. Dwelling will need to be split level to accommodate garage access from rear lane at ground level.



Section B: 10m wide lot product with MDH fronting park

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

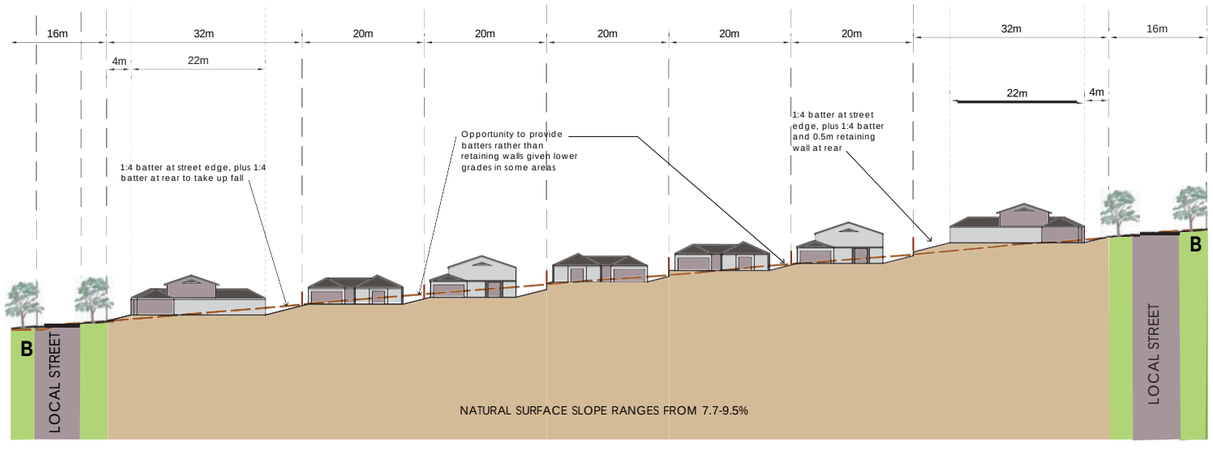
16 x 32m Lot product:
Lots fronting park and streets require 1:4 batters at front and rear.
Most side boundaries require retaining to keep walls at less than 1m high , and there is some opportunity to provide 1:4 batters rather than retaining walls.
More opportunity to avoid built to boundary wall solutions that can impact on retaining walls given wider lot product.



Section B: 16m wide lot product

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

20 x 32m Lot product:
Lots fronting park and streets require 1:4 batters at front and rear.
A mix of low (less than 1m) retaining walls and 1:4 batters along side boundaries.
More opportunity to avoid built to boundary wall solutions that can impact on retaining walls given wider lot product, and significantly more opportunity to provide landscaping solutions to mitigate impact of cut and fill.



Section B: 20m wide lot product

NOTE This plan has been prepared based on preliminary information only. Detailed site and internal dimensions will need to be confirmed by survey.
The plan is subject to review and approval by relevant authorities, and is subject to change.

