Attachment 3

GHD cross-sections v2 for Steering Committee meeting on 24th Oct

NOTES:

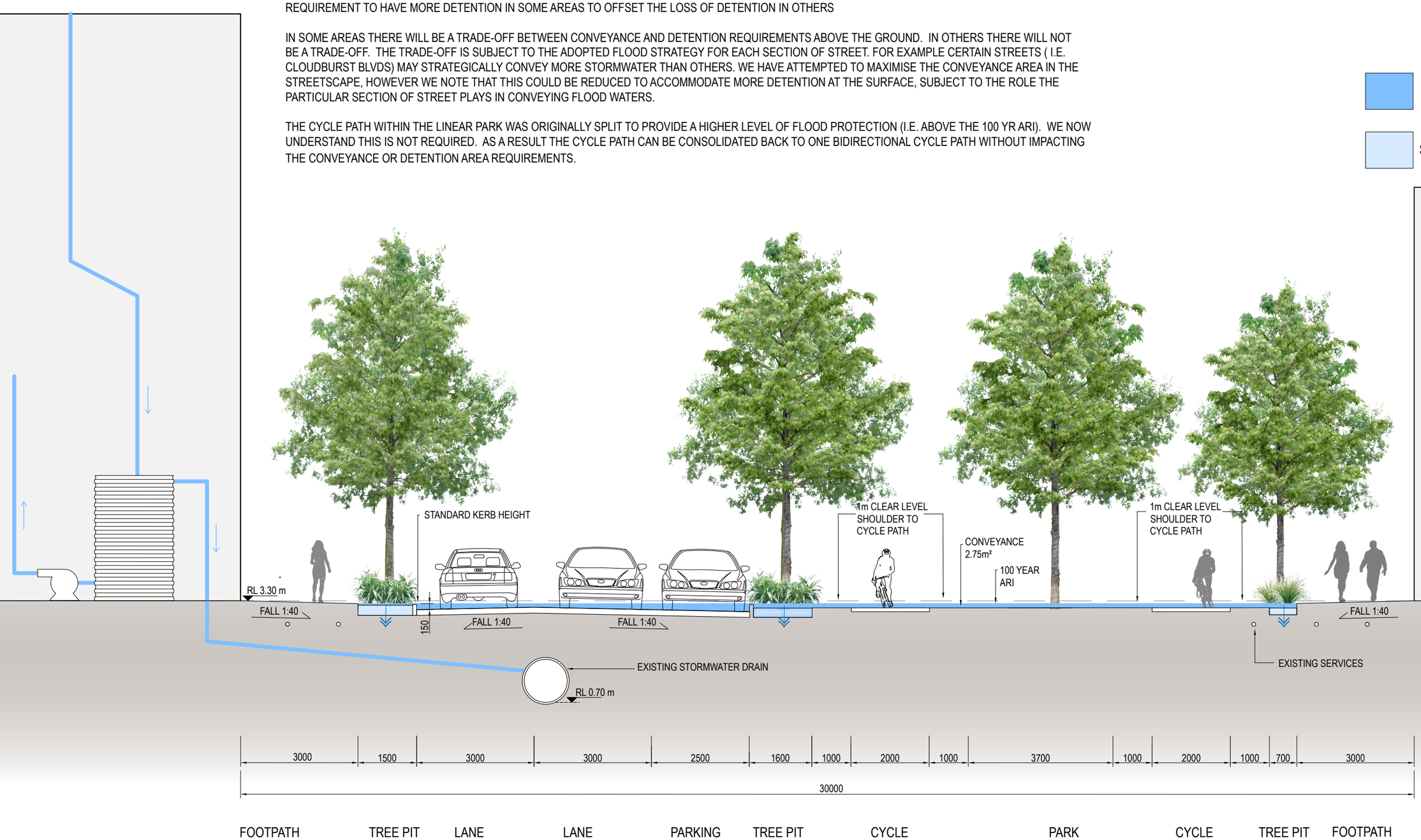
DETENTION CHARACTERISTICS ARE LIKELY TO VARY ALONG THE STREET DUE TO DIFFERENT CONSTRAINTS (I.E. AT INTERSECTIONS) AND THERE WILL BE A REQUIREMENT TO HAVE MORE DETENTION IN SOME AREAS TO OFFSET THE LOSS OF DETENTION IN OTHERS

IN SOME AREAS THERE WILL BE A TRADE-OFF BETWEEN CONVEYANCE AND DETENTION REQUIREMENTS ABOVE THE GROUND. IN OTHERS THERE WILL NOT BE A TRADE-OFF. THE TRADE-OFF IS SUBJECT TO THE ADOPTED FLOOD STRATEGY FOR EACH SECTION OF STREET. FOR EXAMPLE CERTAIN STREETS (I.E. CLOUDBURST BLVDS) MAY STRATEGICALLY CONVEY MORE STORMWATER THAN OTHERS. WE HAVE ATTEMPTED TO MAXIMISE THE CONVEYANCE AREA IN THE STREETSCAPE, HOWEVER WE NOTE THAT THIS COULD BE REDUCED TO ACCOMMODATE MORE DETENTION AT THE SURFACE, SUBJECT TO THE ROLE THE PARTICULAR SECTION OF STREET PLAYS IN CONVEYING FLOOD WATERS.

THE CYCLE PATH WITHIN THE LINEAR PARK WAS ORIGINALLY SPLIT TO PROVIDE A HIGHER LEVEL OF FLOOD PROTECTION (I.E. ABOVE THE 100 YR ARI). WE NOW UNDERSTAND THIS IS NOT REQUIRED. AS A RESULT THE CYCLE PATH CAN BE CONSOLIDATED BACK TO ONE BIDIRECTIONAL CYCLE PATH WITHOUT IMPACTING THE CONVEYANCE OR DETENTION AREA REQUIREMENTS.

CONVEYANCE - 2.75 m²

SURFACE DETENTION - 0.85 m²



OPTION 1 - STANDARD DRAINAGE

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - GRAHAM STREET (30m WITH LINEAR PARK)

Original Size: **A3**

Date: **24.10.2018**

Rev: **A**

GHDWOODHEAD

NOTES:

DETENTION CHARACTERISTICS ARE LIKELY TO VARY ALONG THE STREET DUE TO DIFFERENT CONSTRAINTS (I.E. AT INTERSECTIONS) AND THERE WILL BE A REQUIREMENT TO HAVE MORE DETENTION IN SOME AREAS TO OFFSET THE LOSS OF DETENTION IN OTHERS

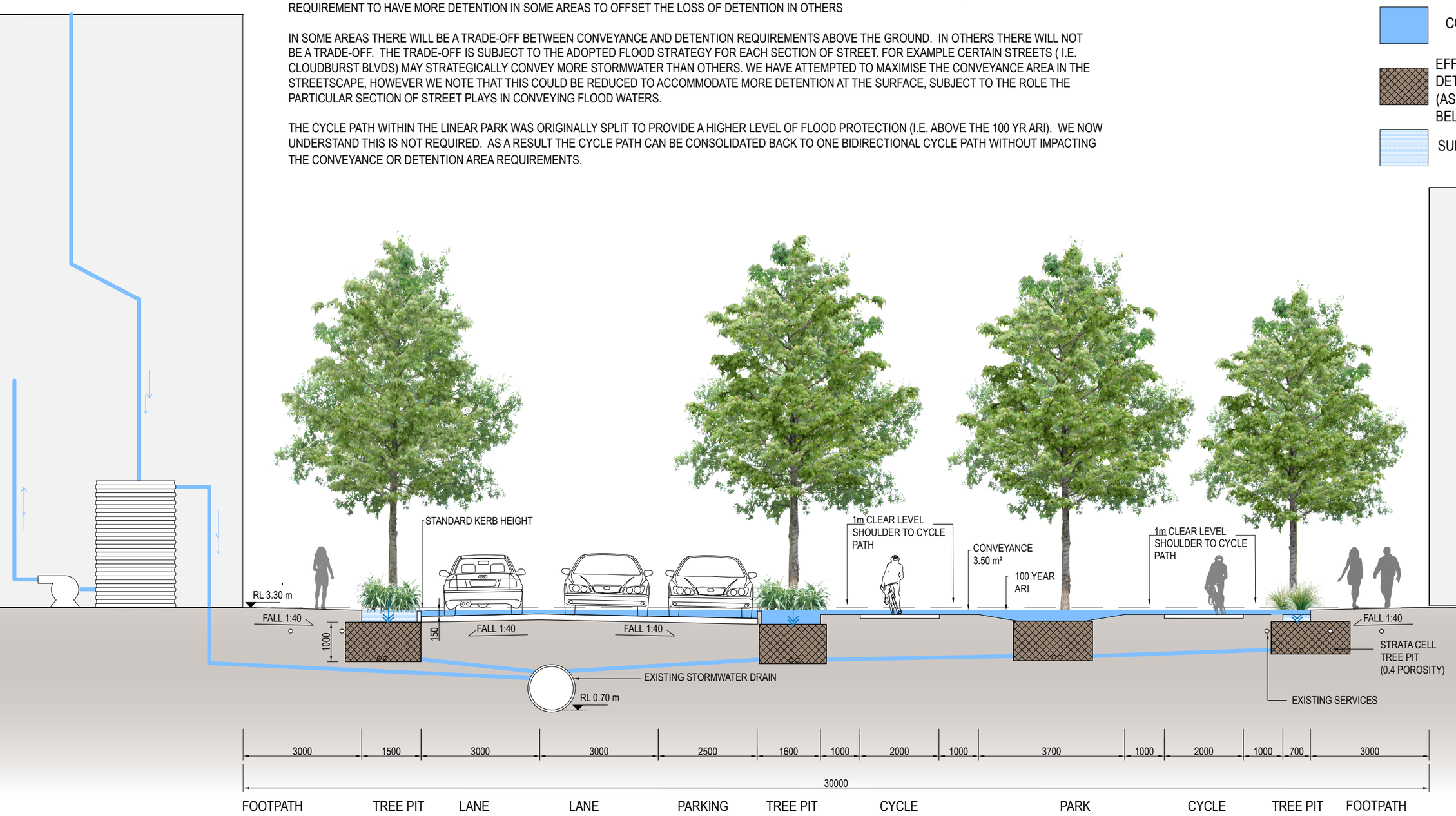
IN SOME AREAS THERE WILL BE A TRADE-OFF BETWEEN CONVEYANCE AND DETENTION REQUIREMENTS ABOVE THE GROUND. IN OTHERS THERE WILL NOT BE A TRADE-OFF. THE TRADE-OFF IS SUBJECT TO THE ADOPTED FLOOD STRATEGY FOR EACH SECTION OF STREET. FOR EXAMPLE CERTAIN STREETS (I.E. CLOUDBURST BLVDS) MAY STRATEGICALLY CONVEY MORE STORMWATER THAN OTHERS. WE HAVE ATTEMPTED TO MAXIMISE THE CONVEYANCE AREA IN THE STREETSCAPE, HOWEVER WE NOTE THAT THIS COULD BE REDUCED TO ACCOMMODATE MORE DETENTION AT THE SURFACE, SUBJECT TO THE ROLE THE PARTICULAR SECTION OF STREET PLAYS IN CONVEYING FLOOD WATERS.

THE CYCLE PATH WITHIN THE LINEAR PARK WAS ORIGINALLY SPLIT TO PROVIDE A HIGHER LEVEL OF FLOOD PROTECTION (I.E. ABOVE THE 100 YR ARI). WE NOW UNDERSTAND THIS IS NOT REQUIRED. AS A RESULT THE CYCLE PATH CAN BE CONSOLIDATED BACK TO ONE BIDIRECTIONAL CYCLE PATH WITHOUT IMPACTING THE CONVEYANCE OR DETENTION AREA REQUIREMENTS.

CONVEYANCE - 3.50 m²

EFFECTIVE UNDERGROUND DETENTION - 2.94 m² (ASSUMING 40% POROSITY FOR BELOW GROUND DETENTION)

SURFACE DETENTION - 0.54 m²



OPTION 2 - STANDARD TREE PIT CELLS FOR DETENTION

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - GRAHAM STREET (30m WITH LINEAR PARK)

Original Size: **A3**

Date: **24.10.2018**

Rev: **A**

GHDWOODHEAD

NOTES:

DETENTION CHARACTERISTICS ARE LIKELY TO VARY ALONG THE STREET DUE TO DIFFERENT CONSTRAINTS (I.E. AT INTERSECTIONS) AND THERE WILL BE A REQUIREMENT TO HAVE MORE DETENTION IN SOME AREAS TO OFFSET THE LOSS OF DETENTION IN OTHERS

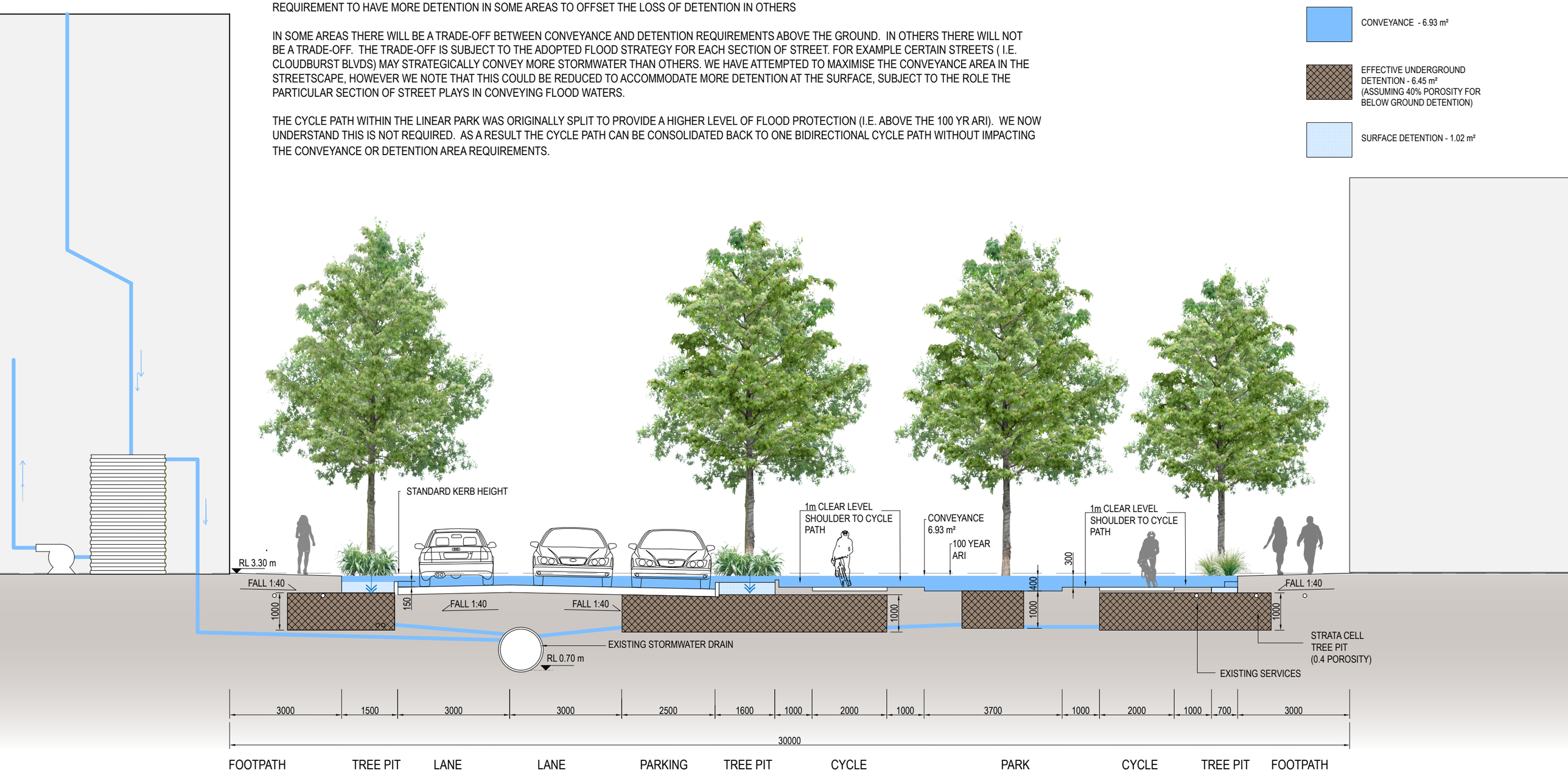
IN SOME AREAS THERE WILL BE A TRADE-OFF BETWEEN CONVEYANCE AND DETENTION REQUIREMENTS ABOVE THE GROUND. IN OTHERS THERE WILL NOT BE A TRADE-OFF. THE TRADE-OFF IS SUBJECT TO THE ADOPTED FLOOD STRATEGY FOR EACH SECTION OF STREET. FOR EXAMPLE CERTAIN STREETS (I.E. CLOUDBURST BLVDS) MAY STRATEGICALLY CONVEY MORE STORMWATER THAN OTHERS. WE HAVE ATTEMPTED TO MAXIMISE THE CONVEYANCE AREA IN THE STREETSCAPE, HOWEVER WE NOTE THAT THIS COULD BE REDUCED TO ACCOMMODATE MORE DETENTION AT THE SURFACE, SUBJECT TO THE ROLE THE PARTICULAR SECTION OF STREET PLAYS IN CONVEYING FLOOD WATERS.

THE CYCLE PATH WITHIN THE LINEAR PARK WAS ORIGINALLY SPLIT TO PROVIDE A HIGHER LEVEL OF FLOOD PROTECTION (I.E. ABOVE THE 100 YR ARI). WE NOW UNDERSTAND THIS IS NOT REQUIRED. AS A RESULT THE CYCLE PATH CAN BE CONSOLIDATED BACK TO ONE BIDIRECTIONAL CYCLE PATH WITHOUT IMPACTING THE CONVEYANCE OR DETENTION AREA REQUIREMENTS.

CONVEYANCE - 6.93 m²

EFFECTIVE UNDERGROUND DETENTION - 6.45 m² (ASSUMING 40% POROSITY FOR BELOW GROUND DETENTION)

SURFACE DETENTION - 1.02 m²



OPTION 3A - INCREASED CONVEYANCE AND DETENTION

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - GRAHAM STREET (30m WITH LINEAR PARK)

Original Size: **A3**

Date: **24.10.2018**

Rev: **A**

GHDWOODHEAD

NOTES:

DETENTION CHARACTERISTICS ARE LIKELY TO VARY ALONG THE STREET DUE TO DIFFERENT CONSTRAINTS (I.E. AT INTERSECTIONS) AND THERE WILL BE A REQUIREMENT TO HAVE MORE DETENTION IN SOME AREAS TO OFFSET THE LOSS OF DETENTION IN OTHERS

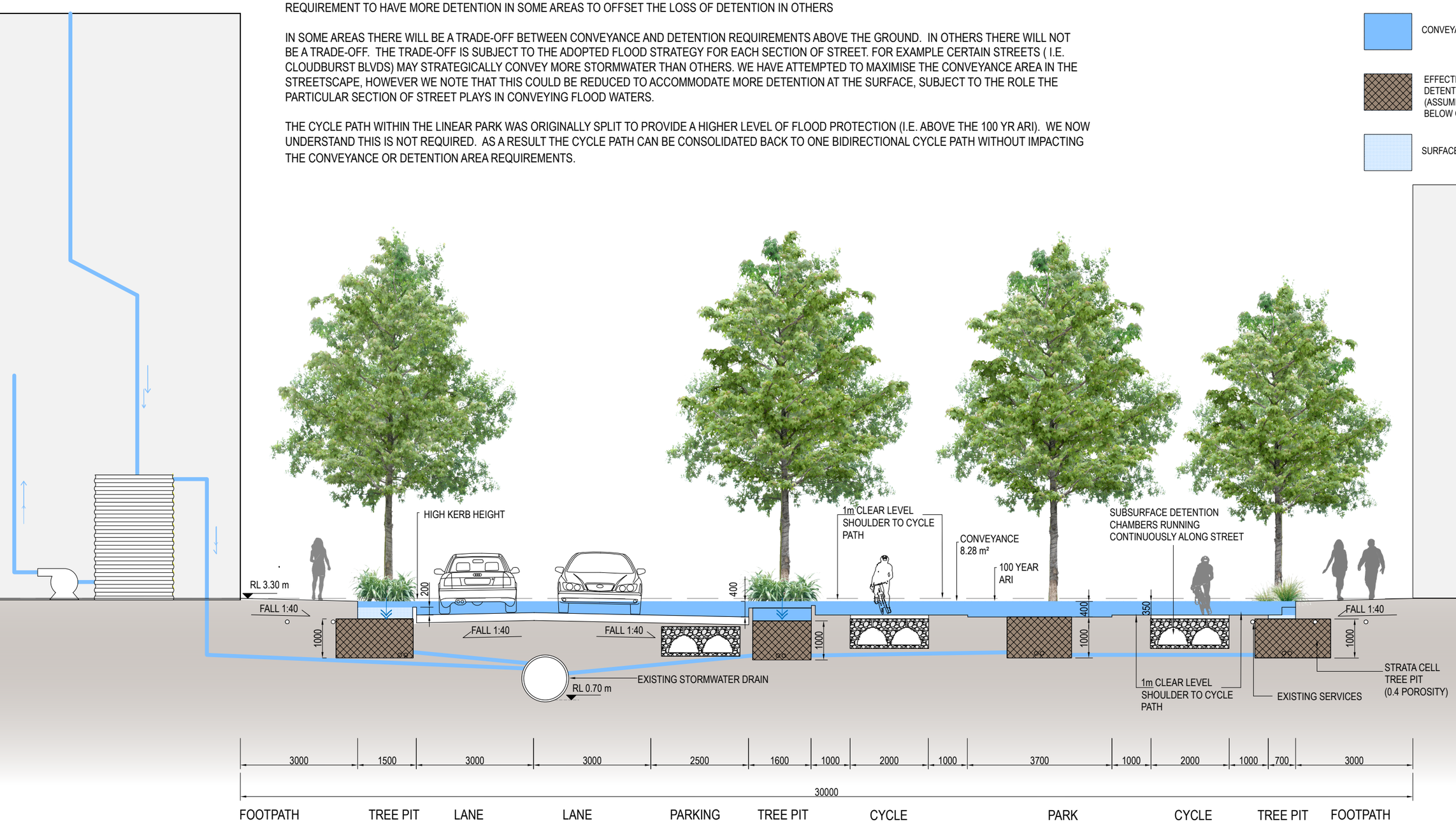
IN SOME AREAS THERE WILL BE A TRADE-OFF BETWEEN CONVEYANCE AND DETENTION REQUIREMENTS ABOVE THE GROUND. IN OTHERS THERE WILL NOT BE A TRADE-OFF. THE TRADE-OFF IS SUBJECT TO THE ADOPTED FLOOD STRATEGY FOR EACH SECTION OF STREET. FOR EXAMPLE CERTAIN STREETS (I.E. CLOUDBURST BLVDS) MAY STRATEGICALLY CONVEY MORE STORMWATER THAN OTHERS. WE HAVE ATTEMPTED TO MAXIMISE THE CONVEYANCE AREA IN THE STREETSCAPE, HOWEVER WE NOTE THAT THIS COULD BE REDUCED TO ACCOMMODATE MORE DETENTION AT THE SURFACE, SUBJECT TO THE ROLE THE PARTICULAR SECTION OF STREET PLAYS IN CONVEYING FLOOD WATERS.

THE CYCLE PATH WITHIN THE LINEAR PARK WAS ORIGINALLY SPLIT TO PROVIDE A HIGHER LEVEL OF FLOOD PROTECTION (I.E. ABOVE THE 100 YR ARI). WE NOW UNDERSTAND THIS IS NOT REQUIRED. AS A RESULT THE CYCLE PATH CAN BE CONSOLIDATED BACK TO ONE BIDIRECTIONAL CYCLE PATH WITHOUT IMPACTING THE CONVEYANCE OR DETENTION AREA REQUIREMENTS.

CONVEYANCE - 8.28 m²

EFFECTIVE UNDERGROUND DETENTION - 5.59 m² (ASSUMING 40% POROSITY FOR BELOW GROUND DETENTION)

SURFACE DETENTION - 0.49 m²



OPTION 3B - MAXIMISING CONVEYANCE AND DETENTION

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - GRAHAM STREET (30m WITH LINEAR PARK)

Original Size: **A3**

Date: **24.10.2018**

Rev: **A**

GHDWOODHEAD

NOTES:

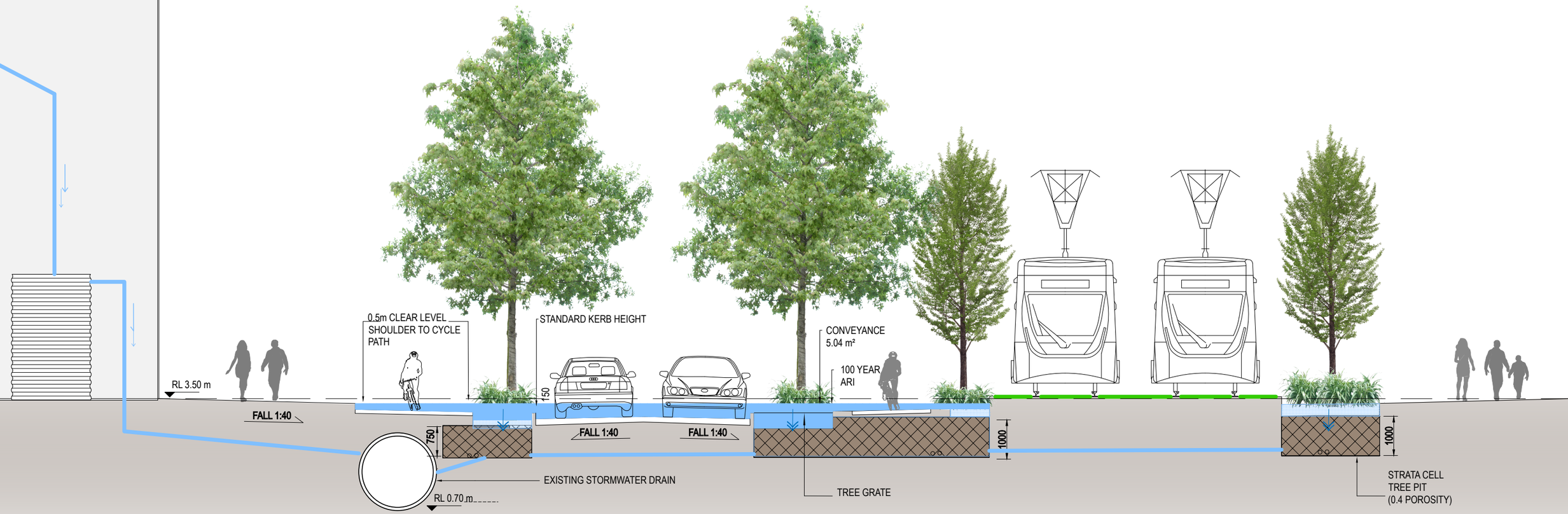
DETENTION CHARACTERISTICS ARE LIKELY TO VARY ALONG THE STREET DUE TO DIFFERENT CONSTRAINTS (I.E. AT INTERSECTIONS) AND THERE WILL BE A REQUIREMENT TO HAVE MORE DETENTION IN SOME AREAS TO OFFSET THE LOSS OF DETENTION IN OTHERS

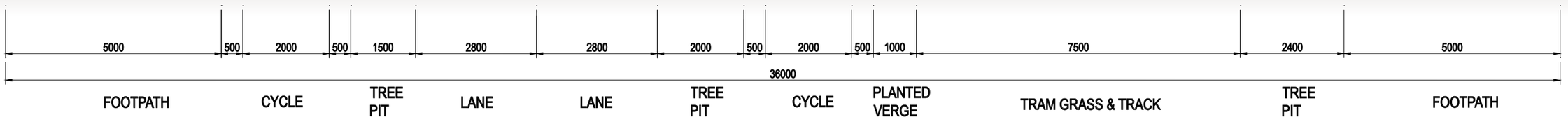
IN SOME AREAS THERE WILL BE A TRADE-OFF BETWEEN CONVEYANCE AND DETENTION REQUIREMENTS ABOVE THE GROUND. IN OTHERS THERE WILL NOT BE A TRADE-OFF. THE TRADE-OFF IS SUBJECT TO THE ADOPTED FLOOD STRATEGY FOR EACH SECTION OF STREET. FOR EXAMPLE CERTAIN STREETS (I.E. CLOUDBURST BLVDS) MAY STRATEGICALLY CONVEY MORE STORMWATER THAN OTHERS. WE HAVE ATTEMPTED TO MAXIMISE THE CONVEYANCE AREA IN THE STREETSCAPE, HOWEVER WE NOTE THAT THIS COULD BE REDUCED TO ACCOMMODATE MORE DETENTION AT THE SURFACE, SUBJECT TO THE ROLE THE PARTICULAR SECTION OF STREET PLAYS IN CONVEYING FLOOD WATERS.

CONVEYANCE - 5.04 m²

EFFECTIVE UNDERGROUND DETENTION - 3.91 m² (ASSUMING 40% POROSITY FOR BELOW GROUND DETENTION)

SURFACE DETENTION - 1.31 m²





SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

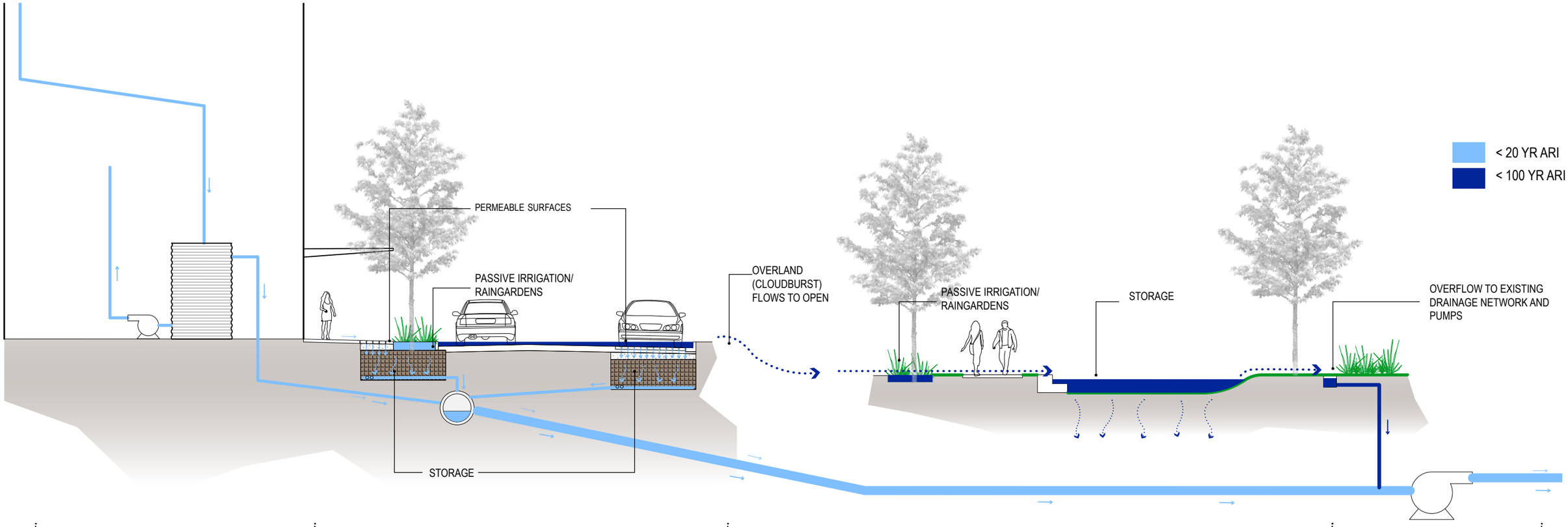
CLOUDBURST BOULEVARD - PLUMMER STREET CIVIC BLVD (36m WIDE)

Original Size: **A3**

Date: **24.10.2018**

Rev: **A**

GHDWOODHEAD



PRIVATE REALM

RAIN TANKS
REUSE
ONSITE PERMEATION

PUBLIC STREET

PERMEABLE PAVING

RAINGARDENS

PASSIVE IRRIGATION

STORAGE

PUBLIC OPEN SPACE

STORAGE

PERMEABLE PAVING

RAINGARDENS

PASSIVE IRRIGATION

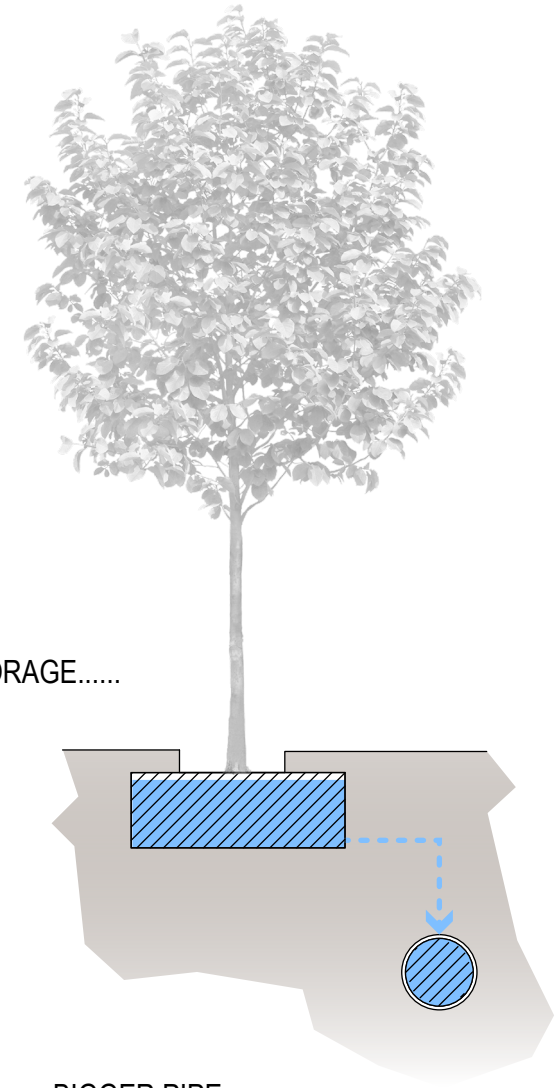
DRAINAGE INFRASTRUCTURE

PITS

PIPES

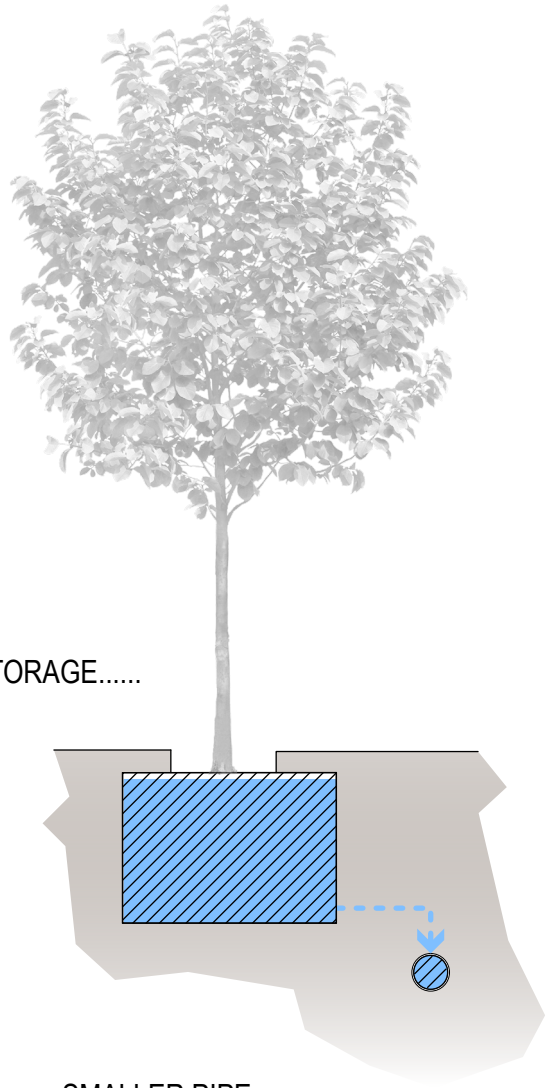
PUMPS

LESS STORAGE.....



BIGGER PIPE.

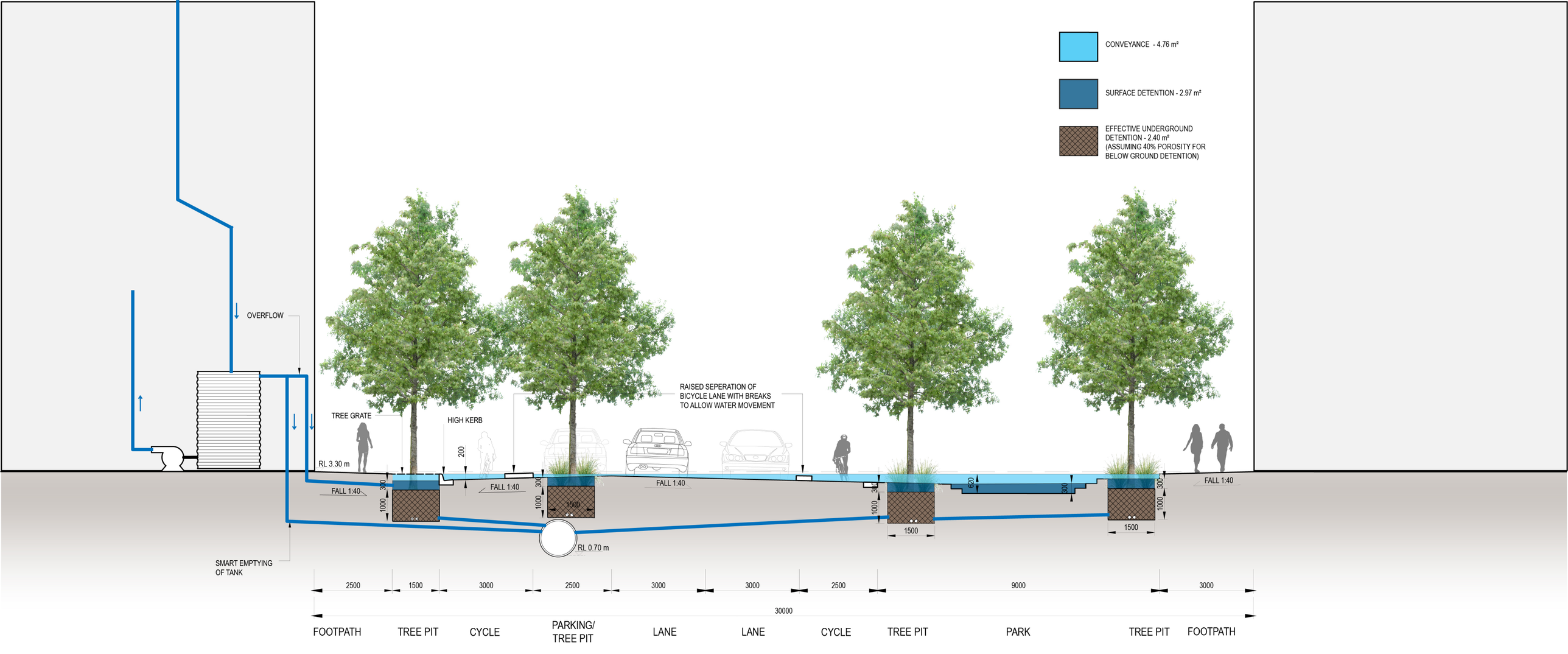
MORE STORAGE.....

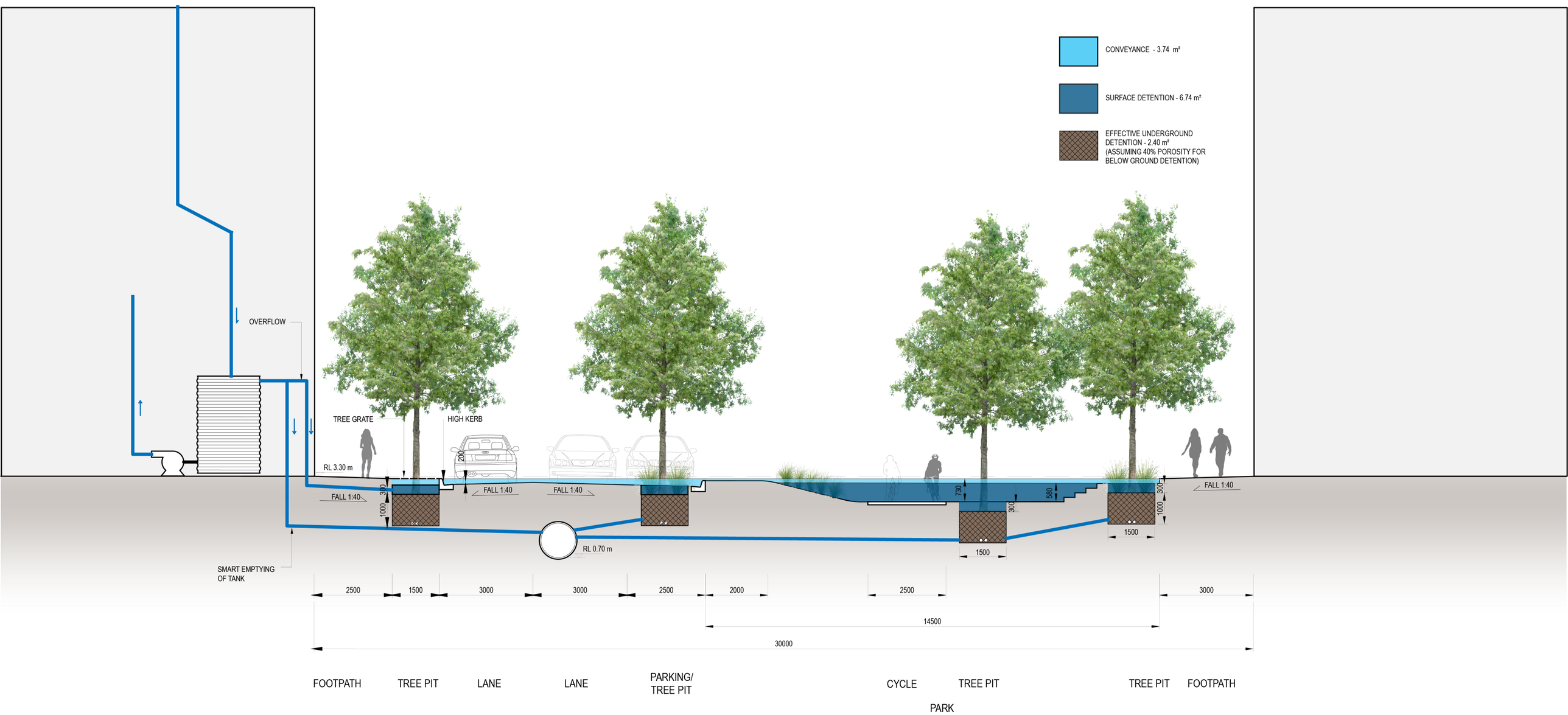


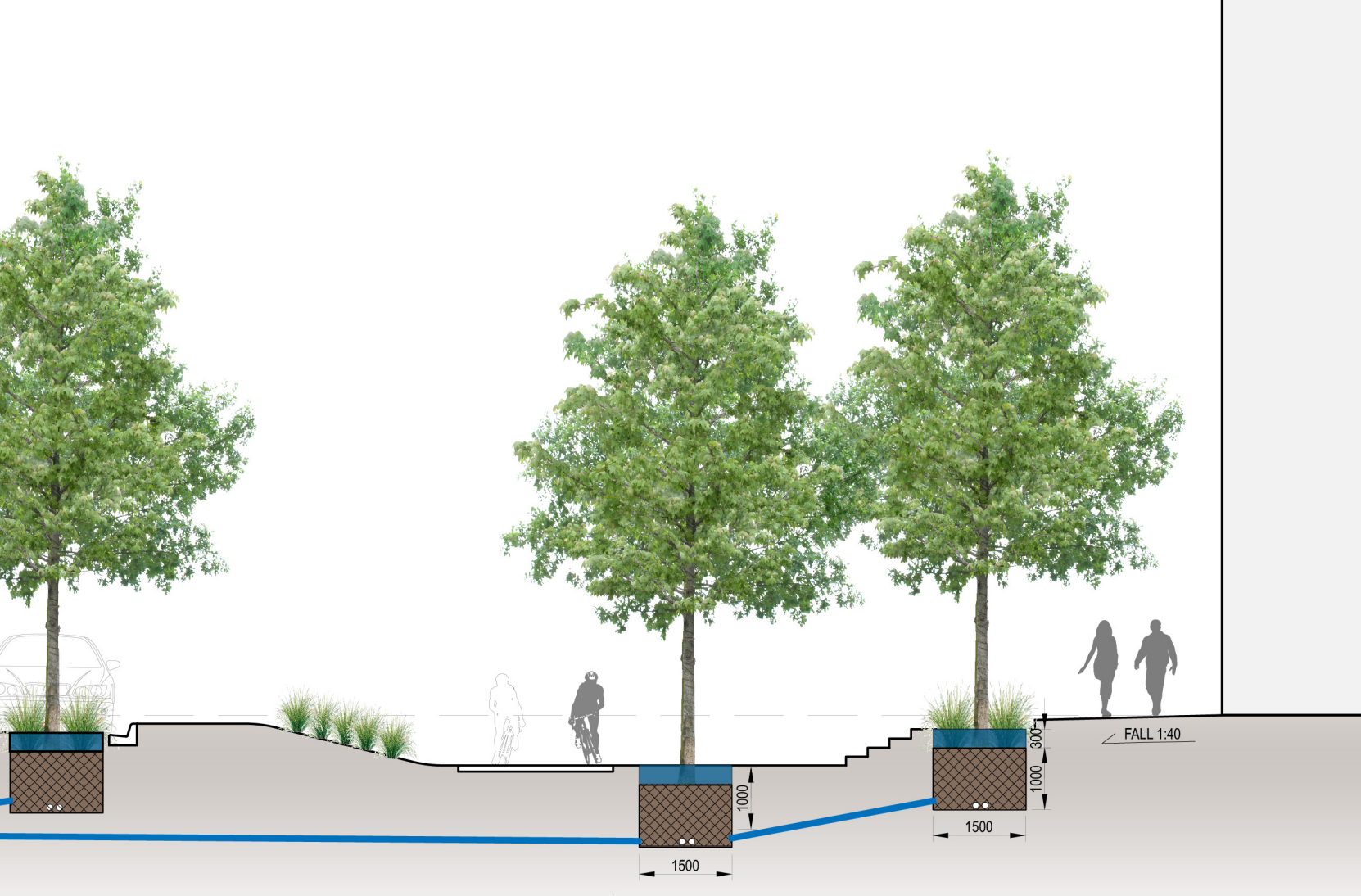
SMALLER PIPE.