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Scale 1:500 @ A1

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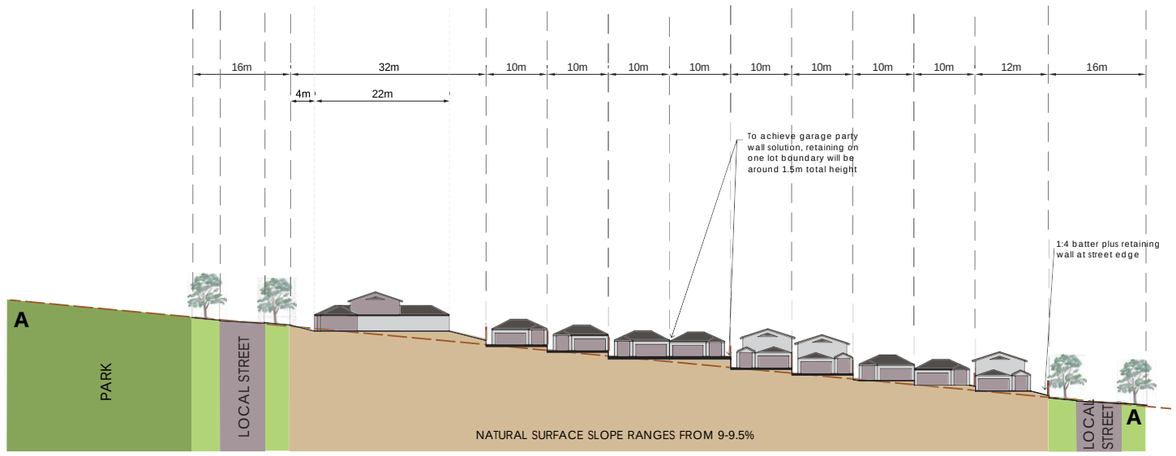
Section B-B: PEPSP Southern Slope

PEPSP - Urban Design and Slope Review

Plan Ref: 15042_XS-B Rev. A Date 28 June 2017 Drawn MH

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

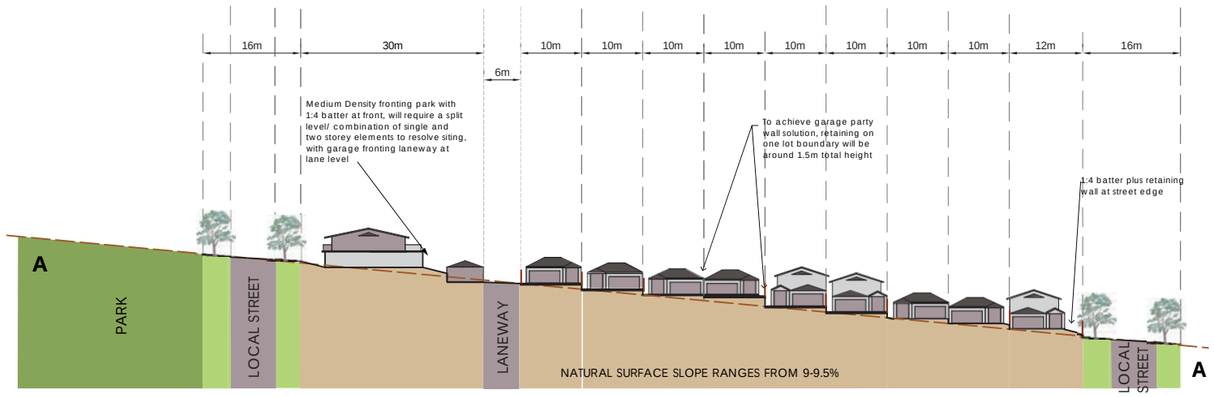
10 x 32m Lot product:
Lot fronting park requires 1:4 batters at front and rear.
All side boundaries require retaining to keep walls at less than 1m high (generally range from 0.7 - 0.9m).
Minimal side setbacks (1m on one boundary, 0m on other) provide limited landscaping opportunity.



Section A: 10m wide lot product

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

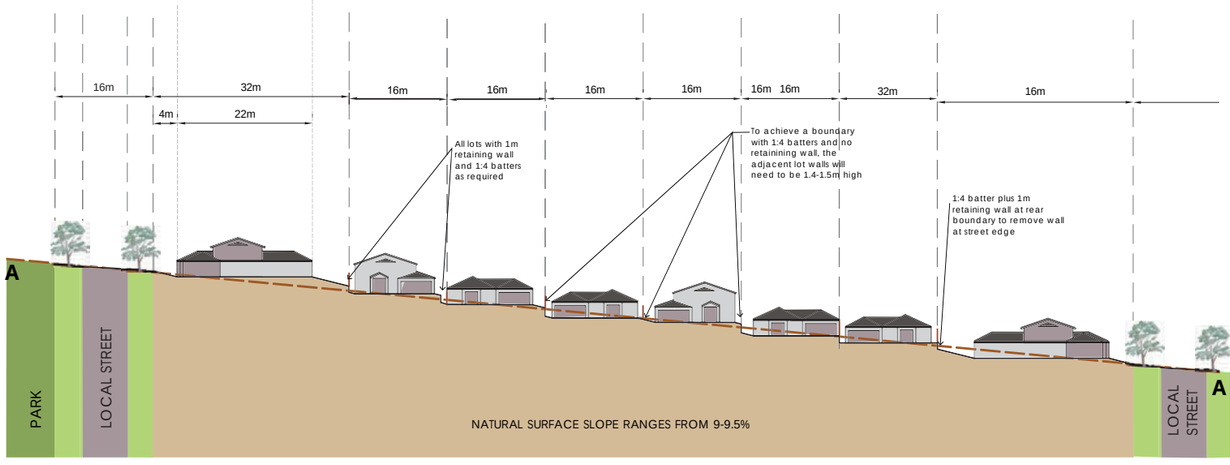
10 x 32m Lot product and Medium Density:
All side boundaries require retaining to keep walls at less than 1m high (generally range from 0.7 - 0.9m).
Minimal side setbacks (1m on one boundary, 0m on other) provide limited landscaping opportunity.
Medium Density fronting park will sit beow street level to achieve suitable batters. Dwelling will need to be split level to accommodate garage access from rear lane at ground level.



Section A: 10m wide lot product with MDH fronting park

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

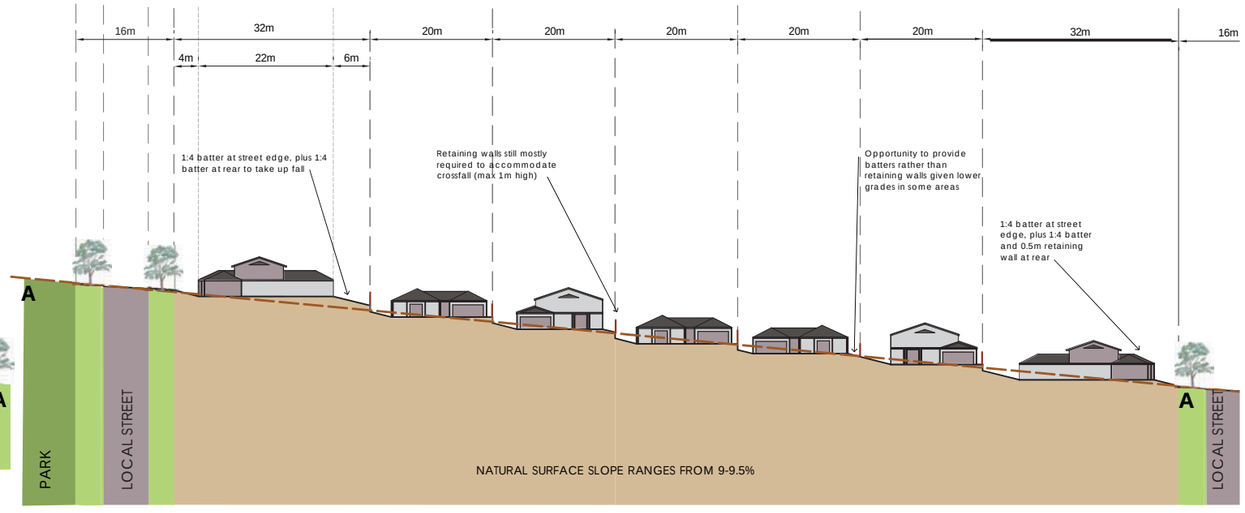
16 x 32m Lot product:
Lot fronting park requires 1:4 batters at front and rear.
Most side boundaries require retaining to keep walls at less than 1m high , and there is some opportunity to provide 1:4 batters rather than retaining walls.
More opportunity to avoid built to boundary wall solutions that can impact on retaining walls given wider lot product.