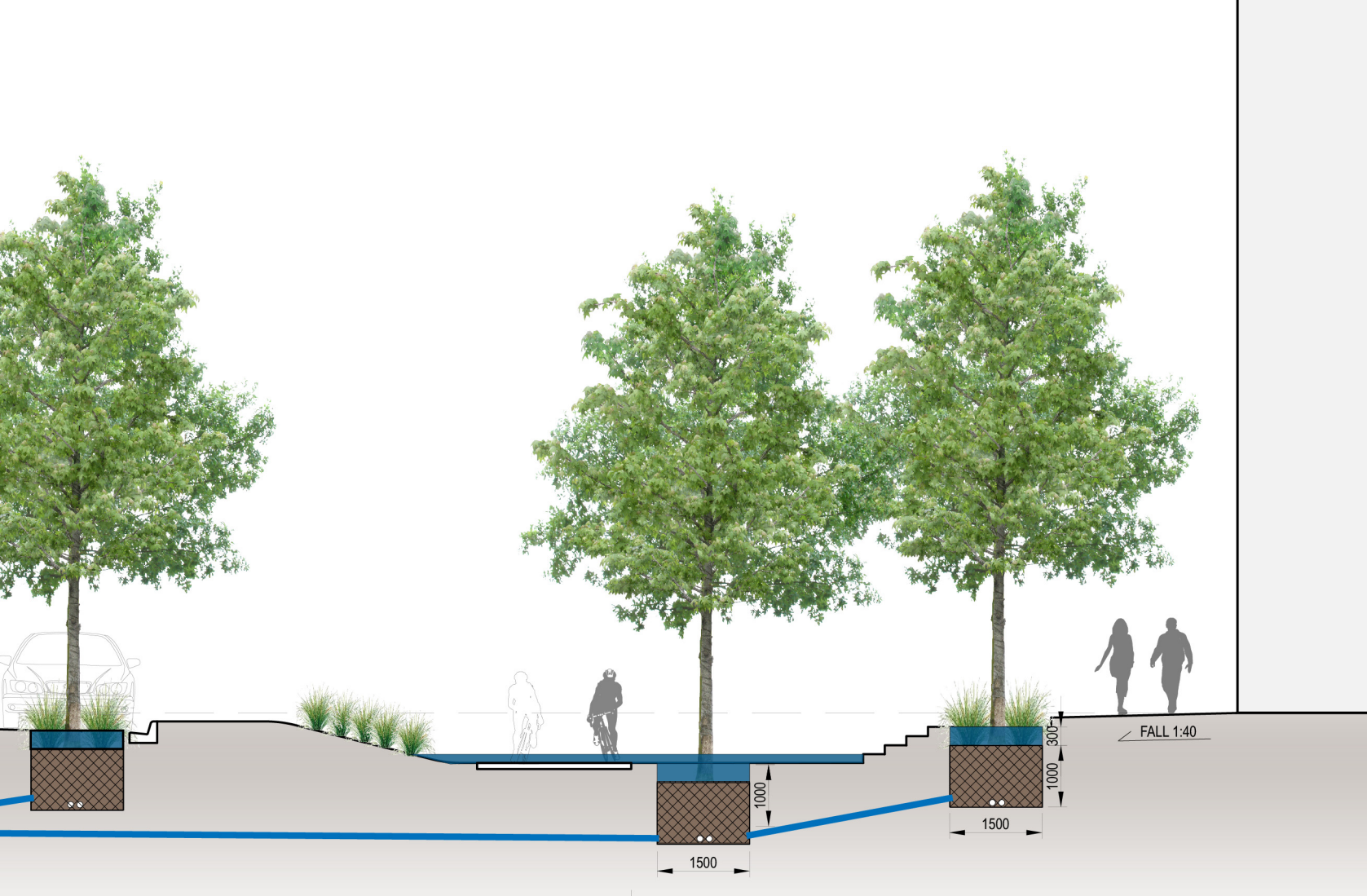
Attachment 4

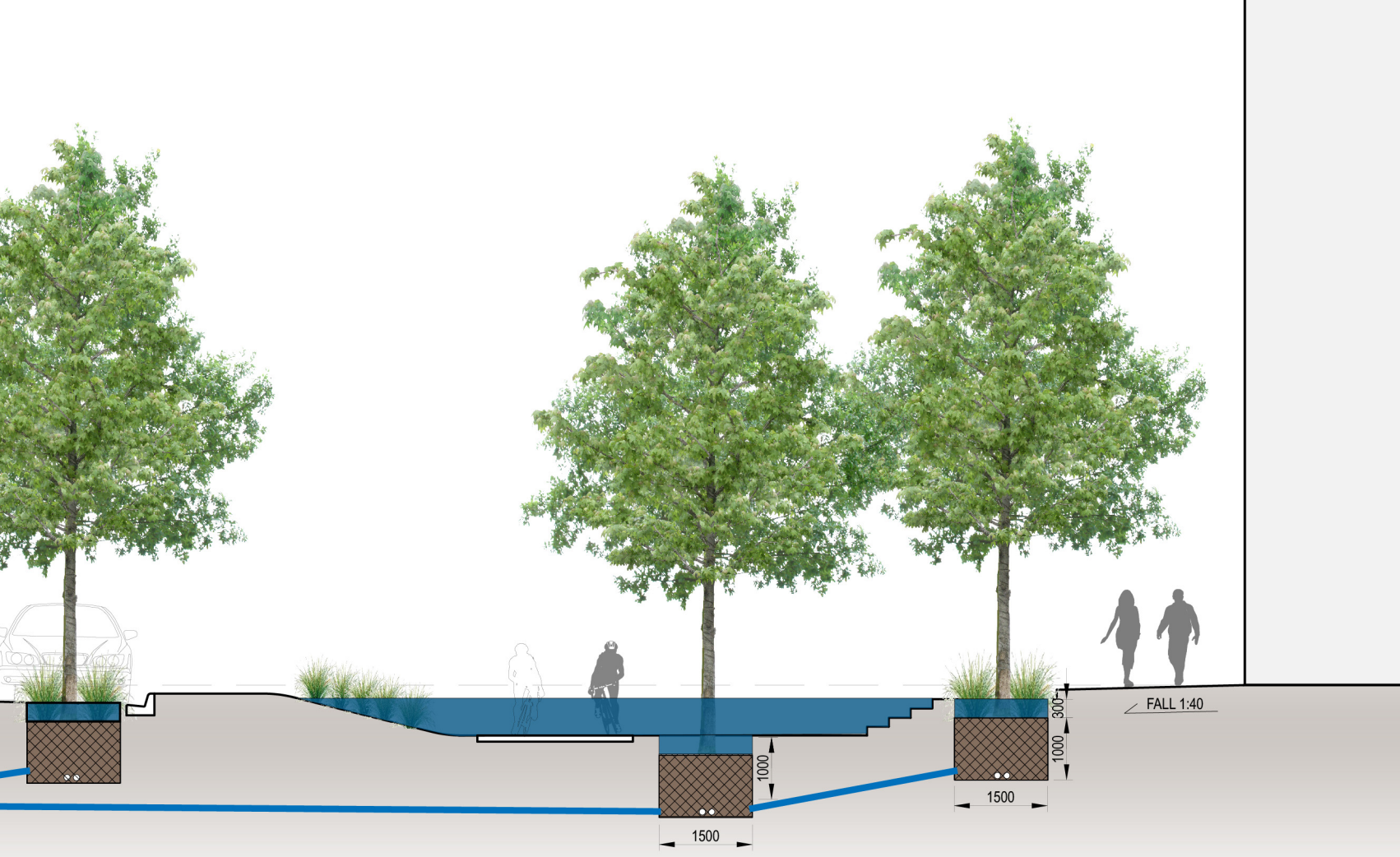
GHD cross-sections v3 for Council meetings on 31st Oct – 2nd Nov

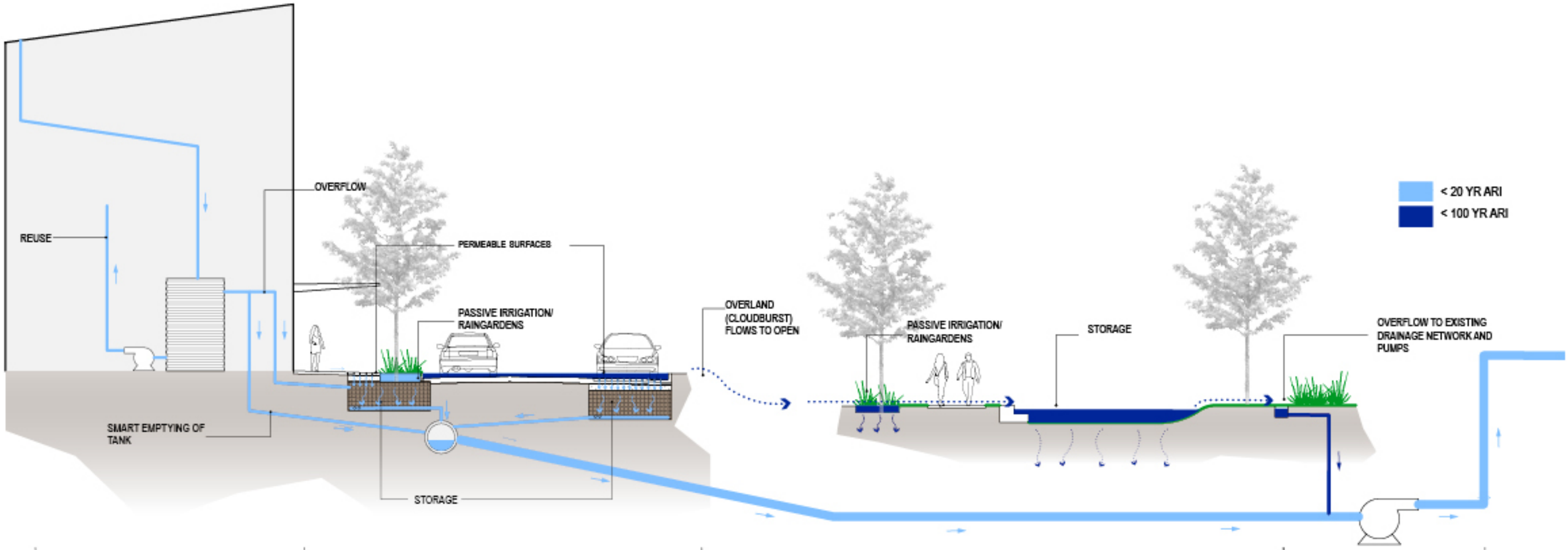

CONVEYANCE - 4.76 m²
SURFACE DETENTION - 2.97 m²
EFFECTIVE UNDERGROUND DETENTION - 2.40 m²
(ASSUMING 40% POROSITY FOR BELOW GROUND DETENTION)
OVERFLOW
TREE GRATE
HIGH KERB
RAISED SEPERATION OF BICYCLE LANE WITH BREAKS TO ALLOW WATER MOVEMENT
RL 3.30 m
200
FALL 1:40
300
1000
1500
620
730
580
RL 0.70 m
SMART EMPTYING OF TANK
2500
1500
3000
2500
3000
3000
2500
9000
3000
30000
FOOTPATH
TREE PIT
CYCLE
PARKING/ TREE PIT
LANE
LANE
CYCLE
TREE PIT
PARK
TREE PIT
FOOTPATH


CONVEYANCE - 3.74 m²
SURFACE DETENTION - 6.74 m²
EFFECTIVE UNDERGROUND DETENTION - 2.40 m²
(ASSUMING 40% POROSITY FOR BELOW GROUND DETENTION)
OVERFLOW
TREE GRATE
HIGH KERB
RL 3.30 m
200
FALL 1:40
300
1000
1500
730
580
RL 0.70 m
SMART EMPTYING OF TANK
2500
1500
3000
3000
2500
2000
2500
3000
14500
30000
FOOTPATH
TREE PIT
LANE
LANE
PARKING/ TREE PIT
CYCLE
PARK
TREE PIT
TREE PIT
FOOTPATH


FALL 1:40
300
1000
1000
1500
1500


FALL 1:40
300
1000
1000
1500
1500


FALL 1:40
300
1000
1000
1500
1500



PRIVATE REALM

RAIN TANKS

REUSE

ONSITE PERMEATION

PUBLIC STREET

STORAGE

PERMEABLE PAVING

RAINGARDENS

PASSIVE IRRIGATION

PUBLIC OPEN SPACE

STORAGE

PERMEABLE PAVING

RAINGARDENS

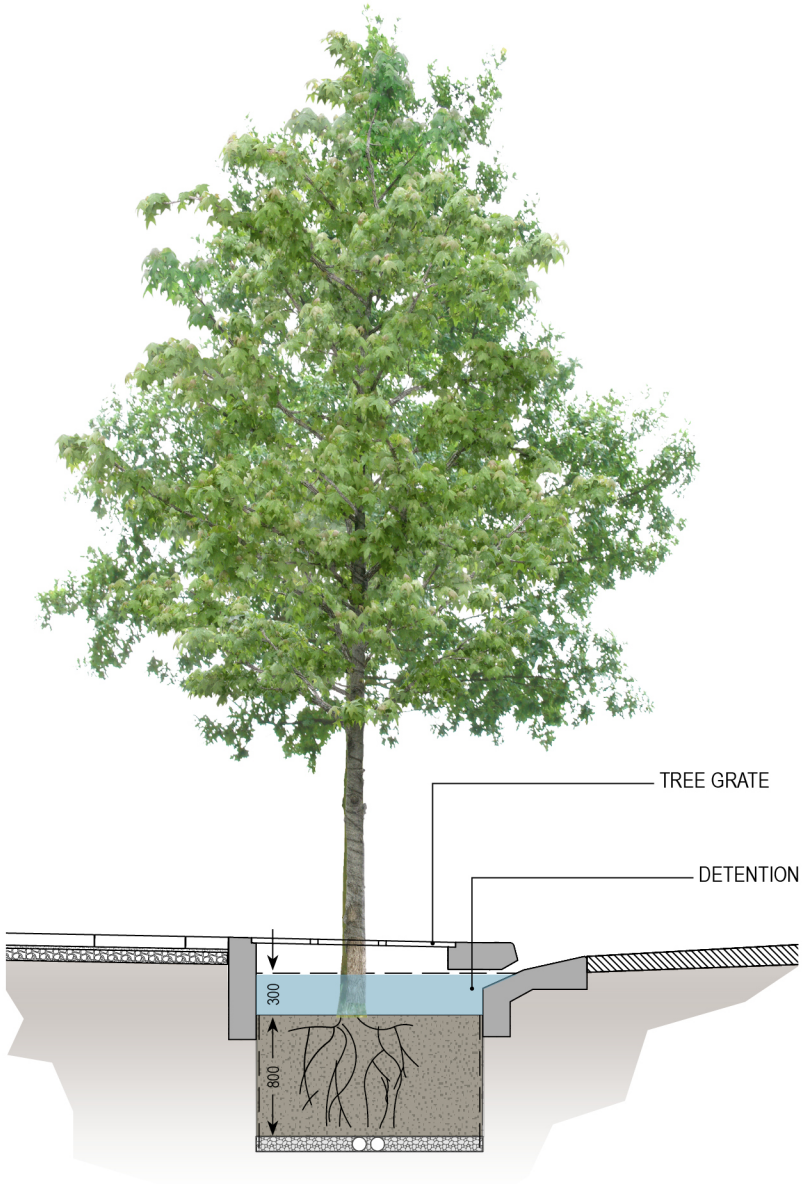
PASSIVE IRRIGATION

DRAINAGE INFRASTRUCTURE

PITS

PIPES

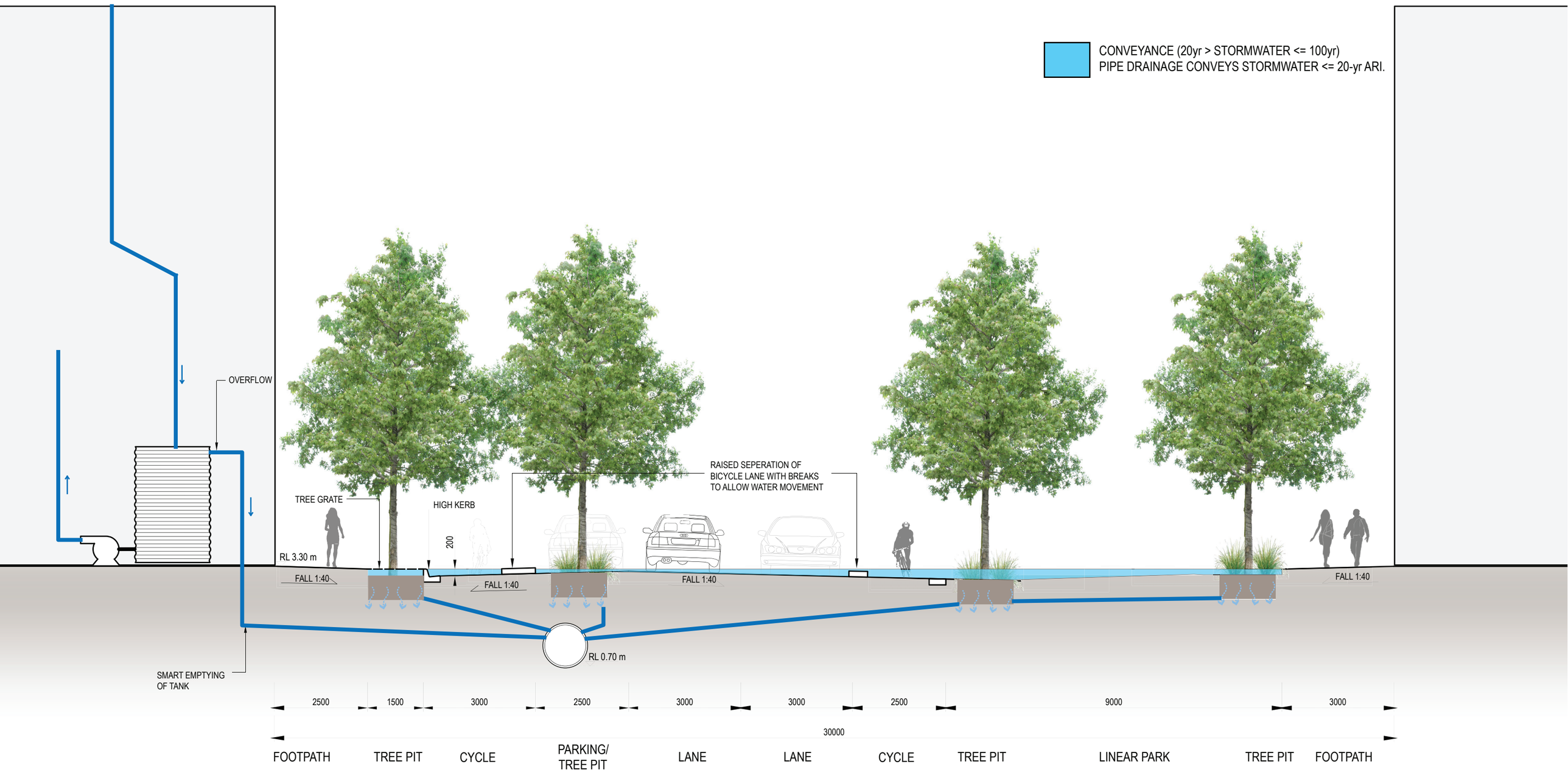
PUMPS


TREE GRATE
DETENTION
300
800

Attachment 5

GHD cross-sections v4 for Steering Committee meeting on 24th Oct

CONVEYANCE (20yr > STORMWATER <= 100yr)
PIPE DRAINAGE CONVEYS STORMWATER <= 20-yr ARI.



TYPICAL STREET SECTION WITH NO STORAGE

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

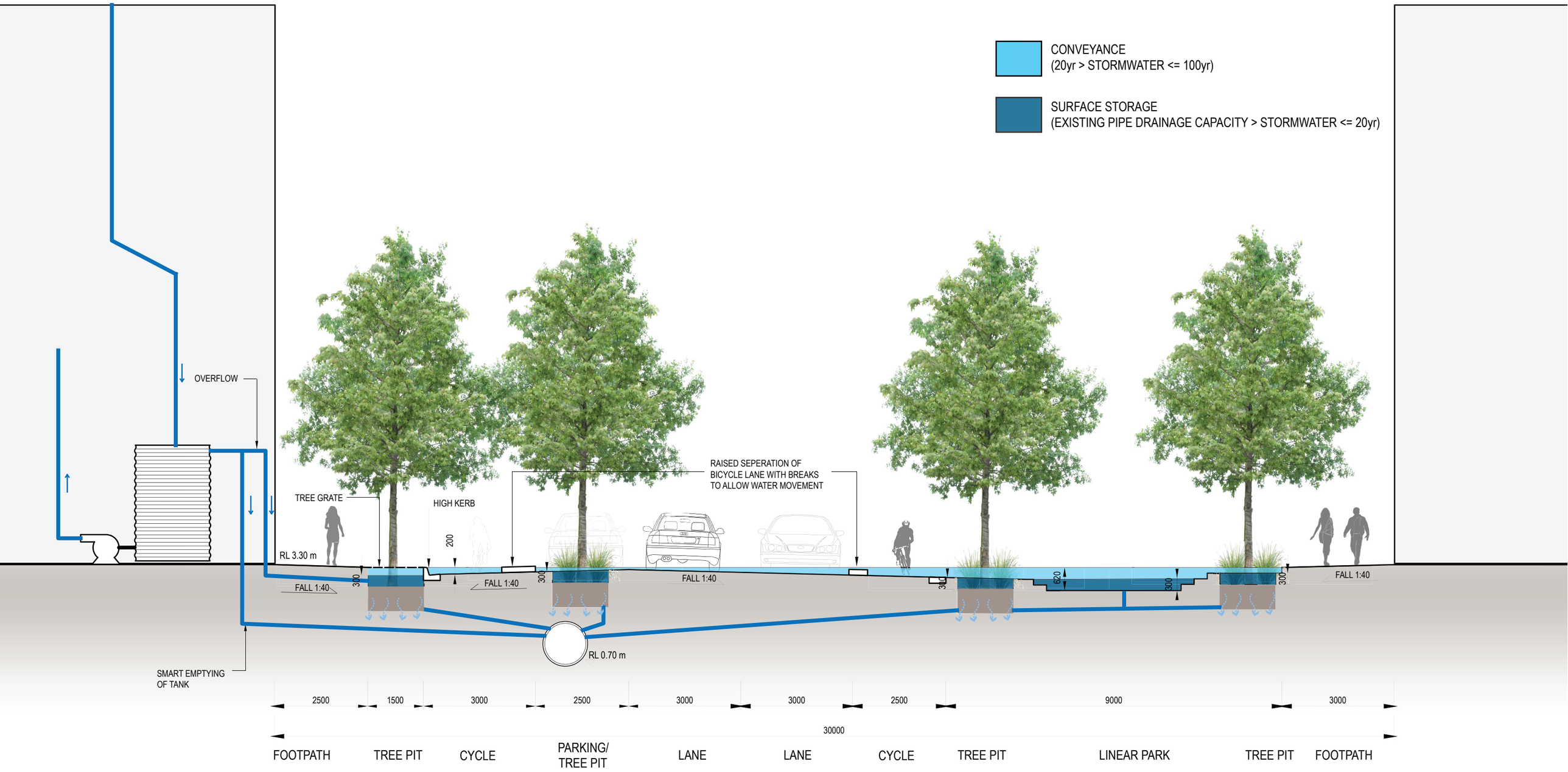
GREEN STREET - WITHOUT STORAGE

Original Size: **A3**
Date: **05.12.2018**
Rev: **A**

GHDWOODHEAD

CONVEYANCE
(20yr > STORMWATER <= 100yr)

SURFACE STORAGE
(EXISTING PIPE DRAINAGE CAPACITY > STORMWATER <= 20yr)



TYPICAL STREET SECTION WITH STORAGE

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITH STORAGE

Original Size: **A3**

Date: **05.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

FALL 1:40

300

200

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 5 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITH STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

200

FALL 1:40

300

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 10 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITHOUT STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

200

FALL 1:40

300

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 20 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITHOUT STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