Section A: 16m wide lot product

General Design Principles used to achieve flat pads for slab construction:
Road designed to achieve VPA Engineering guideline crossfall requirements.
1:4 (25%) maximum batter.
1:50 flat pad for slab construction.
Aim for no higher than 1m retaining walls - if higher than 1m, to be stepped.

20 x 32m Lot product:
Lots fronting park and streets require 1:4 batters at front and rear.
Still mostly low (up to 1m) retaining walls along side boundaries, with some opportunity on lower gradients for 1:4 batters.
More opportunity to avoid built to boundary wall solutions that can impact on retaining walls given wider lot product, and significantly more opportunity to provide landscaping solutions to mitigate impact of cut and fill.



Section A: 20m wide lot product

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Scale 1:500 @ A1

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Section A-A: PEPSP Northern Slope

PEPSP - Urban Design and Slope Review

Plan Ref: 15042_XS-A Rev. A Date 28 June 2017 Drawn MH

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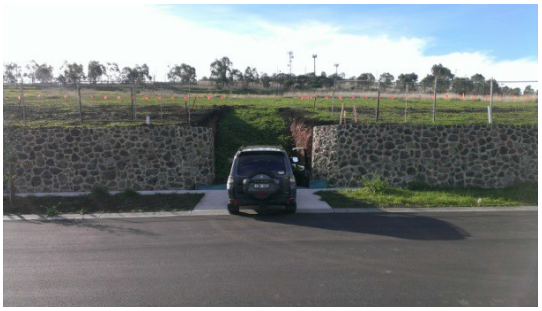
Attachment 2

Photographs of poor examples of retaining wall design responses

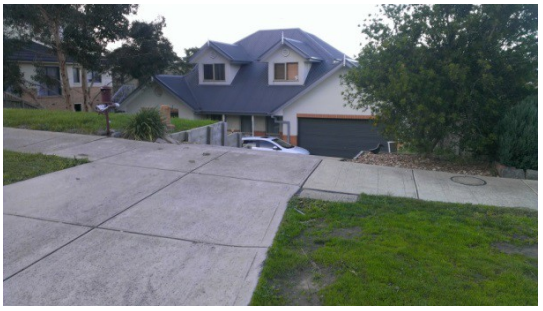
Examples of what we are trying to avoid:



High Retaining walls with step driveways

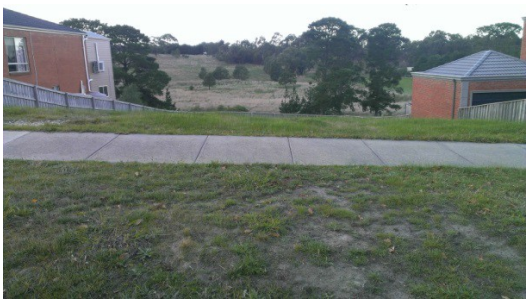
No ability to park in driveway

Flat pad on significant cross fall with no retaining



House in a hole

Retaining walls with batters, and more retaining walls



Not dealing with the slope at all

No sense of streetscape due to wall height

Issues of overlooking and overshadowing

Attachment 3

Slope Analysis Plan – Pakenham East PSP

LEGEND

- PEPSP Area1
- Slope > 20%
- Slope 15-20%
- Slope 10-15%
- Transmission Easement
- Contours (2.5m intervals)

NOTE This plan has been prepared based on preliminary information only. Detailed site and internal dimensions will need to be confirmed by survey. The plan is subject to review and approval by relevant authorities, and is subject to change.

UrbanDesign and management

Land Development | Project Management
Planning | Urban Design | Civil Engineering

0 150 300 450m

Scale 1:15,000 @ A3

N

Slope over 10%

Pakenham East PSP

Plan Ref: 15042_SA-10% Rev. A Date December 2017 Drawn MH