STORMWATER

OVERFLOW

TREE GRATE

HIGH KERB

RAISED SEPERATION OF
BICYCLE LANE WITH BREAKS
TO ALLOW WATER MOVEMENT

RL 3.30 m

200

FALL 1:40

300

FALL 1:40

300

FALL 1:40

300

620

300

300

FALL 1:40

RL 0.70 m

SMART EMPTYING
OF TANK

2500	1500	3000	2500	3000	3000	2500	9000	3000

30000

FOOTPATH	TREE PIT	CYCLE	PARKING/ TREE PIT	LANE	LANE	CYCLE	TREE PIT	LINEAR PARK	TREE PIT	FOOTPATH

TYPICAL STREET SECTION WITH STORAGE IN A 100 - YR ARI EVENT

SCALE 1:100 @A3 0 1 2 5 m

FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - WITHOUT STORAGE

Original Size: **A3**

Date: **06.12.2018**

Rev: **A**

GHDWOODHEAD

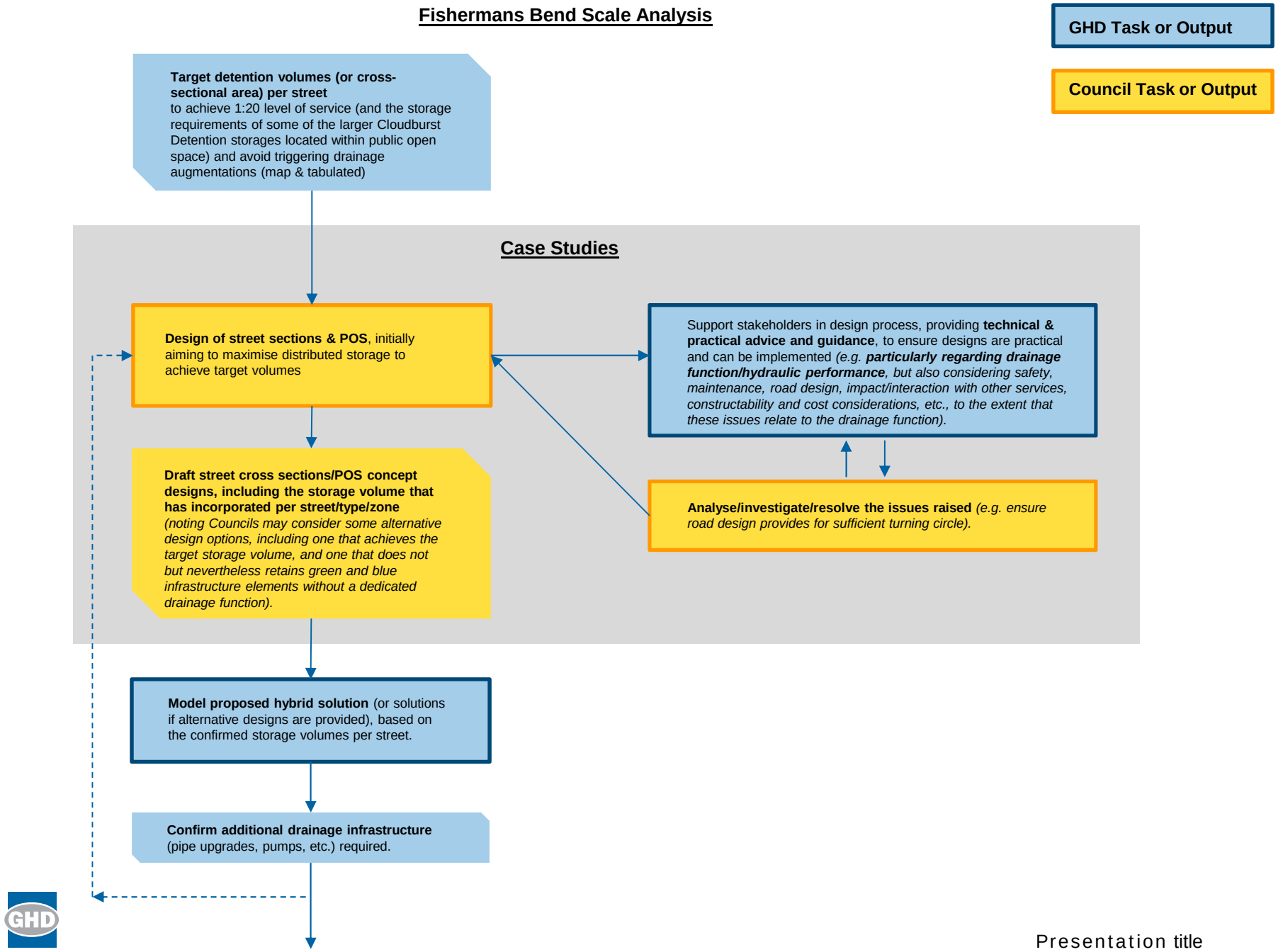
Attachment 6

Proposal workflow diagram

Fishermans Bend

WSC Drainage and Flood Management Strategy

Fishermans Bend Scale Analysis



Working Group Meeting Mark-Ups 6th September

Fishermans Bend Scale Analysis

GHD Task or Output

Council Task or Output

Target detention volumes (or cross-sectional area) per street
to achieve 1:20 level of service (and the storage requirements of some of the larger Cloudburst Detention storages located within public open space) and avoid triggering drainage augmentations (map & tabulated)

Clarify format and level of detail (i.e. spatial scale) of output

Case Studies

Design of street sections & POS, initially aiming to maximise distributed storage to achieve target volumes

Support stakeholders in design process, providing **technical & practical advice and guidance**, to ensure designs are practical and can be implemented *(e.g. **particularly regarding drainage function/hydraulic performance**, but also considering safety, maintenance, road design, impact/interaction with other services, constructability and cost considerations, etc., to the extent that these issues relate to the drainage function).*

What level of design of drainage related elements (functional, detailed) … what information will be shown on cross-sections and plans?

Is this a separate output, or is it incorporated into the council cross-section or plan? If the latter, how does this work?

Draft street cross sections/POS concept designs, including the storage volume that has incorporated per street/type/zone *(noting Councils may consider some alternative design options, including one that achieves the target storage volume, and one that does not but nevertheless retains green and blue infrastructure elements without a dedicated drainage function).*

What level of design?
What exact outputs?
What format?

Analyse/investigate/resolve the issues raised *(e.g. ensure road design provides for sufficient turning circle).*

This is a starting position. Is this realistic? Where might Council need support?

Probably need to represent a step in here that is scaling up the case study learnings to the typologies across all of study area to enable the modelling

Model proposed hybrid solution (or solutions if alternative designs are provided), based on the confirmed storage volumes per street.

Confirm additional drainage infrastructure (pipe upgrades, pumps, etc.) required.

There is some decision point, *to select a particular option, or revisit/refine the option*, that could be represented

Attachment 7

Opportunities and Constraints Workshop Presentation

Opportunities & Constraints

GHD Water

Potential Constraints & Benefits

Services
- Routing

Robustness of Solution
- Pumping
- Pipe Augmentation
- Floor Level Controls

Maintenance
- Hydrocarbons
- Gross Pollutants
- Sediments
- Access
- Inspections

Safety
- Pedestrians
- Vehicles
- Wildlife

Access
- Property Access
- Vehicular Movements
- Pedestrian Movement

Environmental Benefits
- Urban Cooling
- Air Quality
- Water Quality
- Flora & Fauna

Liveability
- Visual Appeal

Construction
- Contaminated Soils
- Vegetation Selection

Groundwater
- Groundwater Level
- Groundwater Quality

Cost
- Capital Cost
- Maintenance Cost

Four Main Typologies for Drainage

- Blue Laneways
- Green Streets
- Cloudburst Boulevards
- Cloudburst Detention

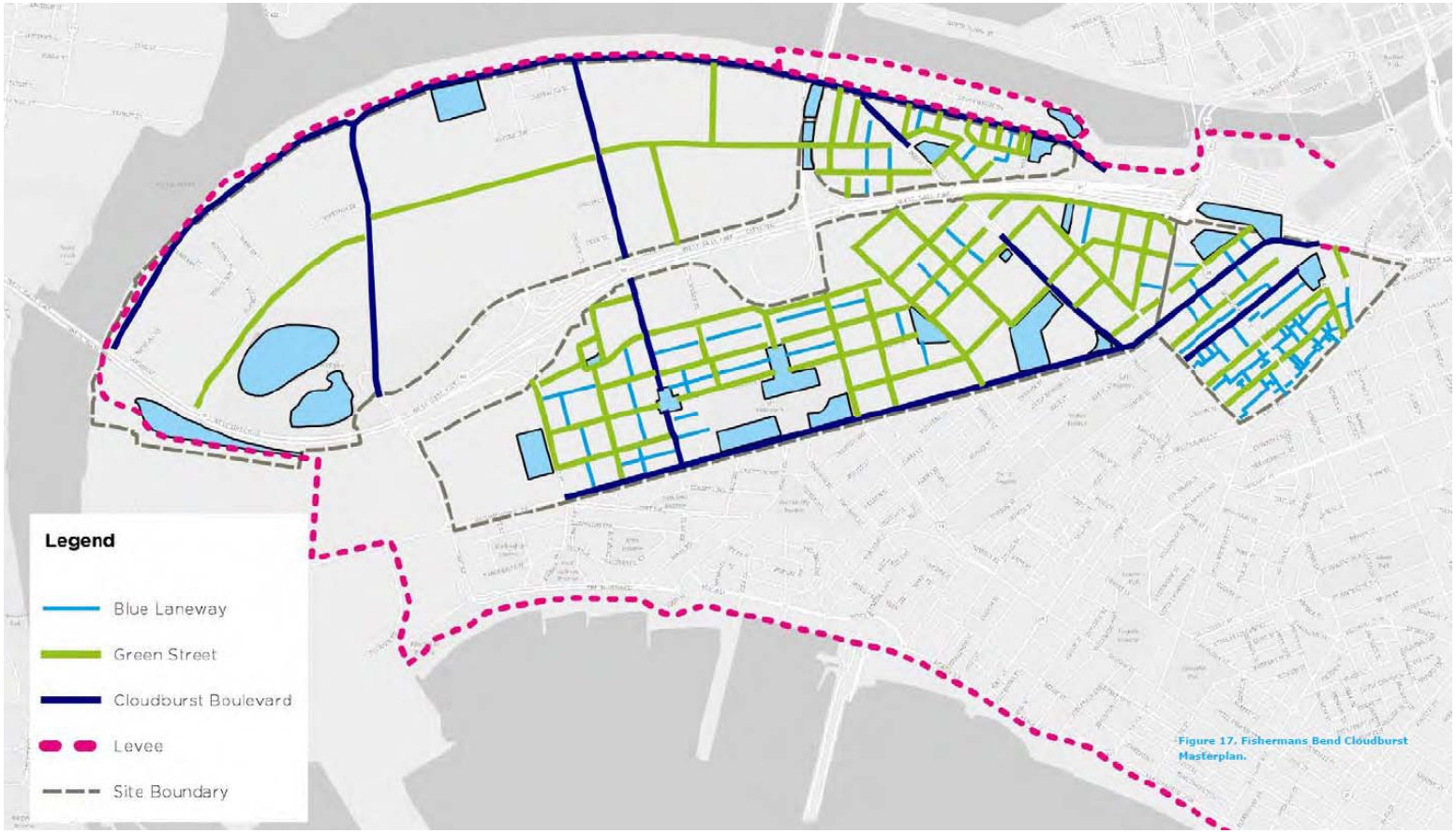


Figure 17. Fishermans Bend Cloudburst Masterplan.

Blue Laneways

Storage Requirements

- Average 2m width and 0.3m depth

Rambol impression:

Green Streets

Storage Requirements

- Average 8m width and 0.4m depth

Rambol impression:

Cloudburst Boulevards

Storage Requirements

- Average 10m width and 0.4m depth

Rambol impression:

Cloudburst Detention

Storage Requirements

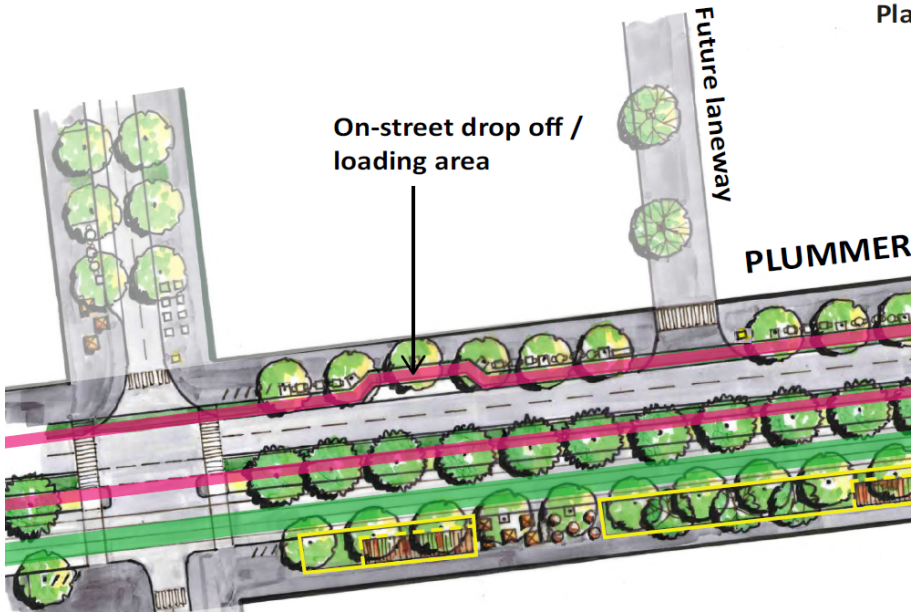
- Average 1.0m depth

Rambol impression:

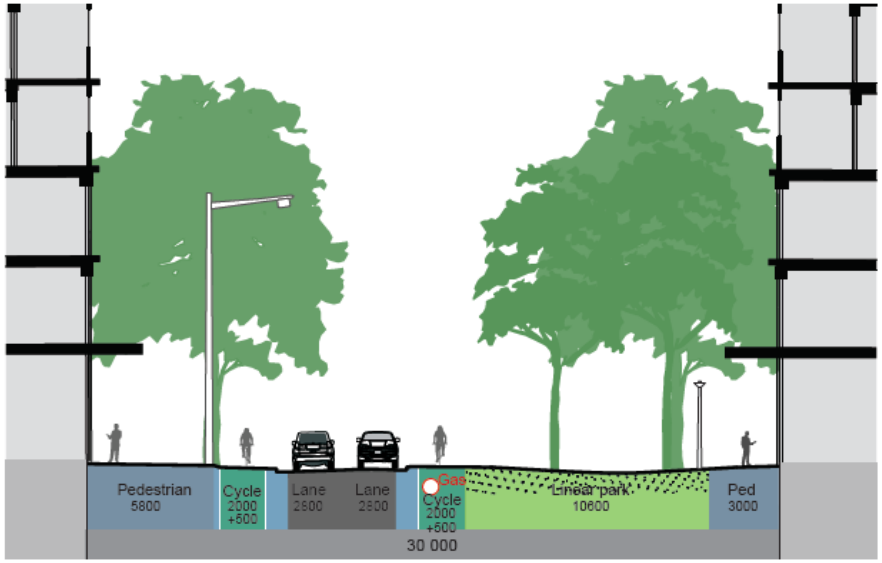
Examples of Outputs

Examples of Outputs

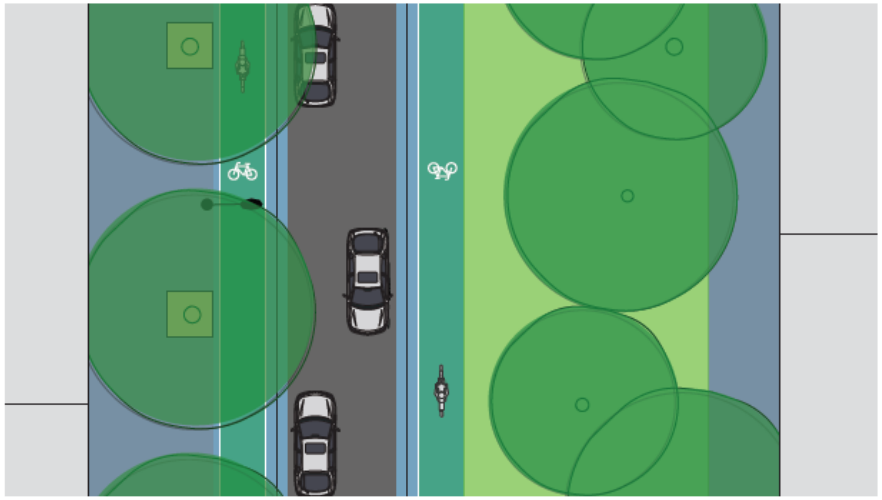
Concept Outputs:



5.10 Buckhurst Street



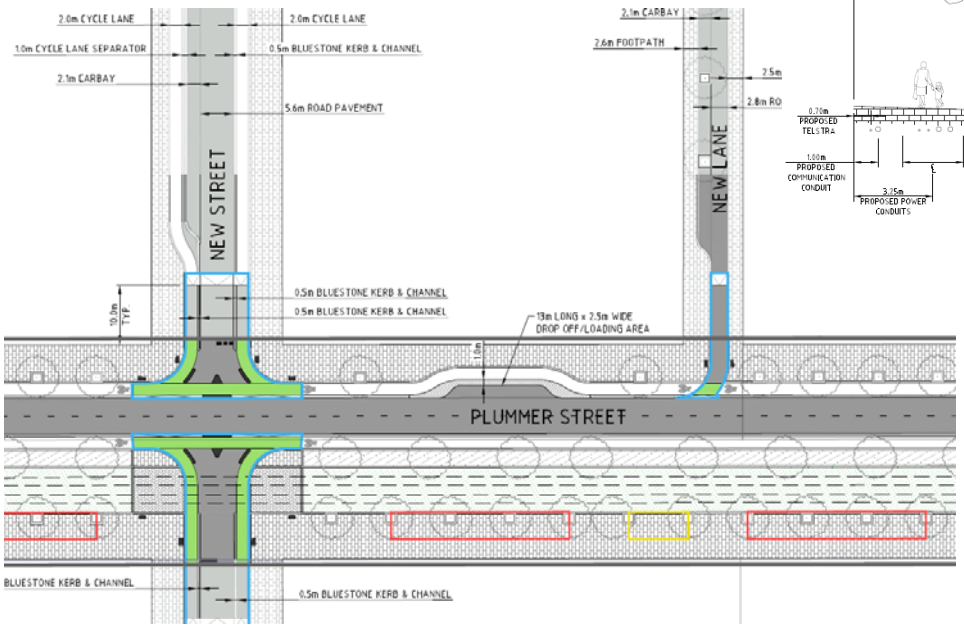
Typical profil

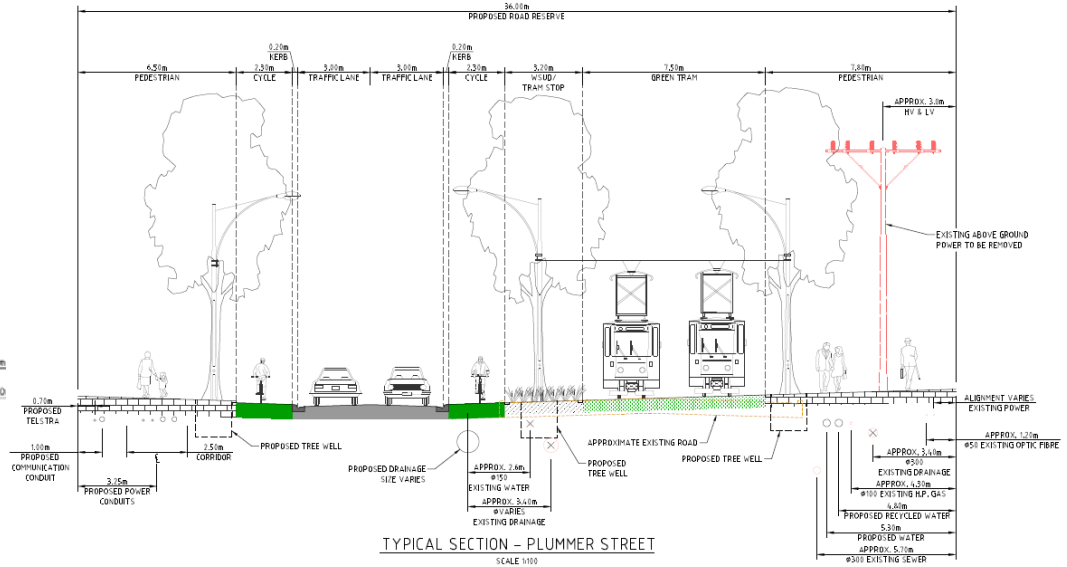


Typical plan

Examples of Outputs

Functional Outputs:





www.ghd.com

Attachment 8

Cross Section & Case Study Review Memorandum

Memorandum

05 October 2018

To	Shelley Bennett (CoPP), Alex Robinson (CoM)		
Copy to	Theodora Hogan (Melbourne Water), Todd Berry (DELWP)		
From	David Howard	Tel	+61 3 8687 8789
Subject	Fishermans Bend Streetscape Case Study Review	Job no.	3136555

1 Introduction

1.1 Purpose of this memorandum

The purpose of this memorandum is to provide a high level summary of our initial critique of the preliminary case study streetscape cross sections provided the City of Port Phillip (CoPP) and City of Melbourne (CoM).

This memorandum is provided to facilitate collaborative discussion and allow for further iterative modifications to be made to the initial streetscape cross. ***We propose to provide additional alternative streetscape configurations for the Graham St case study next Monday (08/10/2018)***. ***This includes an alternative cycle path arrangement***. Further exploration of the opportunities and challenges associated with the case study streetscape cross sections and JL Murphy Reserve will be undertaken in the coming weeks. This includes accommodation of services in the streetscape.

2 General Feedback –CoPP Case Study Streetscape Cross Sections

Provision for Flood Detention

The provision of flood detention areas generally appears to be adequate when compared to the Ramboll breakdowns for blue laneways, green streets and cloudburst boulevards.

Provision for Flood Conveyance

The provision of flood conveyance areas (100 yr ARI) generally appear to be inadequate when compared to GHD's flood modelling. This is particularly relevant to the streetscapes that carry flood waters in the 100 yr ARI event and include sections of the following streetscapes across the entire Fishermans Bend precinct:

- Todd Rd
- Williamstown Rd
- Cook St
- Prohasky St
- Salmon St
- Graham St
- Woolboard Rd
- Bertie St
- Ingles St
- Boundary St
- Lorimer St

GHD
Level 8 180 Lonsdale Street Melbourne VIC 3000 Australia
T 61 3 8687 8000 F 61 3 8687 8522 E melmail@ghd.com W www.ghd.com

From a flood conveyance perspective, a tailored streetscape approach in each of these locations will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). For this reason, we have prepared a specific review of the Green Street (34 m linear park) and applied it to one of the above streets. The attached Graham St cross section provides a before and after comparison of the provision of flood conveyance in the streetscape. In this scenario the initial cross sectional area (assuming a Green St of 34 m with linear park typology applies) provided a conveyance area of 4 sq m whilst GHD's modelling indicated a required conveyance area of 10 sq m. Modifications to the cross section provides the additional 6 sq m required. Further collaborative work is required here.

Drainage Functionality

From a drainage functionality perspective, a tailored streetscape approach will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). Refer to the attached Graham St cross section for a before and after comparison of how the streetscape drainage functionality can be improved. Further collaborative work is required here.

Vertical depth of detention systems

The vertical depth of detention systems will also need to be tailored based on the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy, location if the catchment, and the local conditions (i.e. topography, tail water constraints). Further collaborative work is required here.

Streetscape Cross Fall, Grades & Drop Offs

The existing sections do not provide adequate vertical detail to critique streetscape cross fall, grades and drop-offs. Refer to the attached Graham St cross section for a before and after comparison of how the streetscape cross fall, grades & drop offs can be improved. Further collaborative work is required here.

Conflicts with Existing & future Provision of Services

The future service requirements are yet to be confirmed (TBC by Taskforce in the coming weeks/months). This will impact the need and desire to relocate services.

Based on our review of the Plummer St cross section there appears to be conflicts between the tree pit detention and existing services based on the Mesh Funding and Financing Infrastructure Case Studies.

Refer to the attached Graham St cross section for a review of existing services.

3 General Feedback –CoPP JL Murphy Reserve

Based on the review of the Graham St cross as an example, the depth of detention areas within the streetscape is likely to be a minimum 1.5 m below the ground level (current sections show a 1.0-1.35 m deep approach). With this as a starting point the JL Murphy Reserve would need to (not consider broadening the catchment area, which would likely deepen the detention requirement or part thereof). Any future detention requirements should consider future smart tank consideration, retention, and reuse on open space (i.e. not all the water draining to JL Murphy needs to be pumped to a receiving waterway/Port Phillip Bay).

GHD
Level 8 180 Lonsdale Street Melbourne VIC 3000 Australia
T 61 3 8687 8000 F 61 3 8687 8522 E melmail@ghd.com W www.ghd.com

Further exploration of the opportunities and challenges associated with the JL Murphy Reserve will be explored further in the coming weeks.

4 General Feedback –CoM Case Study Streetscape Cross Sections

Provision for Flood Detention
The provision of flood detention areas generally appears to be adequate when compared to the Ramboll breakdowns for blue laneways, green streets and cloudburst boulevards.
Section A should provide some level of detention (0.6 sq m as per Ramboll blue lane way detention interpretation). Further collaborative work is required here.

Provision for Flood Conveyance
The provision of flood conveyance areas (100 yr AR) will need to be explored in further detail with GHD's flood modelling. From a flood conveyance perspective, a tailored streetscape approach in each of these locations will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). Further collaborative work is required here.

Drainage Functionality
From a drainage functionality perspective, a tailored streetscape approach will be required subject to the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy and the local conditions (i.e. topography). Refer to the attached Graham St cross section for a before and after comparison of how the streetscape drainage functionality can be improved. Further collaborative work is required here.

Vertical depth of detention systems
The vertical depth of detention systems will also need to be tailored based on the future typology (TBC by Taskforce in the coming weeks), role in overall flood strategy, location if the catchment, and the local conditions (i.e. topography, tail water constraints). Further collaborative work is required here.

Streetscape Cross Fall, Grades & Drop Offs
The existing sections do not provide adequate vertical detail to critique streetscape cross fall, grades and drop-offs. Further collaborative work is required here.

Conflicts with Existing & future Provision of Services
The future service requirements are yet to be confirmed (TBC by Taskforce in the coming weeks/months). This will impact the need and desire to relocate services. Further collaborative work is required here.

5 Specific Feedback – Graham St

Refer to the attached Graham St cross section for a before and after comparison of how the streetscape drainage functionality, vertical depth of detention systems, streetscape cross-falls/grades/drop-offs, and conflict with existing/future provision of services can be improved.

A detention area exceeding the 3.2 sq m target can be provided (based on Ramboll green street detention interpretation).

GHD
Level 8 180 Lonsdale Street Melbourne VIC 3000 Australia
T 61 3 8687 8000 F 61 3 8687 8522 E melmail@ghd.com W www.ghd.com

A conveyance area equivalent to 10 sq m can be provided (in accordance with GHD modelled area), and is based on:

- Tree pits/raingardens providing an average 400 mm of conveyance (1.66 sq m);
- Road and parking bay providing an average 350 mm of conveyance (2.84 sq m);
- Cycle path providing an average 325 mm of conveyance (1.95 sq m); and
- Linear park providing an average 350 mm of conveyance (3.60 sq m).

The maximum allowable depth of flooding was assumed to be 400 mm at any one point in the streetscape.

We propose to provide additional alternative streetscape configurations for the Graham St case study next Monday (08/10/2018).

6 Challenges & Innovative Considerations in Streetscape Design

Table 1 presents challenges and innovative considerations in the streetscape design. A hierarchy and level of flood protection are provided for each component of the streetscape.

Table 1 Challenges and Innovative Consideration in Streetscape Design

Hierarchy of Flood Protection	Level of Flood Protection	Challenges/Potential Conflicts with Other Objectives	Innovative Considerations
Footpath (or path thereof)	Flood free in 100 yr ARI.	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens Cross fall grade on footpath means step downs into street trees and road required. Accommodation of services through street trees.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath) Exploration of new innovative servicing approach, i.e. footpath v centre median (TBC based the need for larger services) Provision of services through tree pits using structural soils and root control. Kerb break throughs to allow for passive irrigation of street trees and increase in streetscape conveyance area
Tram line	Flood free in 100 yr ARI.	Potential desire for passively irrigated green tram lines. Accommodation of tram stops in the streetscape (potential impacts on flood conveyance)	Drought proof vegetation selection (i.e. sedum) along tramways (refer case study). Storage under tram lines. Innovative tram stop design (include access) to minimise impacts to conveyance.

GHD
Level 8 180 Lonsdale Street Melbourne VIC 3000 Australia
T 61 3 8687 8000 F 61 3 8687 8522 E melmail@ghd.com W www.ghd.com

Hierarchy of Flood Protection	Level of Flood Protection	Challenges/Potential Conflicts with Other Objectives	Innovative Considerations
Cycle Path	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Lane separators impacts path of low flows from road to street trees/detention zones. Maintaining access during 100 yr ARI flood event.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath). Raise part of cycle path above 100 yr ARI flood level. Relocation of cycle paths adjacent to footpaths and allow road drainage to filter into linear park. As a results cycle path remains flood free in 100 yr ARI. Relocation/future services under cycle path.
Road & Parking Bays	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens. Position of street trees to maximise passive irrigation/detention and provide shading of pedestrians and cyclists	Street trees in centre median of road if road is inverted Two way cross fall to maximise passive irrigation/detention. Permeable pavements in parking bays to street trees for detention/irrigation. Larger street tree footprint and detention volumes (i.e. strata cells under parking bays).
Linear Park	Some detention in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Intersection treatments. Streetscape furniture & vegetation impacts conveyance capacity. Egress over linear park during flood events. DDA compliant grading and access.	Streetscape furniture selection. Vegetation selection. Bridging to provide egress at regular intervals.

Regards,

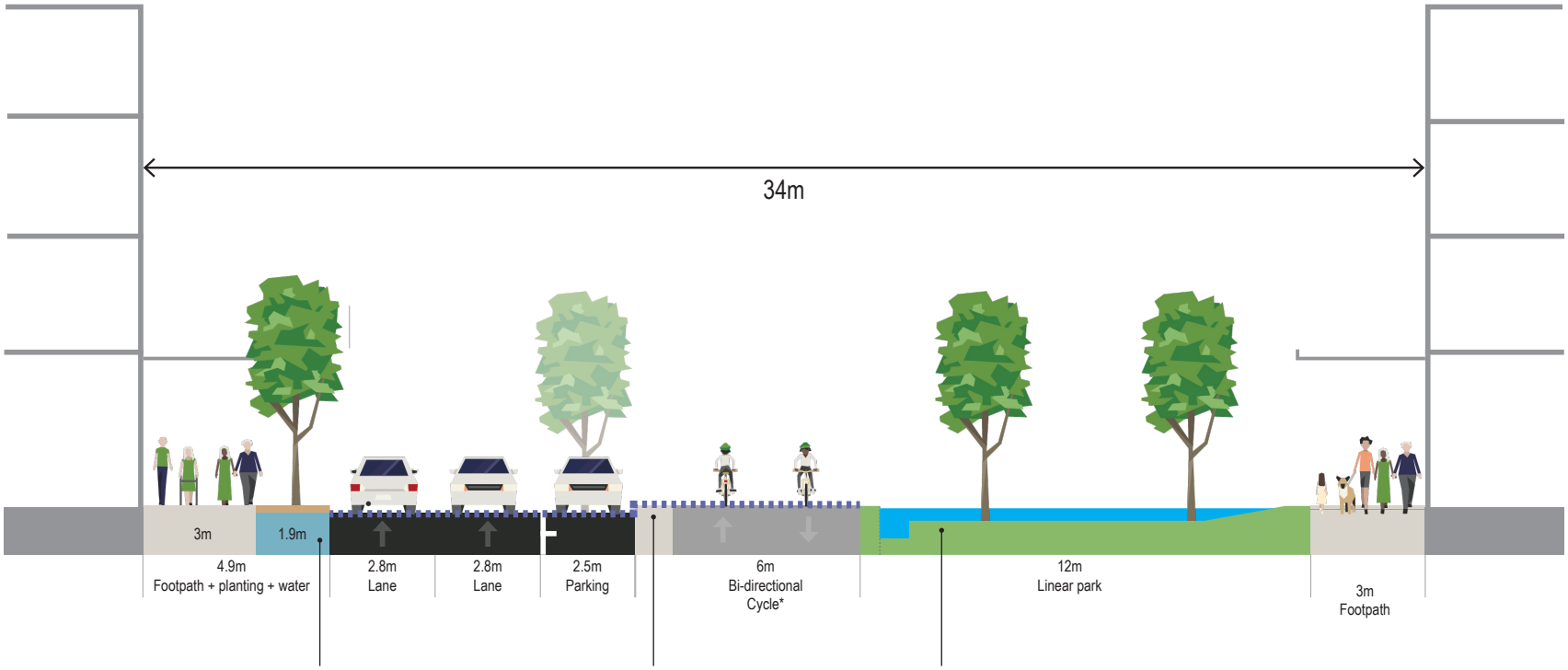
David Howard
Team Leader, Water Strategy
(03) 86878789

Attachments (2 No.) Graham St Streetscape Mark-ups

GHD
Level 8 180 Lonsdale Street Melbourne VIC 3000 Australia
T 61 3 8687 8000 **F** 61 3 8687 8522 **E** melmail@ghd.com **W** www.ghd.com

Green Street

New street (34m with linear park)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*6m separated bi-directional cycle = 5m cycle lane + 1m buffer (to car parking)

*Option for trees and stormwater planters within parking lane (e.g. interspersed with car parks).

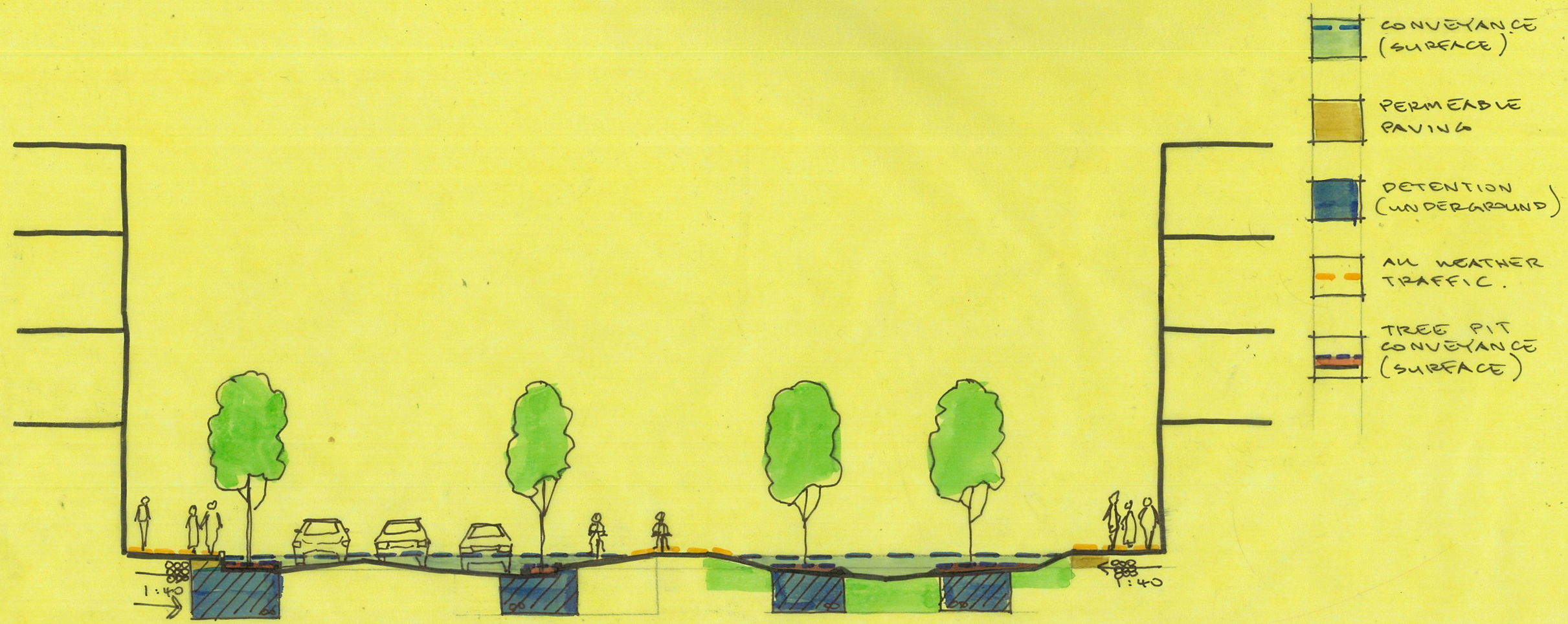
* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.

* Services to be located underneath footpaths

Permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

Small-scale channel + lowered linear park (to contain a mix of passive & active uses, softscape & hardscape areas)



3M FOOTPATH | 1.9M | 2.6M LANE | 2.6M LANE | 2.5M PARKING | 6M CYCLE | 12M LINEAR PARK | 3M FOOTPATH.

2M FOOT PATH. — 2.9M PERMEABLE PAVEMENT. & STRUCTURAL SOIL W/ STORAGE.

TREE PIT W/ CONVEYANCE

TREE PIT W/ CONVEYANCE & STRUCT. SOIL.

ALL WEATHER CYCLE

TREE PIT W/ CONVEY. & STRUCT. SOIL.

TREE PIT W/ CONVEY. & STRUCT. SOIL.

GREEN STREET ALTERNATE CONFIGURATION SK01.

NTS GHDW.

5.10.2016.

Attachment 9

Case Study Review Workshop Presentation

Fishermans Bend Drainage Strategy – Case Study Review

Progress Workshop – 10 October 2018

Agenda

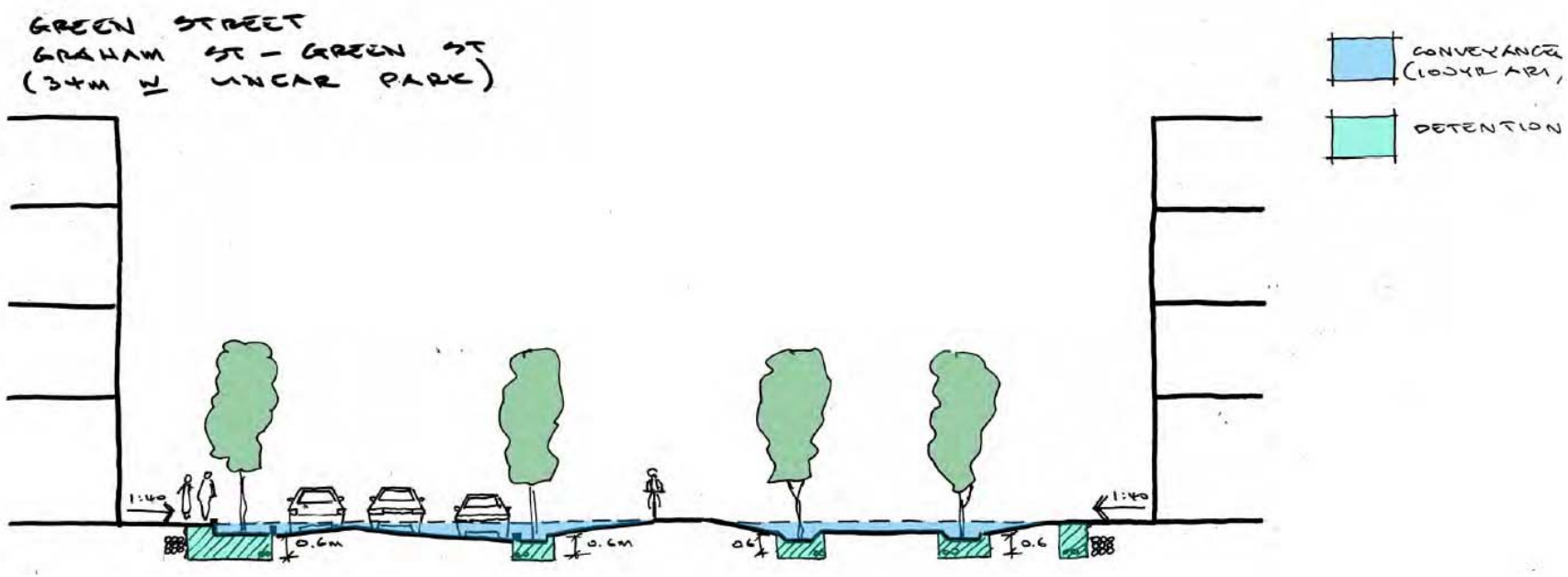
Item	Time
Recap on scope of review	5 mins
How do we manage conveyance and storage in streetscape?	15 mins
Street conveyance capacities from flood modelling	10 mins
Detention storage requirements	5 mins
Achieving detention storage elsewhere	5 mins
Recap on CoPP/CoM streetscape sections	5 mins
General Comments on CoPP & CoM streetscape sections Challenges and innovative considerations in streetscape design	5 mins
Detailed Review of CoPP Green St (34 m wide with Linear Park) – Graham St Application	15 mins
CoPP Cloudburst Boulevard Review	5 mins
CoPP Green St (22 m) Review	5 mins
CoPP Blue Laneways (6 m & 9 m) Review	5 mins
Next Steps	5 mins

Recap on Scope of Review

Our review of CoPP and CoM Streetscapes focused on a critique of:

- Provision for Flood Detention
- Provision for Flood Conveyance
- Drainage Functionality
- Vertical depth of detention systems
- Streetscape Cross Fall, Grades & Drop Offs
- Conflicts with Existing & Future Provision of Services
- Streetscape integration with JL Murphy Reserve

How do we manage conveyance and storage in streetscape?



Street conveyance capacities from flood modelling

Street Names	Length (m)	Length Flooded (m)	% Flooded	Ave. Conveyance Area (m2)	Ave. Road Width (m)	Likely to be impacted by CoPP pipes downstream
Bertie Street	829	531	64%	7.2	32	-
Boundary Street	1392	277	20%	6.5	31	-
Cook Street	1097	535	49%	5.9	30	Yes
Fennel Street	599	168	28%	2.5	32	-
Graham Street	770	514	67%	10.5	30	Yes
Ingles Street	1454	605	42%	4.1	42	-
Lorimer Street	4722	941	20%	2.3	30	-
Prohasky Street	459	267	58%	4.5	38	Yes
Salmon Street	1616	528	33%	4.2	32	Yes
Todd Road	1627	699	43%	9.2	35	Yes
Williamstown Road	2677	2174	81%	6.6	30	Yes
Woodboard Road	320	118	37%	1.3	39	Yes
All Others	47809	0	0%	N/A	N/A	N/A
Total	**65373**	**7357**	**11%**			

Detention storage requirements

Ramboll's Detention Requirements:

- Cloudburst Blvd 4.0 sq m
- Green Streets 3.2 sq m
- Blue Laneways 0.6 sq m

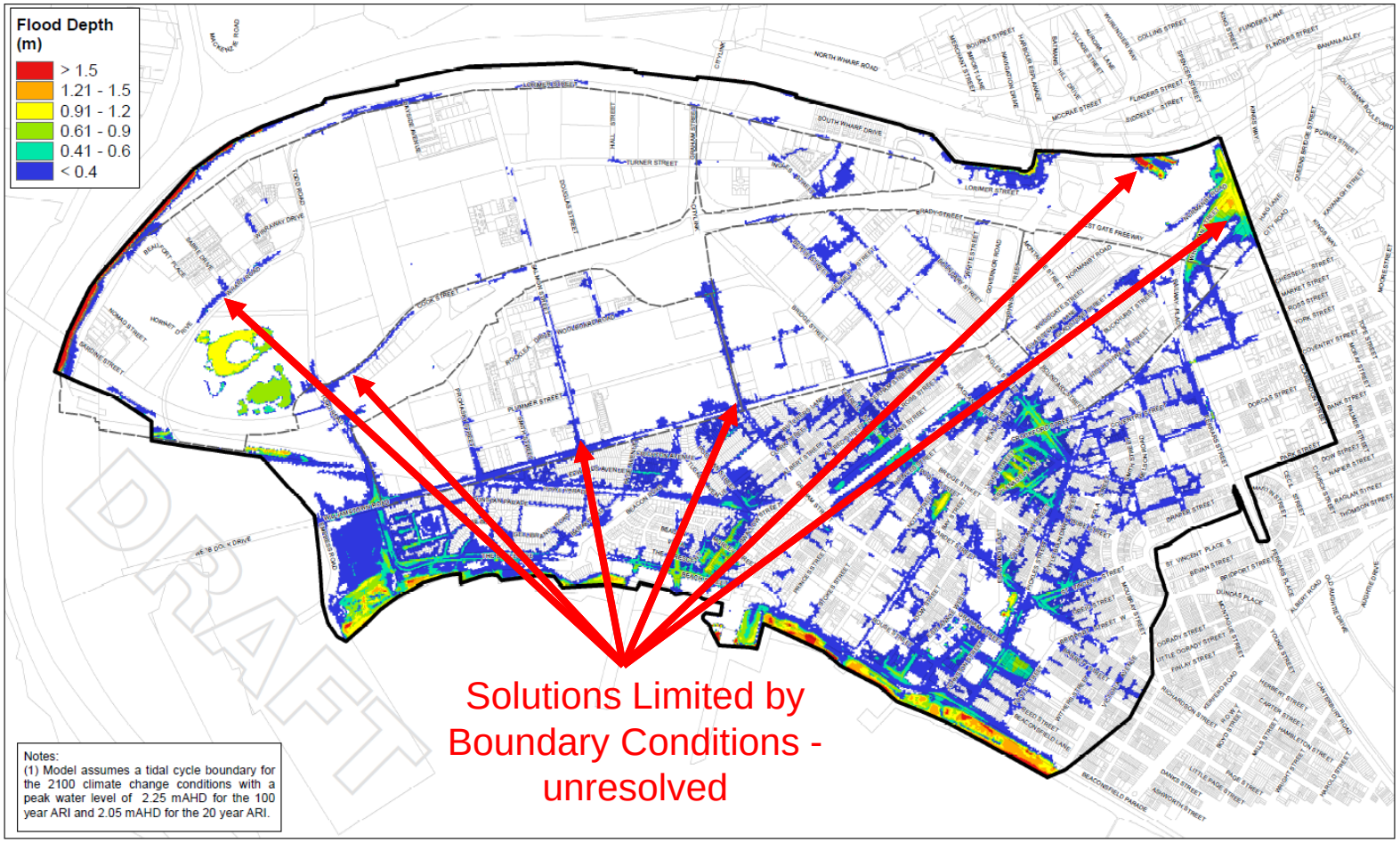
Degree of caution required given the location and nature of streetscape is continually evolving.

Achieving detention storage elsewhere

Trade-offs:

- More rainwater tanks
- Private realm
- Public realm
- Flood certain streets over others

2018 Base Case Drainage Plan



Paper Size A3
0 70 140 280 420 560
Metres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

LEGEND
Model Boundary
Precinct Boundaries

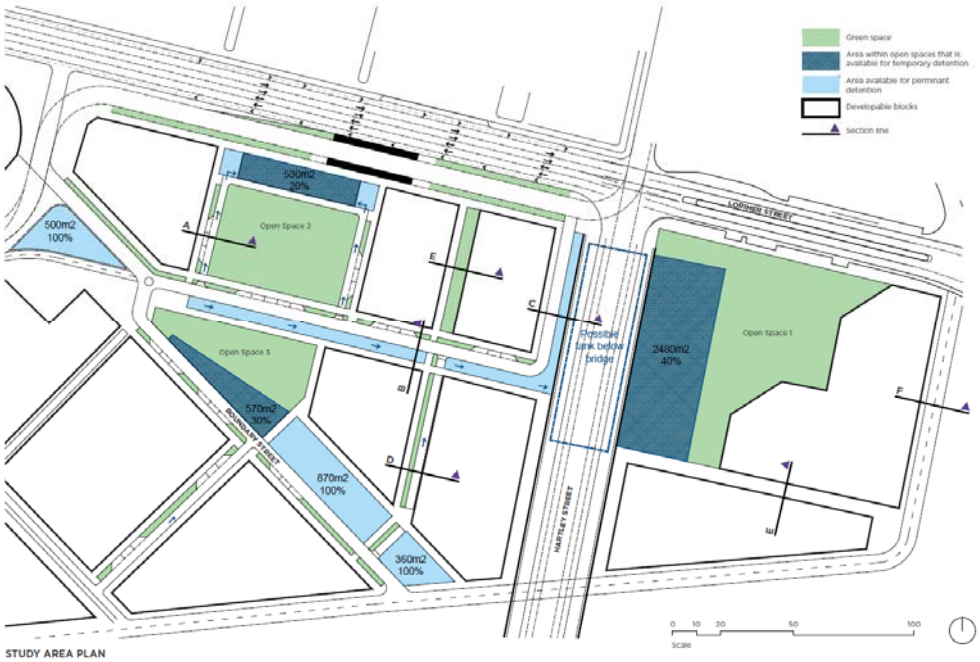
MELBOURNE WATER
FISHERMAN'S BEND DRAINAGE PLAN
Baseline drainage plan
100 year ARI

Job Number 31-35713
Revision A
Date 27/07/2018

Figure C2

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

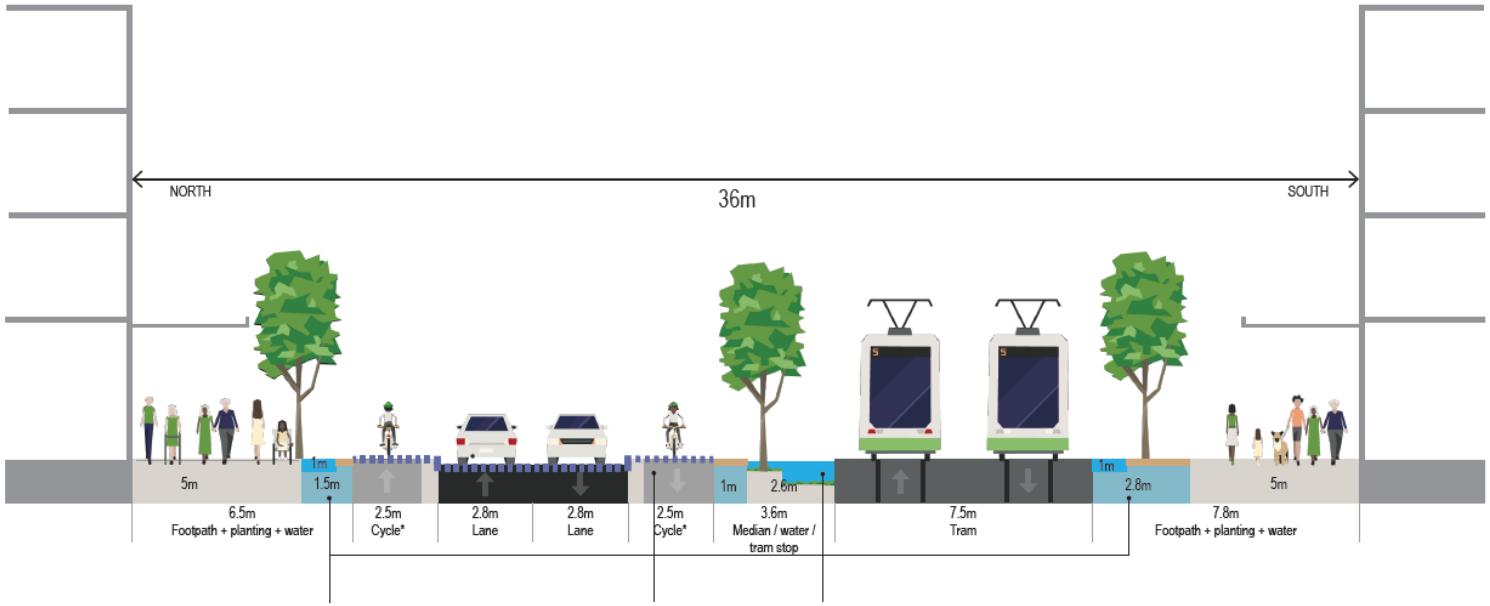
Recap on COPP/COM Streetscape Sections



STUDY AREA PLAN

Cloudburst Boulevard

Plummer Street Civic Boulevard (36m)



Conveyance
Detention (surface)
Permeable Paving
Detention (underground)

NOTES:

* 2.5m separated cycle lane = 2m cycle lane, 0.5m buffer
* Tram stop - minimum 2.4m wide
* Option for 1-way traffic in some areas?
*Option to treat carriageway as a shared space (no kerbs)?
* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.
* Services to be located underneath footpaths

Small-scale channel (1m) + permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

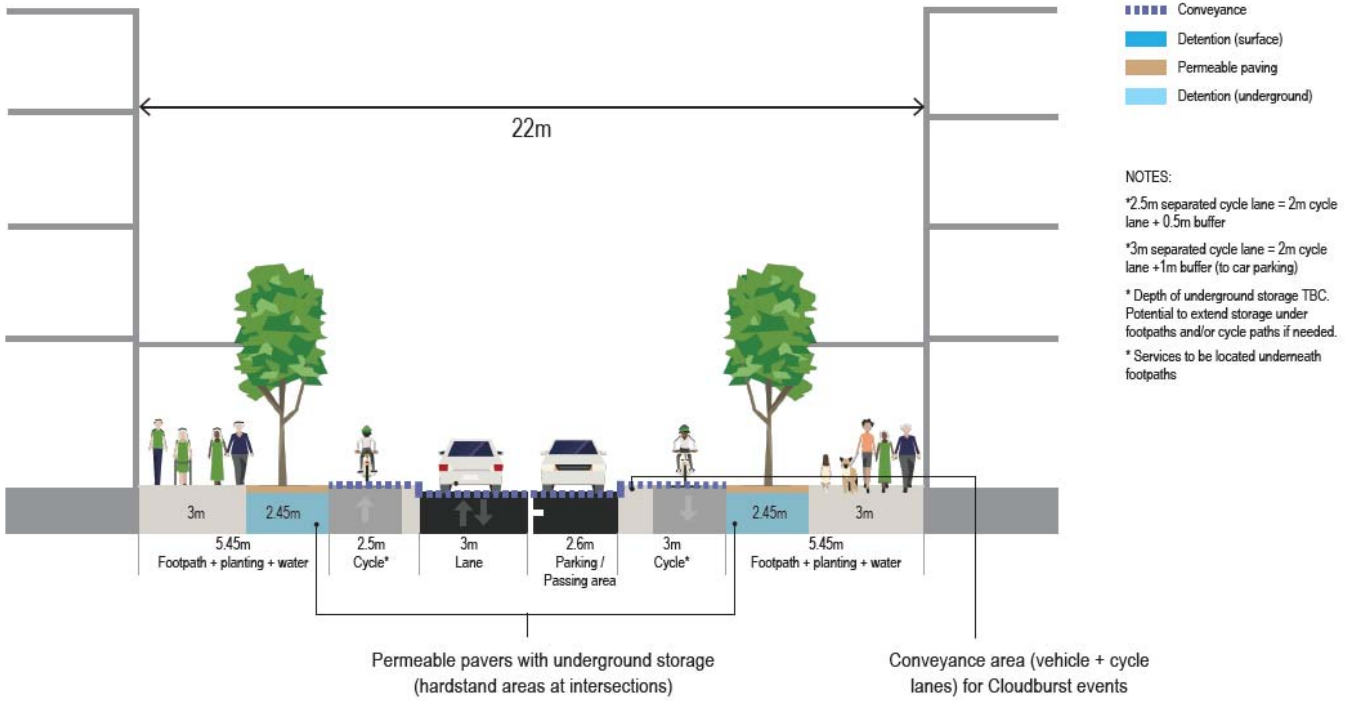
* Option for some stormwater planters (e.g. around trees)

Stormwater planters + permeable paving buffer (hardstand areas at tram stops / intersections)

All intersections / tram stops / pedestrian crossings will be paved.

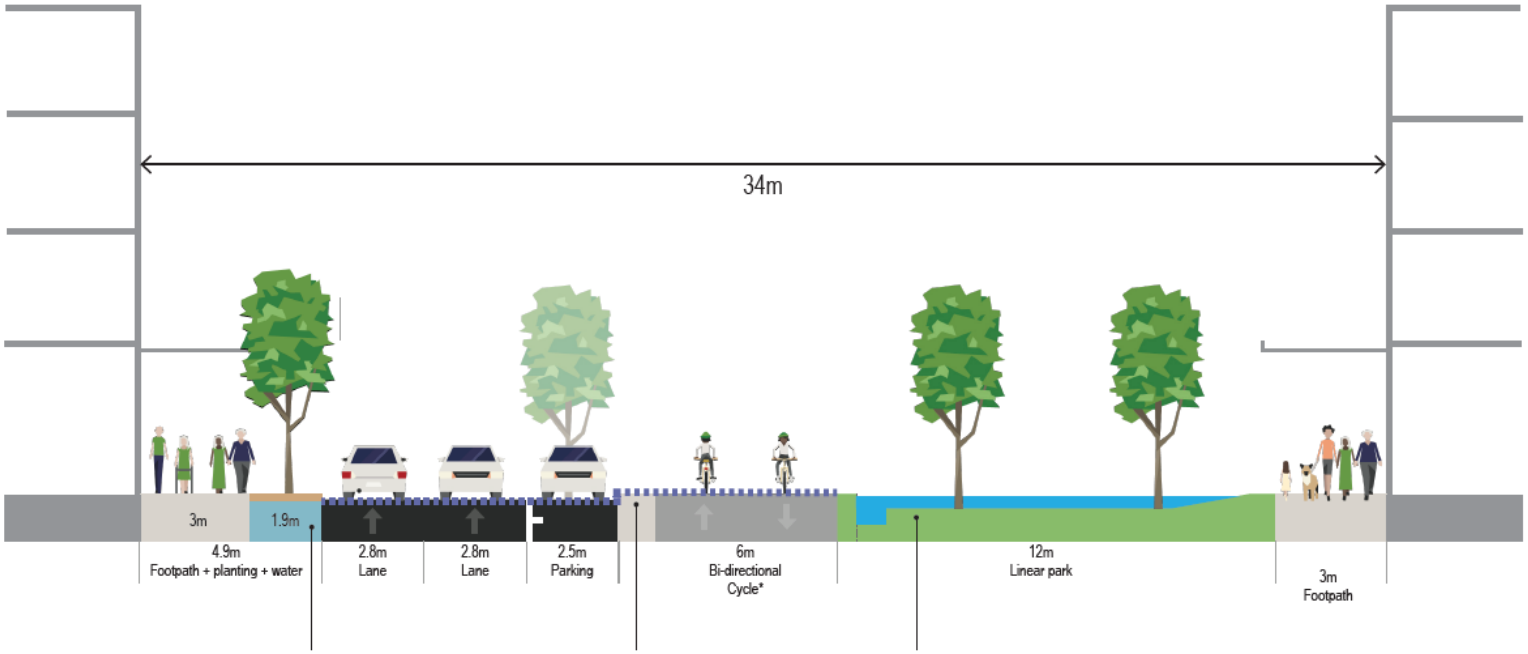
Green Street

New street (22m)



Green Street

New street (34m with linear park)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*6m separated bi-directional cycle = 5m cycle lane + 1m buffer (to car parking)

*Option for trees and stormwater planters within parking lane (e.g. interspersed with car parks).

* Depth of underground storage TBC. Potential to extend storage under footpaths and/or cycle paths if needed.

* Services to be located underneath footpaths

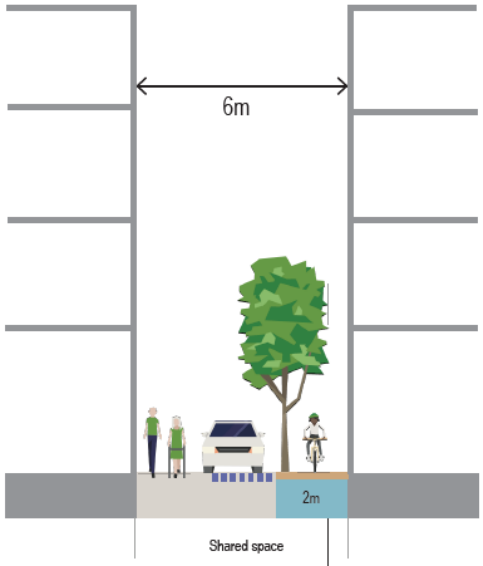
Permeable pavers with underground storage (hardstand areas at intersections)

Conveyance area (vehicle + cycle lanes) for Cloudburst events

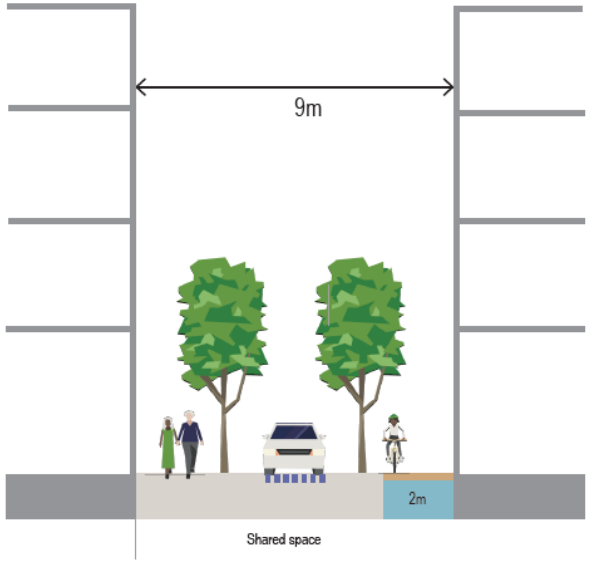
Small-scale channel + lowered linear park (to contain a mix of passive & active uses, softscape & hardscape areas)

Blue Laneway

New laneway (6m)



Permeable pavers with underground storage
(hardstand areas at intersections)



Conveyance
Detention (surface)
Permeable paving
Detention (underground)

NOTES:

*Taskforce preference for 6m wide laneways. CoPP requested 9-12m wide laneways through panel process.

*Laneways assumed to be shared spaces.

* Depth of underground storage TBC. Potential to extend storage under footpaths or bike paths if needed.

SECTION A

LOCAL STREET ADJACENT TO OPEN SPACE

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

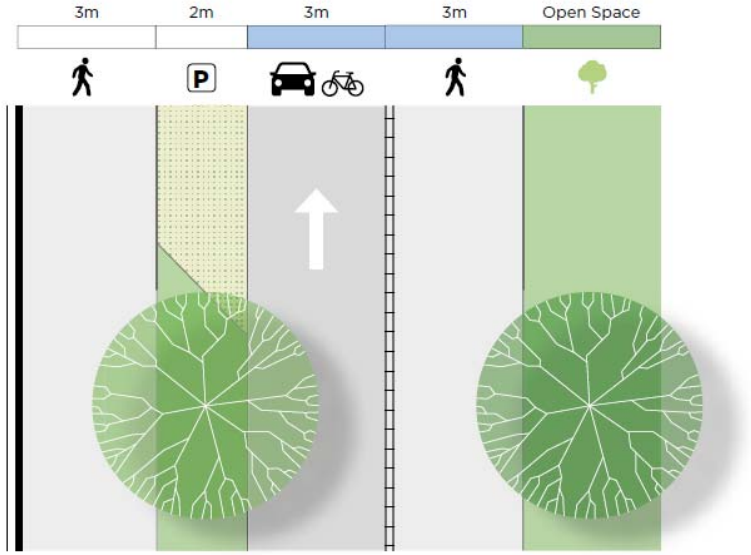
Low-volume street without transit routes. 3m width for one way traffic, focusing on place making over vehicle movement.

Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to vehicular lane and secondary pedestrian footpath.

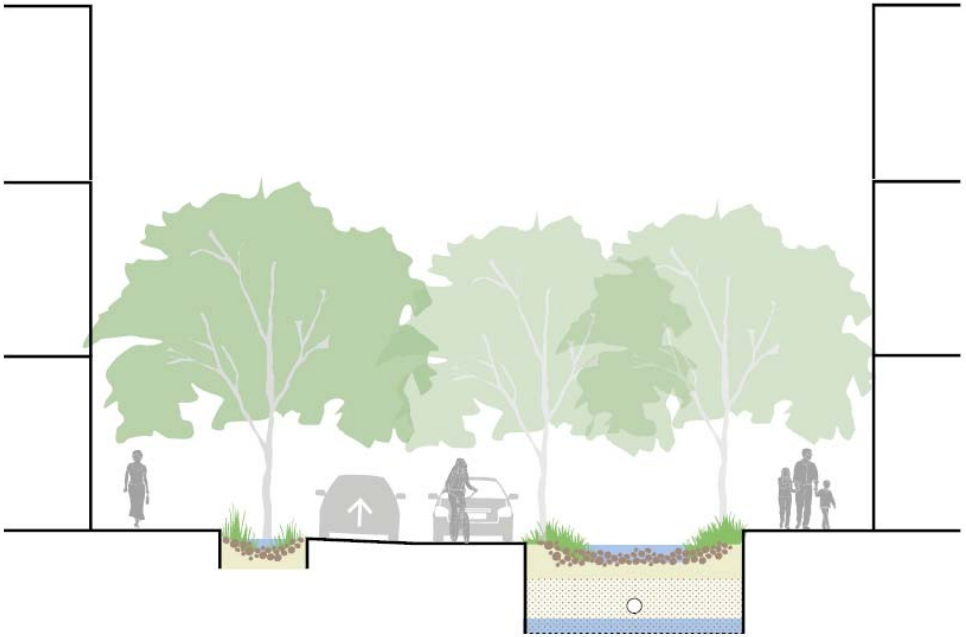
Parking

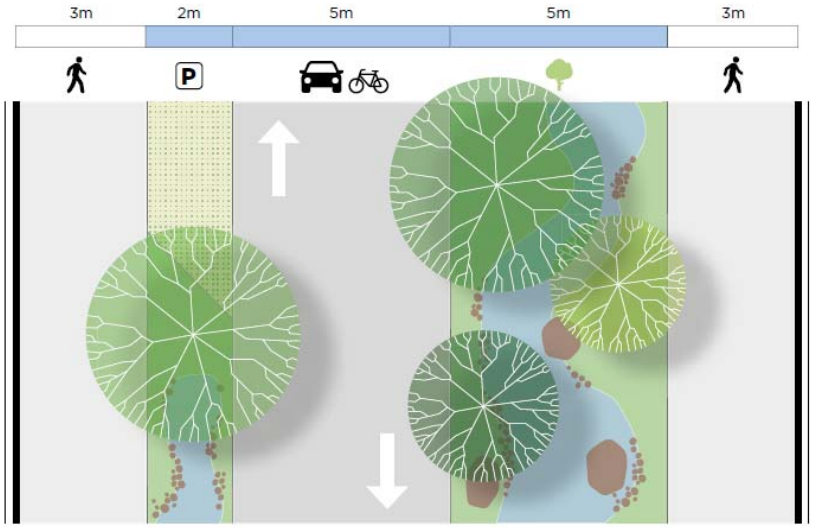
Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



SECTION B

LOCAL STREET WITH LINEAR PARK





Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

5 m width for bidirectional lanes, also known as yield lanes. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass.

Water management

Working as a Cloudburst Street to convey waters to on street detention areas. Detention areas to operate during regular flood events, while the conveyance areas to work during greater than 1 in 20 year flood event (5 per cent AEP). Conveyance area defined to vehicular lane and linear park.

Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.

SECTION C

LOCAL STREET ADJACENT TO PROPOSED TRAM BRIDGE

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

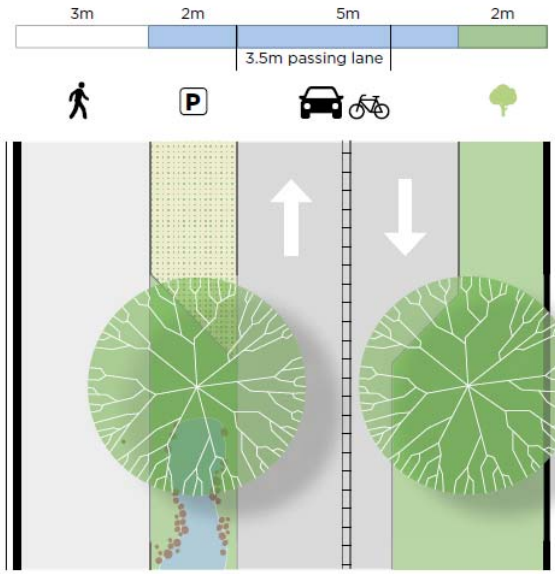
5 m width for bidirectional lanes, also known as yield lanes. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass. 3.5 m passing lanes are introduced for further traffic calming.

Water management

Working as a Cloudburst Street to convey waters to on street detention areas. Detention areas to operate during regular flood events, while the conveyance areas to work during greater than 1 in 20 year flood event (5 per cent AEP). Conveyance area defined to vehicular lane.

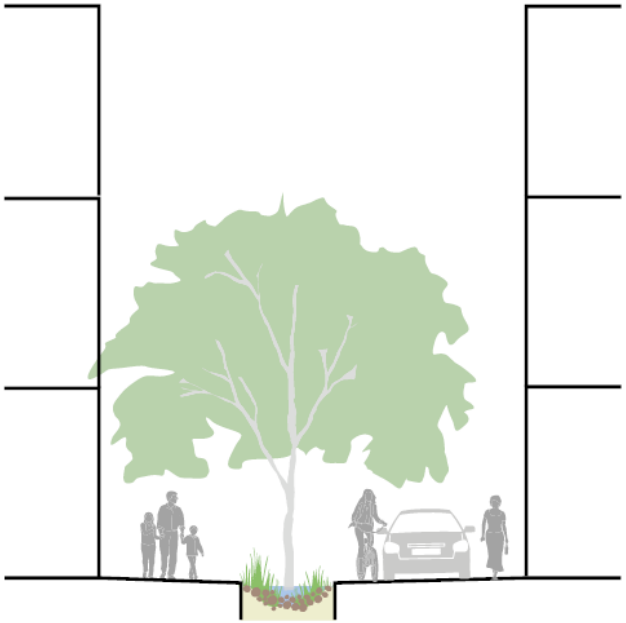
Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



SECTION D

ONEWAY LANEWAY



Function

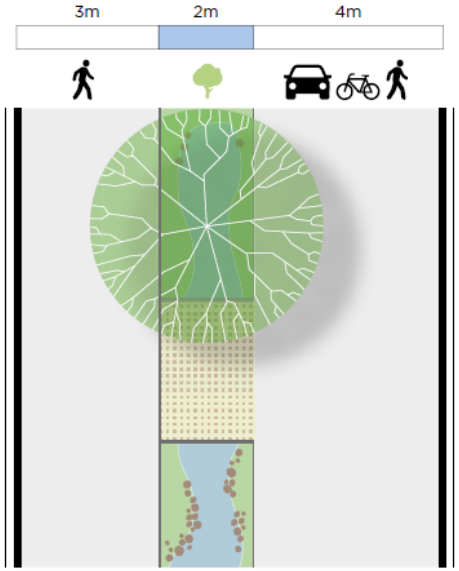
Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

Low-volume street without transit routes. 4m width for one way traffic as part of a shared surface, focusing on place making over vehicle movement.

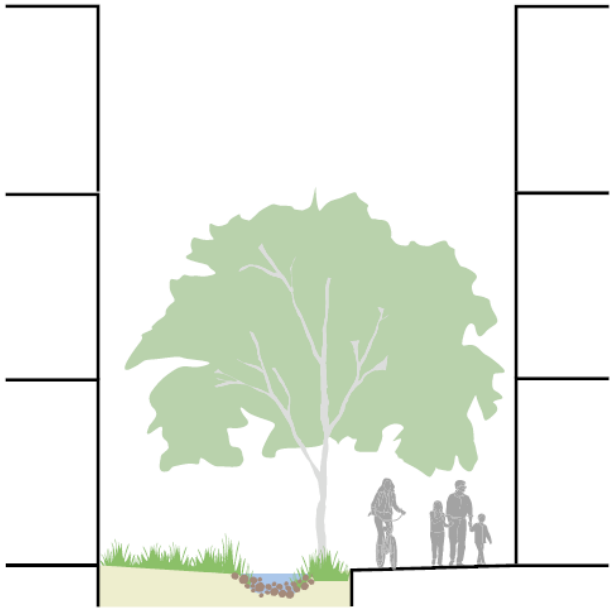
Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to central rain gardens.



SECTION E

PEDESTRIAN LANEWAY



Function

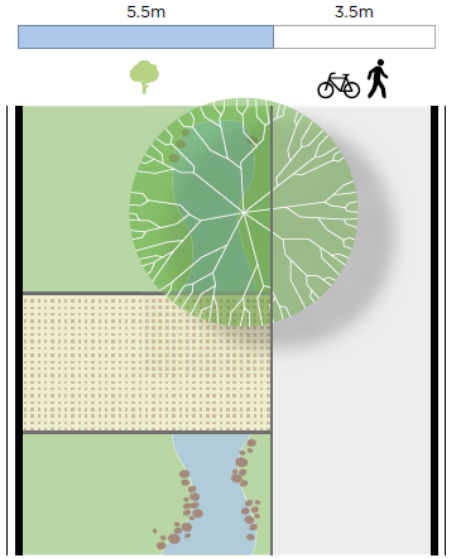
Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

Off limits to private vehicles, however do allow emergency vehicular access.

Water management

Working as a Cloudburst Street to convey waters to nearby detention areas. Conveyance area defined to green space.



SECTION F

SERVICE ROAD

Function

Dedicated service access, concentrating larger vehicles (local freight, waste collection, parking access and servicing) to the perimeter of the precinct.

Vehicle Movement + Access

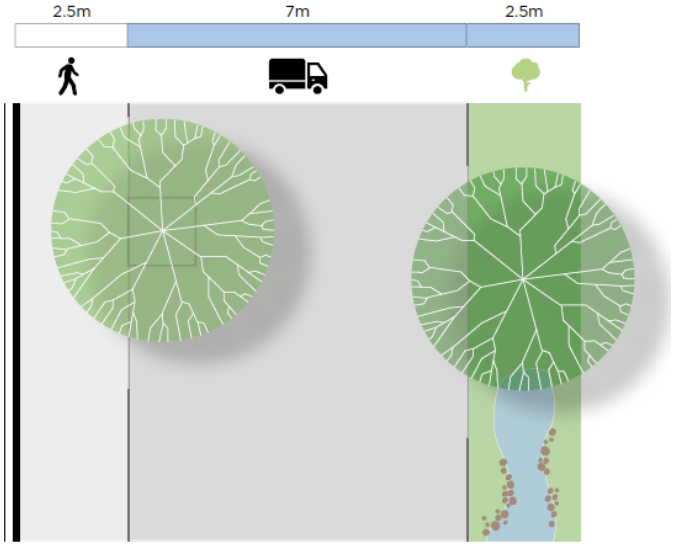
7 m width for two lane traffic. Tree planting introduced for further traffic calming.

Water management

Working as a Green Street to store flood waters at the source.

Parking

No on street parking.



General Comments on CoPP & CoM streetscape sections

Provision for Flood Detention - generally adequate in CoPP and CoM sections relative to Ramboll requirements.

Provision for Flood Conveyance - generally inadequate in CoPP and CoM sections relative to GHD's modelling. Need to tailor streetscape solution for each street on its merits noting there are streets that will have additional factors at play that may limit the ability to get the desired flooding outcome (i.e. due to boundary conditions).

Drainage Functionality – balance of how we get water safely into detention and conveyance areas without compromising amenity (permeable pavements, lowered bike paths, trees next to roads). Can & should be tailored.

Vertical depth of detention systems – subject to individual street characteristics and flood strategy. Can & should be tailored.

Streetscape Cross Fall, Grades & Drop Offs – More detail provided in critique (vertical exaggeration of CoPP sections), balance of drainage function, storage and amenity.

Conflicts with Existing & future Provision of Services

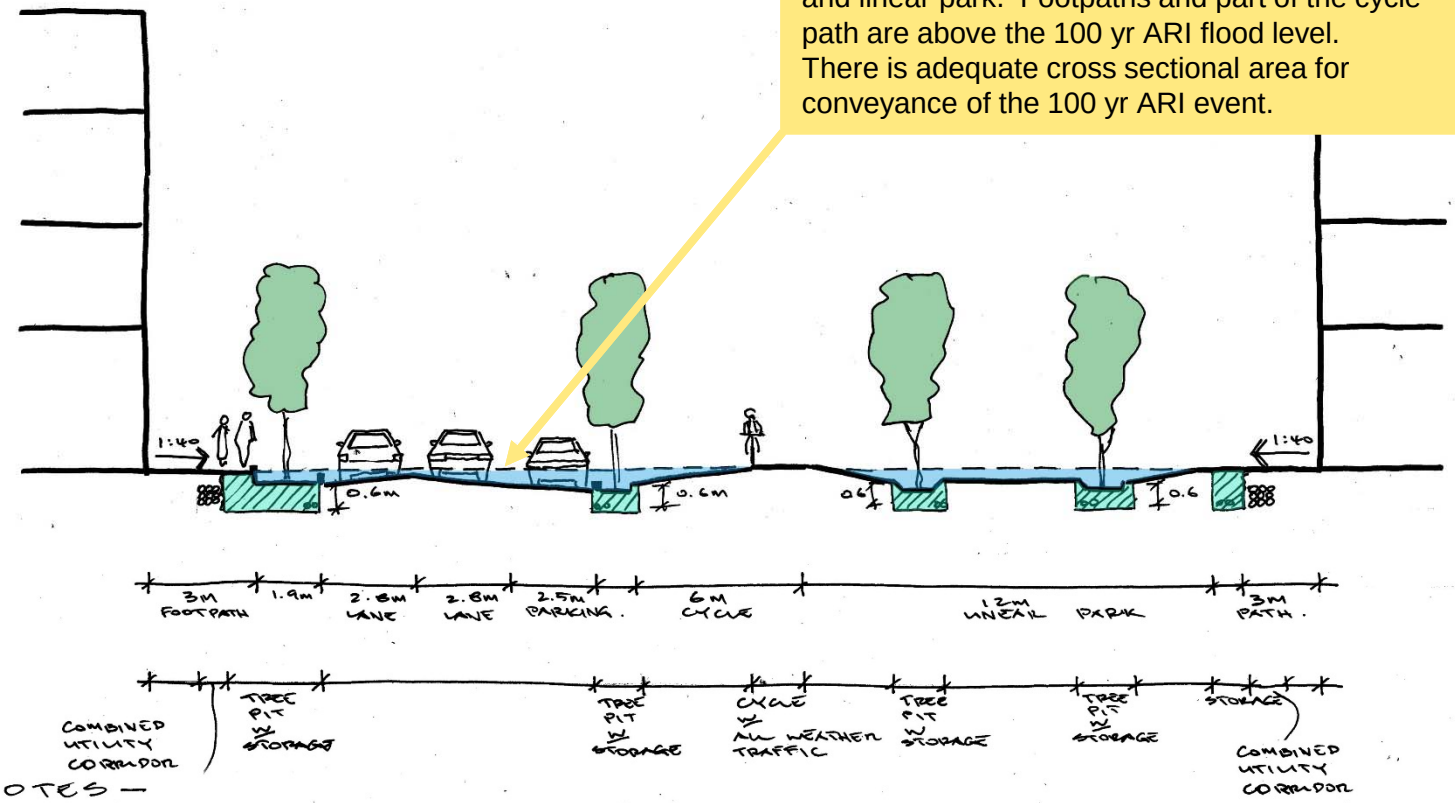
The future service requirements are yet to be confirmed (weeks/months). This will impact the need and desire to relocate services. Integrating services into street tree root ball has benefits (refer City of Toronto case study).

Challenges and Innovative Consideration in Streetscape Design

Hierarchy of Flood Protection	Level of Flood Protection	Challenges/Potential Conflicts with Other Objectives	Innovative Considerations
Footpath (or path thereof)	Flood free in 100 yr ARI.	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens Cross fall grade on footpath means step downs into street trees and road required. Accommodation of services through street trees.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath) Exploration of new innovative servicing approach, i.e. footpath v centre median (TBC based the need for larger services) Provision of services through tree pits using structural soils and root control. Kerb break throughs to allow for passive irrigation of street trees and increase in streetscape conveyance area
Tram line	Flood free in 100 yr ARI.	Potential desire for passively irrigated green tram lines. Accommodation of tram stops in the streetscape (potential impacts on flood conveyance)	Drought proof vegetation selection (i.e. sedum) along tramways (refer case study). Storage under tram lines. Innovative tram stop design (include access) to minimise impacts to conveyance.
Cycle Path	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Lane separators impacts path of low flows from road to street trees/detention zones. Maintaining access during 100 yr ARI flood event.	Larger street tree footprint and detention volumes (i.e. strata cells under footpath). Raise part of cycle path above 100 yr ARI flood level. Relocation of cycle paths adjacent to footpaths and allow road drainage to filter into linear park. As a results cycle path remains flood free in 100 yr ARI Relocation/future services under cycle path.
Road & Parking Bays	Flood free in 20 yr ARI. Max depth of 0.4 m in 100 yr ARI	Cross fall and levels likely to make it difficult to drain to adjacent tree pits/raingardens. Position of street trees to maximise passive irrigation/detention and provide shading of pedestrians and cyclists	Street trees in centre median of road if road is inverted Two way cross fall to maximise passive irrigation/detention. Permeable pavements in parking bays to street trees for detention/irrigation.

Detailed Review of CoPP Green St (34 m wide with Linear Park) – Graham St Application

GREEN STREET
GRAHAM ST – GREEN ST (34M W LINEAR PARK)



NOTES –

- ALL TREE PITS W 2NO. MIN. AGI FOR CONVEYANCE
- COMBINED UTILITY CORRIDOR IN FOOTPATHS, W ROOT CONTROL BARRIER SEPERATION BETWEEN TREE PITS & UTILITIES. PROPOSED UTILITIES TO BE LOCATED 3–4M FROM BUILDING LINES.
- FOOTPATHS TO HAVE 1M MIN. PERMEABLE PAVING BEHIND KERB.
- TREE PITS W CELLS OR STRUCTURAL SOIL AS PER CITY OF TORONTO "BEST PRACTICE MANUEL." (2013)
- DETENTION = $3.6m^2$ (TARGET $3.2m^2$ BASED ON RAMBOLL BREAKDOWN)
- CONVEYANCE = $10m^2$ BASED ON (A) TREEPIT / RAINGARDENS AVG. 400MM / $1.66m^2$
  (B) ROAD AVG. 350MM / $2.84m^2$
  (C) CYCLE PATH AVG. 325MM / $1.95m^2$
  (D) LINEAR PARK AVG. 350MM / $3.60m^2$.

GRAHAM ST
SK01-A
NTS.
GHDW
8.10.2018.

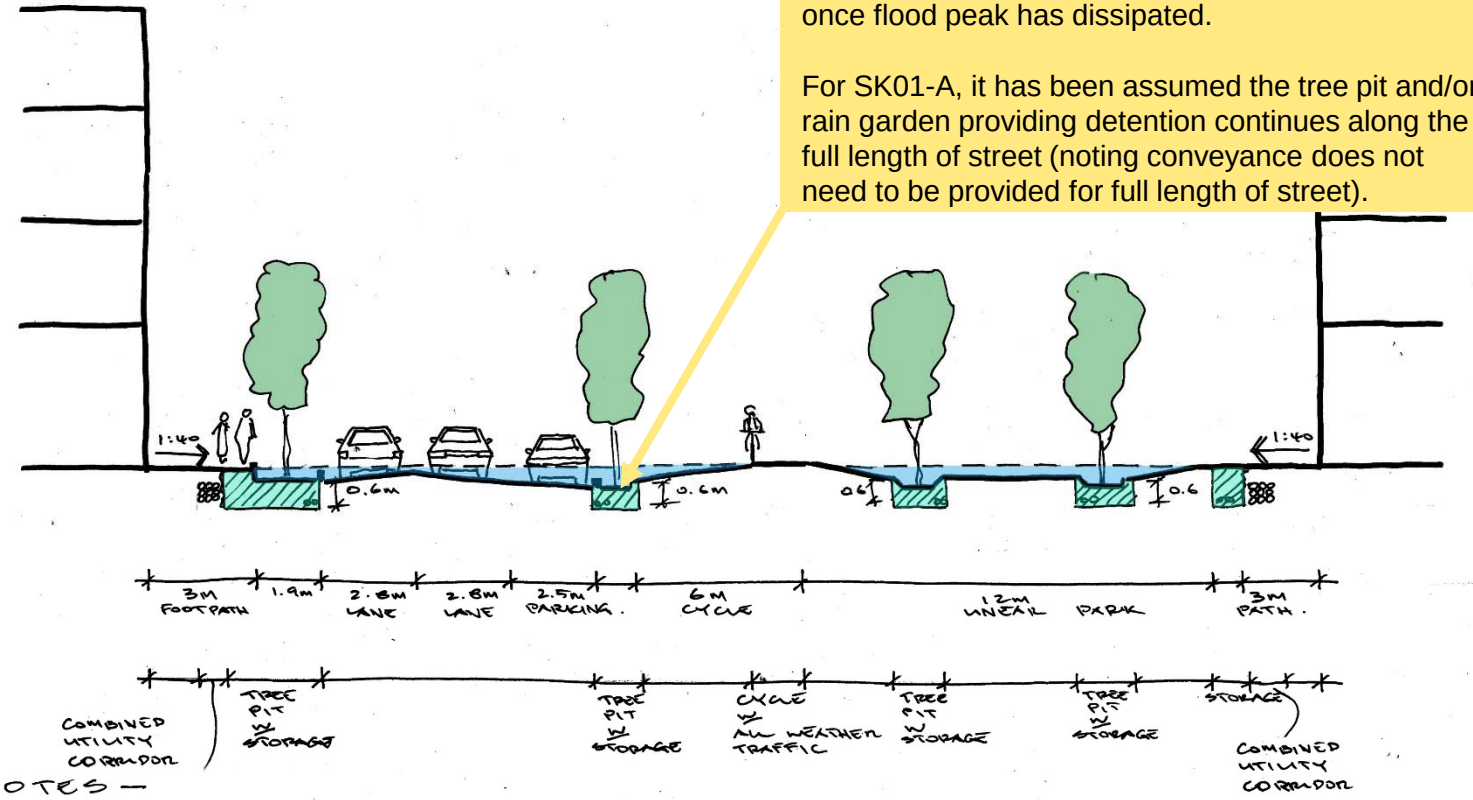
GREEN STREET
GRAHAM ST – GREEN ST (34m W LINEAR PARK)

Tree pits provide conveyance and detention (assuming gravel backfill below root ball in lined storage). Tree pit detention free drains via ag lines once flood peak has dissipated.

For SK01-A, it has been assumed the tree pit and/or rain garden providing detention continues along the full length of street (noting conveyance does not need to be provided for full length of street).

CONVEYANCE (100YR ARI)

DETENTION



NOTES –

- ALL TREE PITS W 2NO. MIN. AGI FOR CONVEYANCE
- COMBINED UTILITY CORRIDOR IN FOOTPATHS, W ROOT CONTROL BARRIER SEPERATION BETWEEN TREE PITS & UTILITIES. PROPOSED UTILITIES TO BE LOCATED 3–4M FROM BUILDING LINES.
- FOOTPATHS TO HAVE 1M MIN. PERMEABLE PAVING BEHIND KERB.
- TREE PITS W CELLS OR STRUCTURAL SOIL AS PER CITY OF TORONTO "BEST PRACTICE MANUEL." (2013)
- DETENTION ~ 3.6m² (TARGET 3.2m² BASED ON RAMBOLL BREAKDOWN)
- CONVEYANCE ~ 10m² BASED ON (A) TREEPIT / RAINGARDENS AVG. 400mm / 1.66m²
  (B) ROAD AVG. 350mm / 2.84m²
  (C) CYCLE PATH AVG. 325mm / 1.95m²
  (D) LINEAR PARK AVG. 350mm / 3.60m².

GRAHAM ST
SK01-A
NTS.
GHDW
8.10.2018.

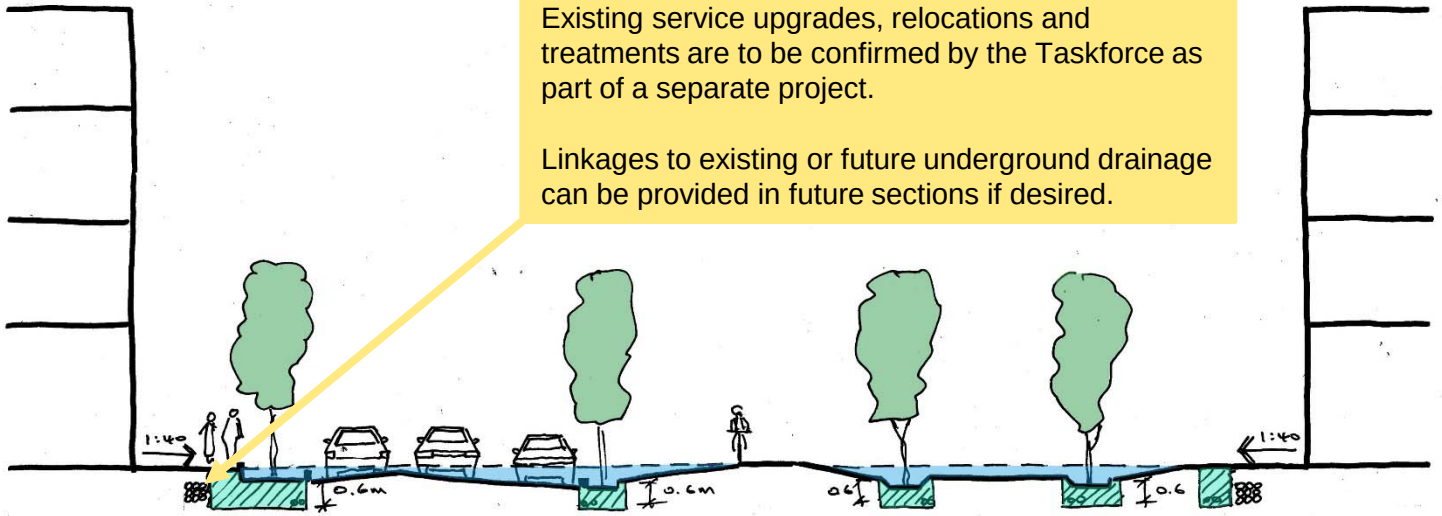
GREEN STREET
GRAHAM ST – GREEN ST
(34M W LINEAR PARK)

CONVEYANCE (100YR ARI)

DETENTION

Existing service upgrades, relocations and treatments are to be confirmed by the Taskforce as part of a separate project.

Linkages to existing or future underground drainage can be provided in future sections if desired.



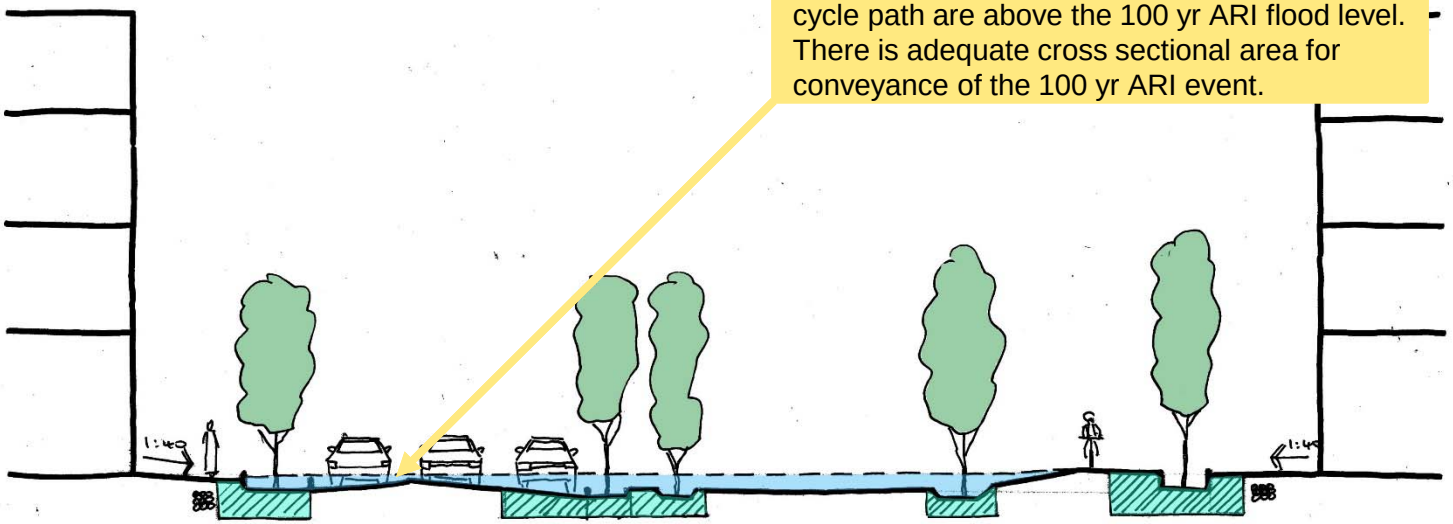
NOTES –

- ALL TREE PITS W 2NO. MIN. AGI FOR CONVEYANCE
- COMBINED UTILITY CORRIDOR IN FOOTPATHS, W ROOT CONTROL BARRIER SEPERATION BETWEEN TREE PITS & UTILITIES. PROPOSED UTILITIES TO BE LOCATED 3–4M FROM BUILDING LINES.
- FOOTPATHS TO HAVE 1M MIN. PERMEABLE PAVING BEHIND KERB.
- TREE PITS W CELLS OR STRUCTURAL SOIL AS PER CITY OF TORONTO "BEST PRACTICE MANUEL." (2013)
- DETENTION W $3.6m^2$ (TARGET $3.2m^2$ BASED ON RAMBOLL BREAKDOWN)
- CONVEYANCE W $10m^2$ BASED ON (A) TREEPIT / RAINGARDENS AVG. 400MM / $1.66m^2$
  (B) ROAD AVG. 350MM / $2.84m^2$
  (C) CYCLE PATH AVG. 325MM / $1.95m^2$
  (D) LINEAR PARK AVG. 350MM / $3.60m^2$.

GRAHAM ST
SK01-A
NTS.
GHDW
8.10.2018.

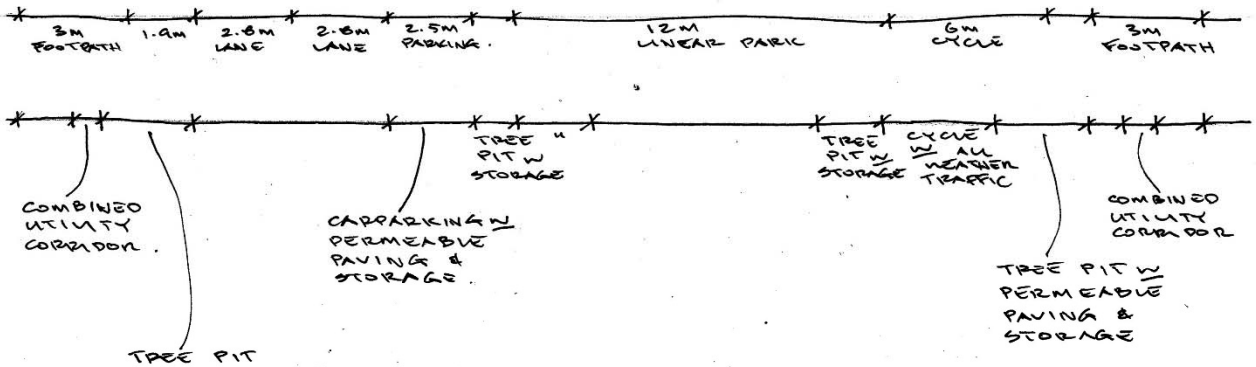
GREEN STREET (ALTERNATE GENERAL ARRANGEMENT)
GRAHAM ST - GREEN ST.
(34 M W LINEAR PARK.)

The 100 yr ARI flood event is confined to road and linear park. Footpaths and part of the cycle path are above the 100 yr ARI flood level. There is adequate cross sectional area for conveyance of the 100 yr ARI event.



CONVEYANCE (100YR ARI)

DETENTION

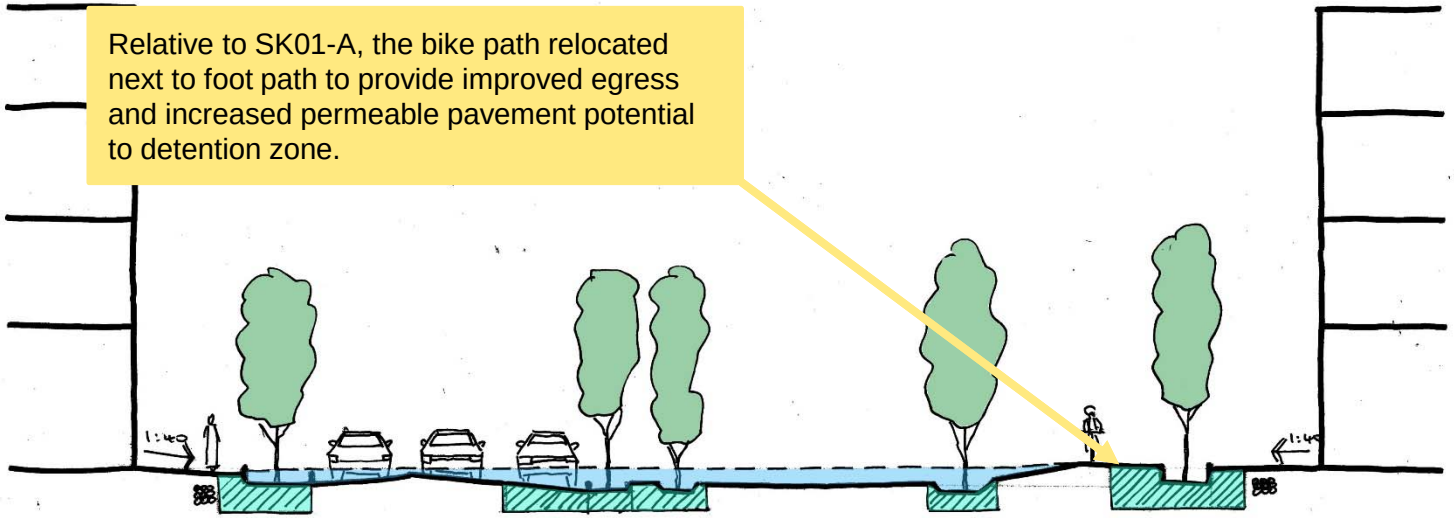


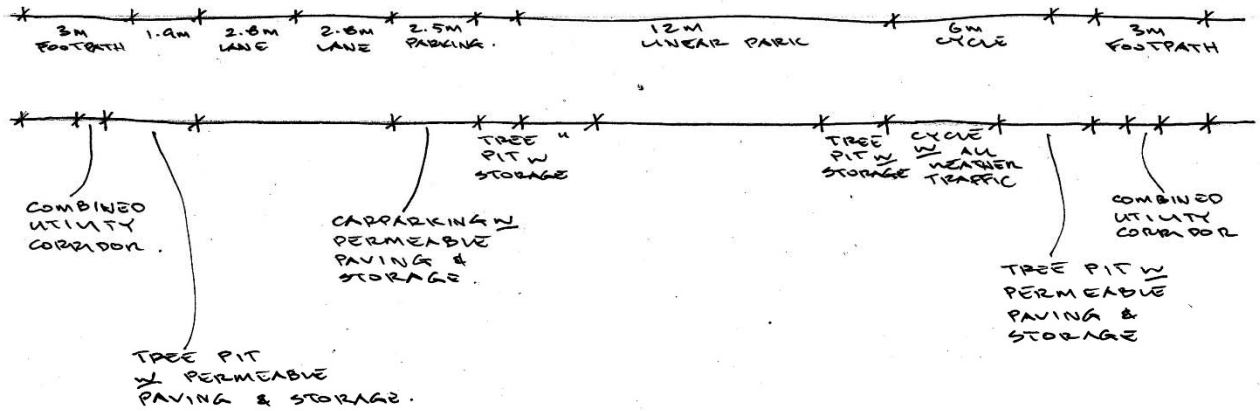
NOTES - AS PER SK01-A.

GRAHAM ST
SK01-B
NTS
GHDW
8.10.2018.

GREEN STREET (ALTERNATE GENERAL ARRANGEMENT)
GRAHAM ST - GREEN ST.
(34 M W LINEAR PARK.)

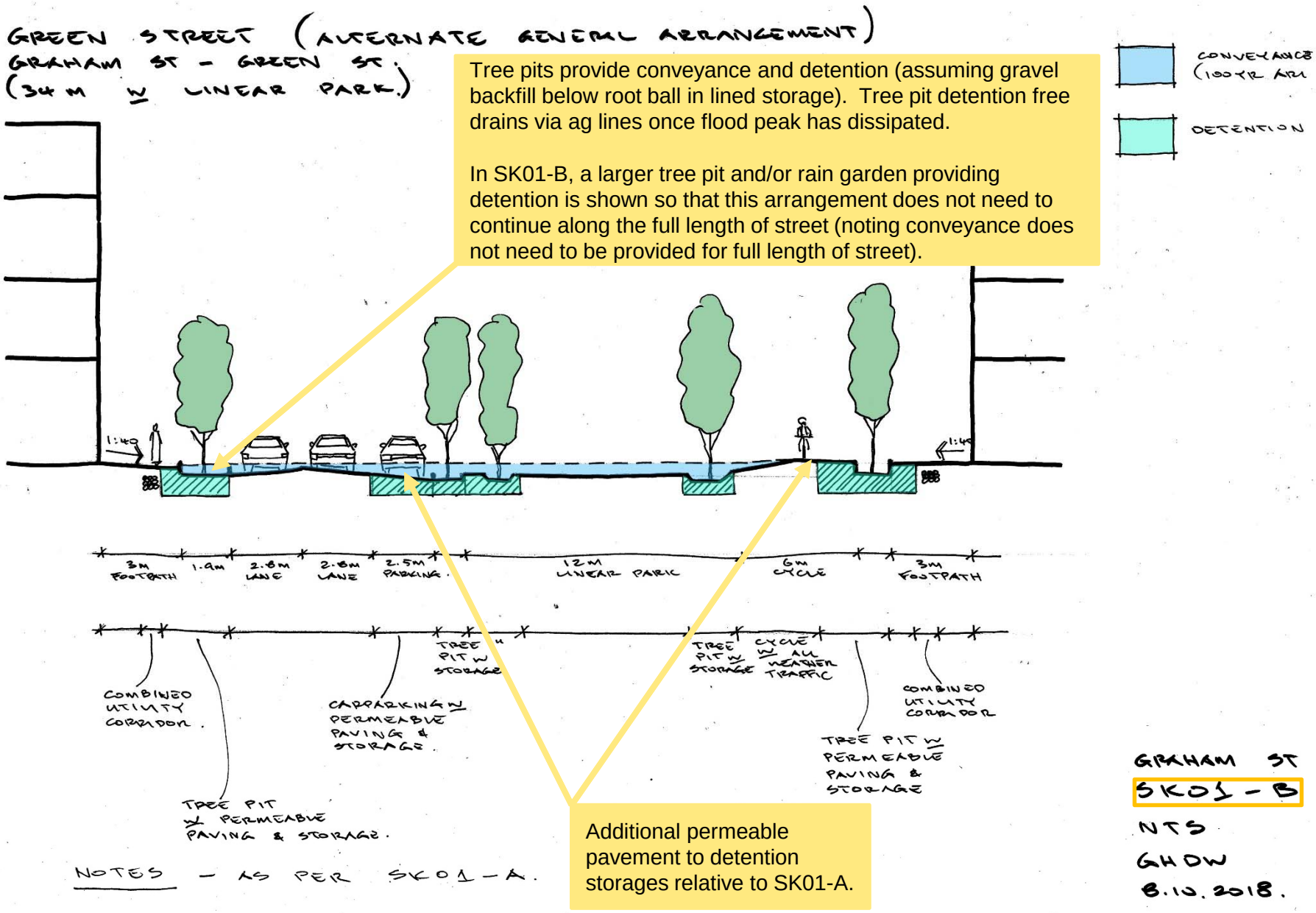
Relative to SK01-A, the bike path relocated next to foot path to provide improved egress and increased permeable pavement potential to detention zone.



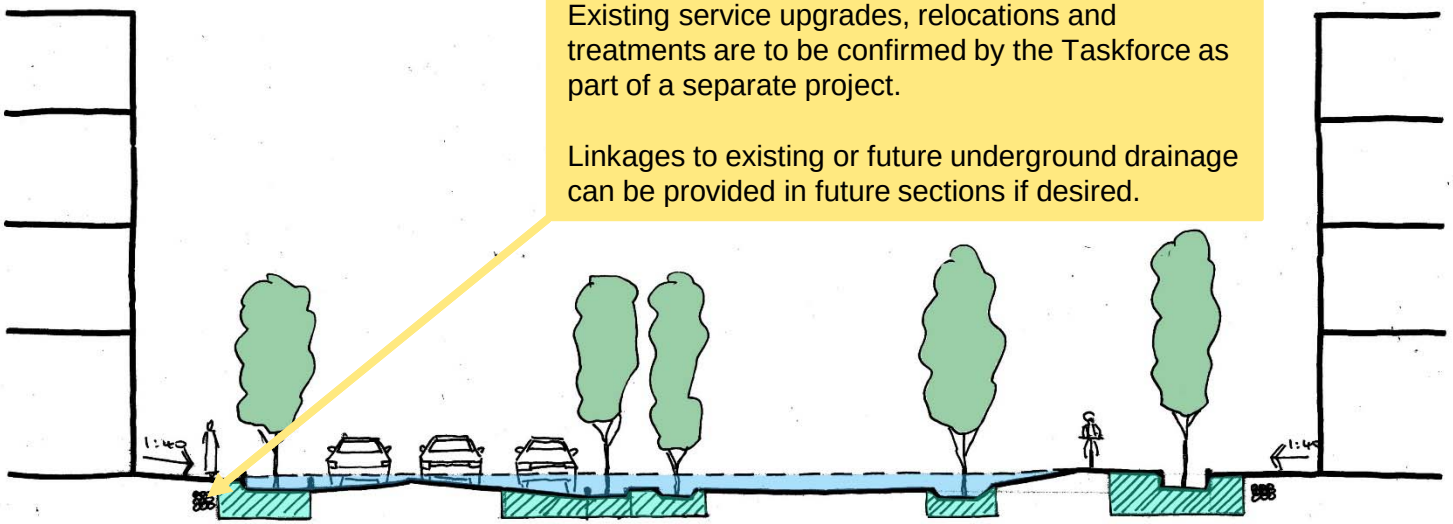


NOTES - AS PER SK01-A.

GRAHAM ST
SK01-B
NTS
GHDW
8.10.2018.


GREEN STREET (ALTERNATE GENERAL ARRANGEMENT)
GRAHAM ST - GREEN ST.
(34 M W LINEAR PARK.)
CONVEYANCE (100YR ARI)
DETENTION
Tree pits provide conveyance and detention (assuming gravel backfill below root ball in lined storage). Tree pit detention free drains via ag lines once flood peak has dissipated.
In SK01-B, a larger tree pit and/or rain garden providing detention is shown so that this arrangement does not need to continue along the full length of street (noting conveyance does not need to be provided for full length of street).
1:40
1:40
3M FOOTPATH
1.9M
2.8M LANE
2.8M LANE
2.5M PARKING
12M LINEAR PARK
6M CYCLE
3M FOOTPATH
COMBINED UTILITY CORRIDOR
TREE PIT W PERMEABLE PAVING & STORAGE
CARPARKING W PERMEABLE PAVING & STORAGE
TREE PIT W STORAGE
TREE PIT W STORAGE
CYCLE W ALL WEATHER TRAFFIC
COMBINED UTILITY CORRIDOR
TREE PIT W PERMEABLE PAVING & STORAGE
NOTES - AS PER SK01-A.
Additional permeable pavement to detention storages relative to SK01-A.
GRAHAM ST
SK01-B
NTS
GHDW
8.10.2018.

GREEN STREET (ALTERNATE GENERAL ARRANGEMENT)
GRAHAM ST - GREEN ST.
(34 M W LINEAR PARK.)

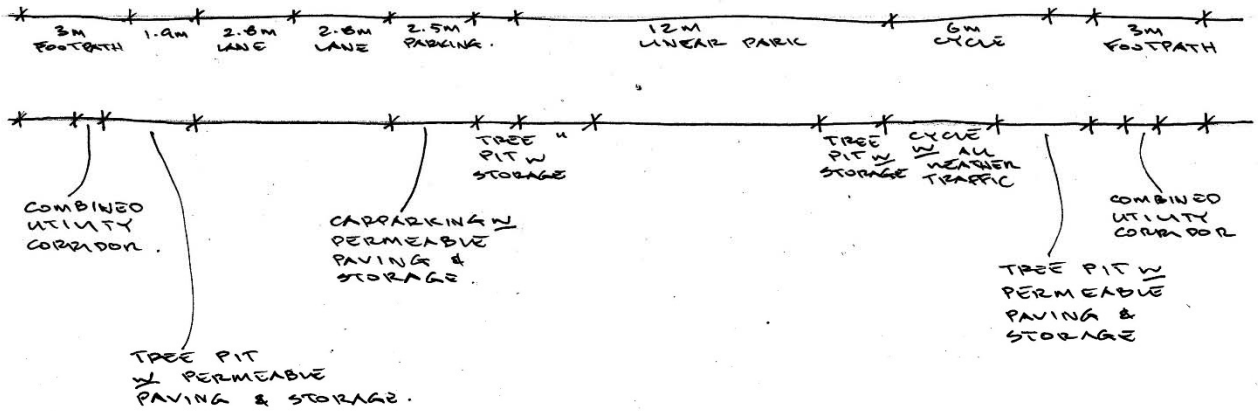


Existing service upgrades, relocations and treatments are to be confirmed by the Taskforce as part of a separate project.

Linkages to existing or future underground drainage can be provided in future sections if desired.

CONVEYANCE (100YR ARI)

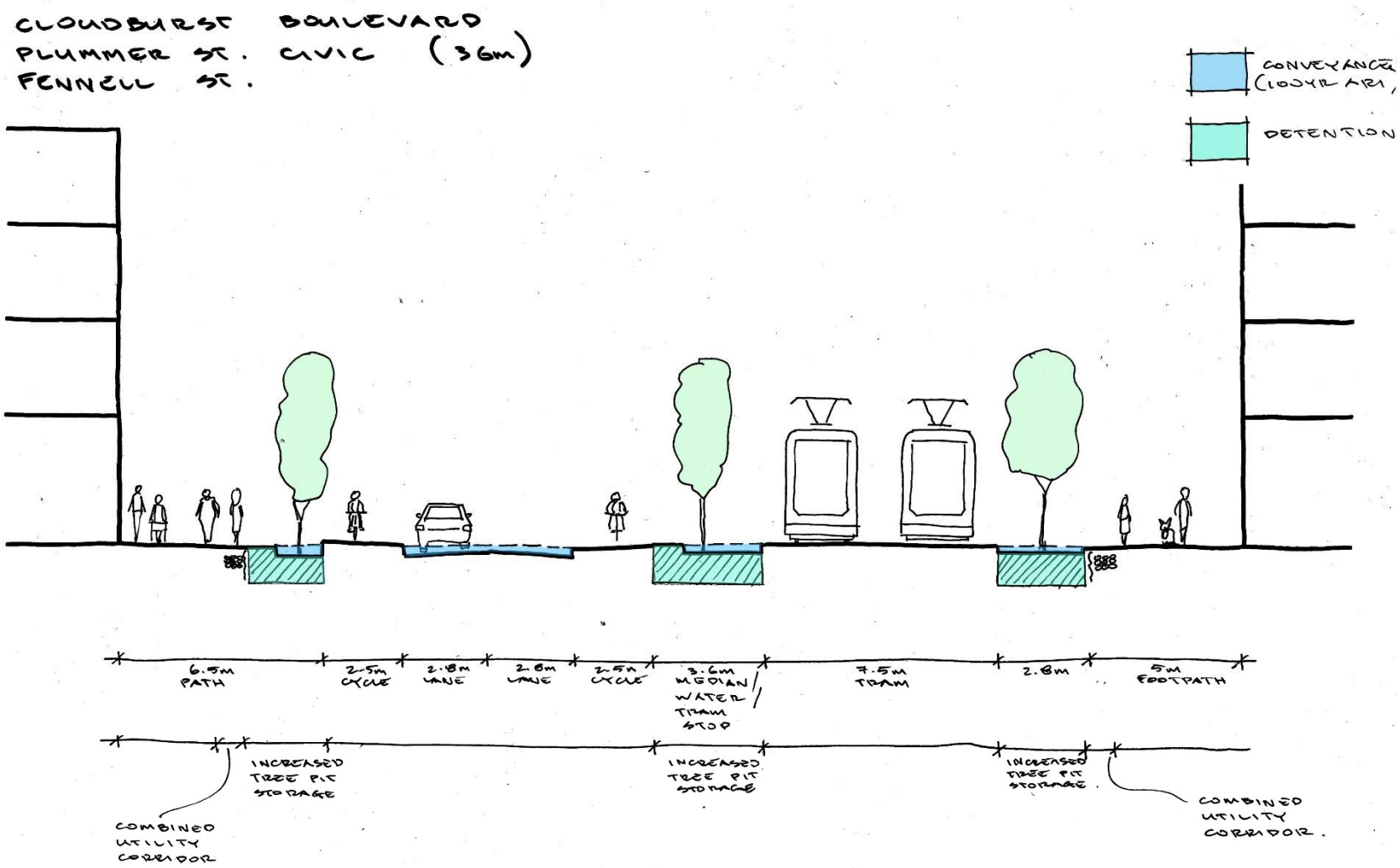
DETENTION

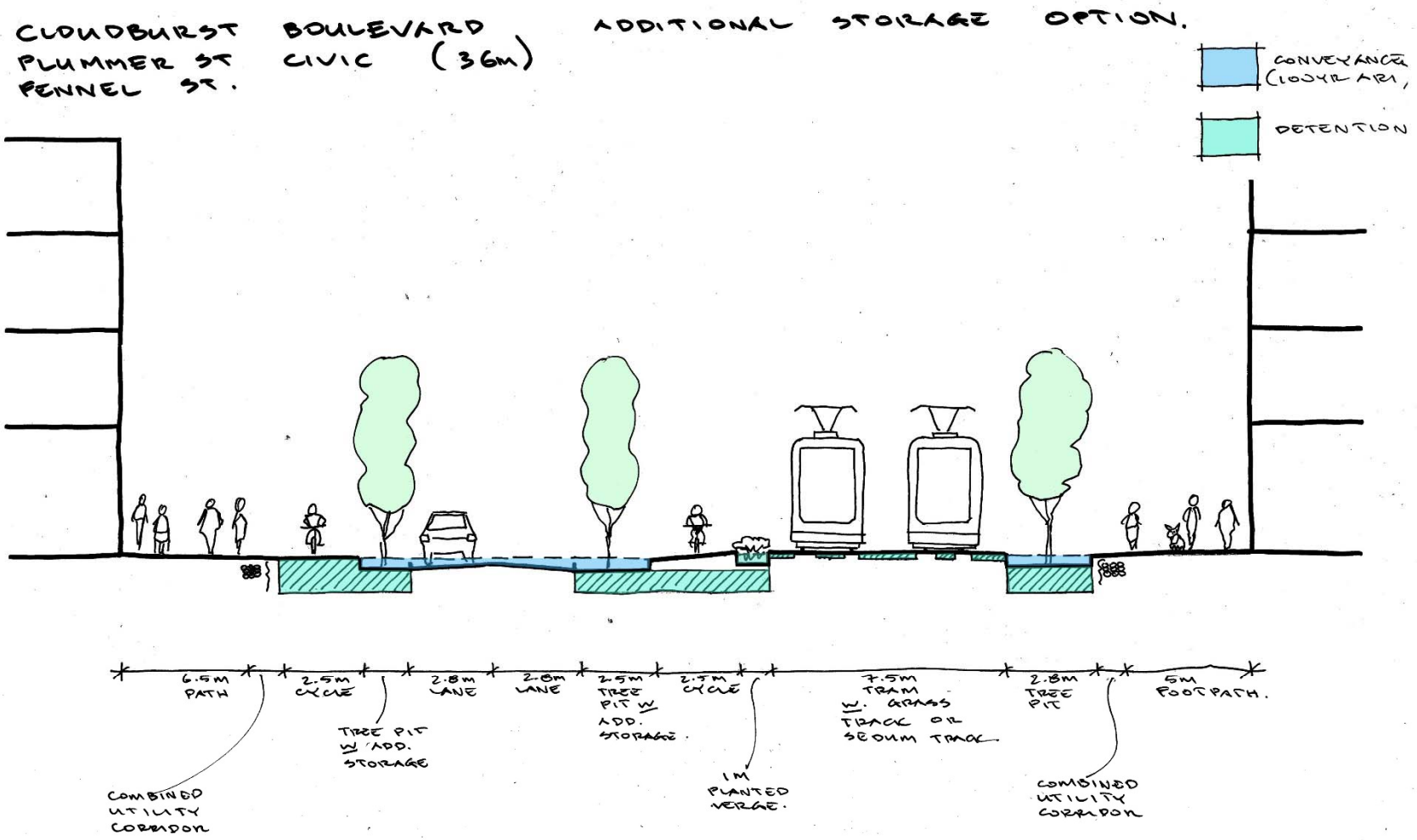


NOTES - AS PER SK01-A.

GRAHAM ST
SK01-B
NTS
GHDW
8.10.2018.

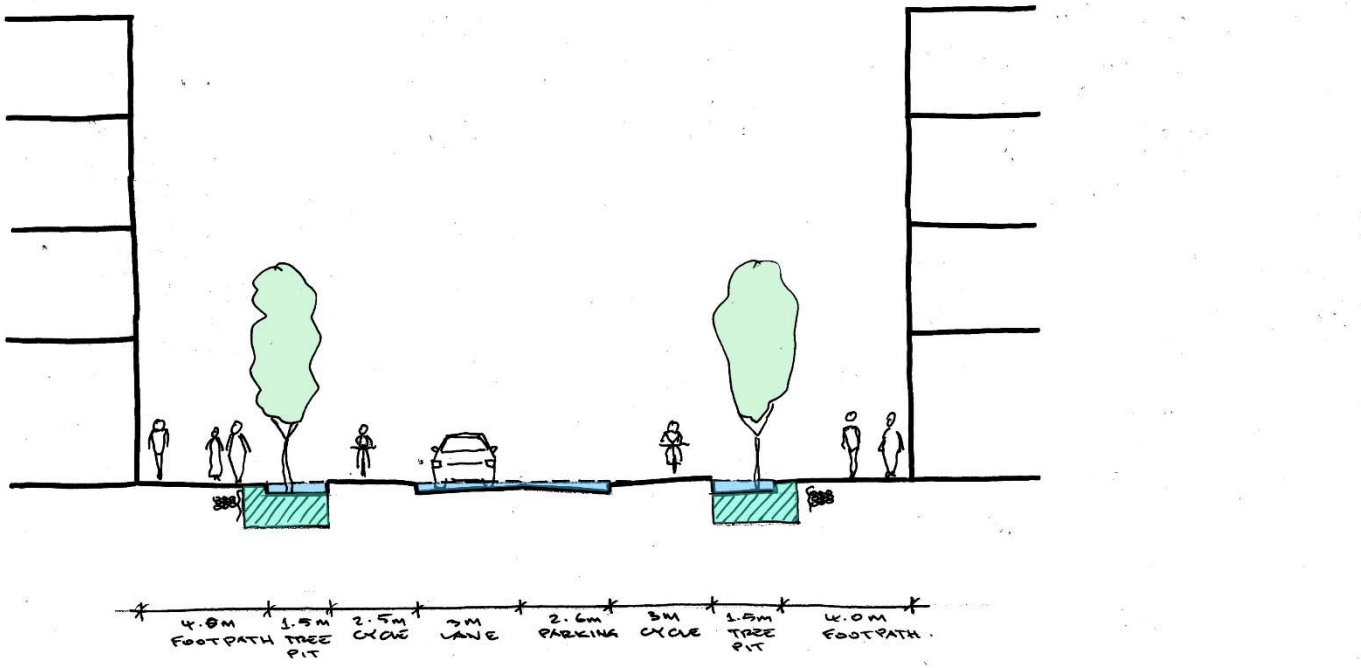
CoPP Cloudburst Boulevard Review


CLOUDBURST BOULEVARD
PLUMMER ST. CIVIC (36m)
FENNELL ST.
CONVEYANCE (100YR ARI)
DETENTION
6.5m PATH
2.5m CYCLE
2.8m LANE
2.8m LANE
2.5m CYCLE
3.6m MEDIAN / WATER / TRAM STOP
7.5m TRAM
2.8m
5m FOOTPATH
INCREASED TREE PIT STORAGE
INCREASED TREE PIT STORAGE
INCREASED TREE PIT STORAGE
COMBINED UTILITY CORRIDOR
COMBINED UTILITY CORRIDOR.


CLOUDBURST BOULEVARD ADDITIONAL STORAGE OPTION.
PLUMMER ST CIVIC (36m)
FENNEL ST.
CONVEYANCE (100YR ARI)
DETENTION
6.5m PATH
2.5m CYCLE
2.8m LANE
2.8m LANE
2.5m TREE PIT W ADD. STORAGE.
2.5m CYCLE
7.5m TRAM W. GRASS TRACK OR SEDUM TRACK
2.8m TREE PIT
5m FOOTPATH.
COMBINED UTILITY CORRIDOR
TREE PIT W ADD. STORAGE
1M PLANTED VERGE.
COMBINED UTILITY CORRIDOR

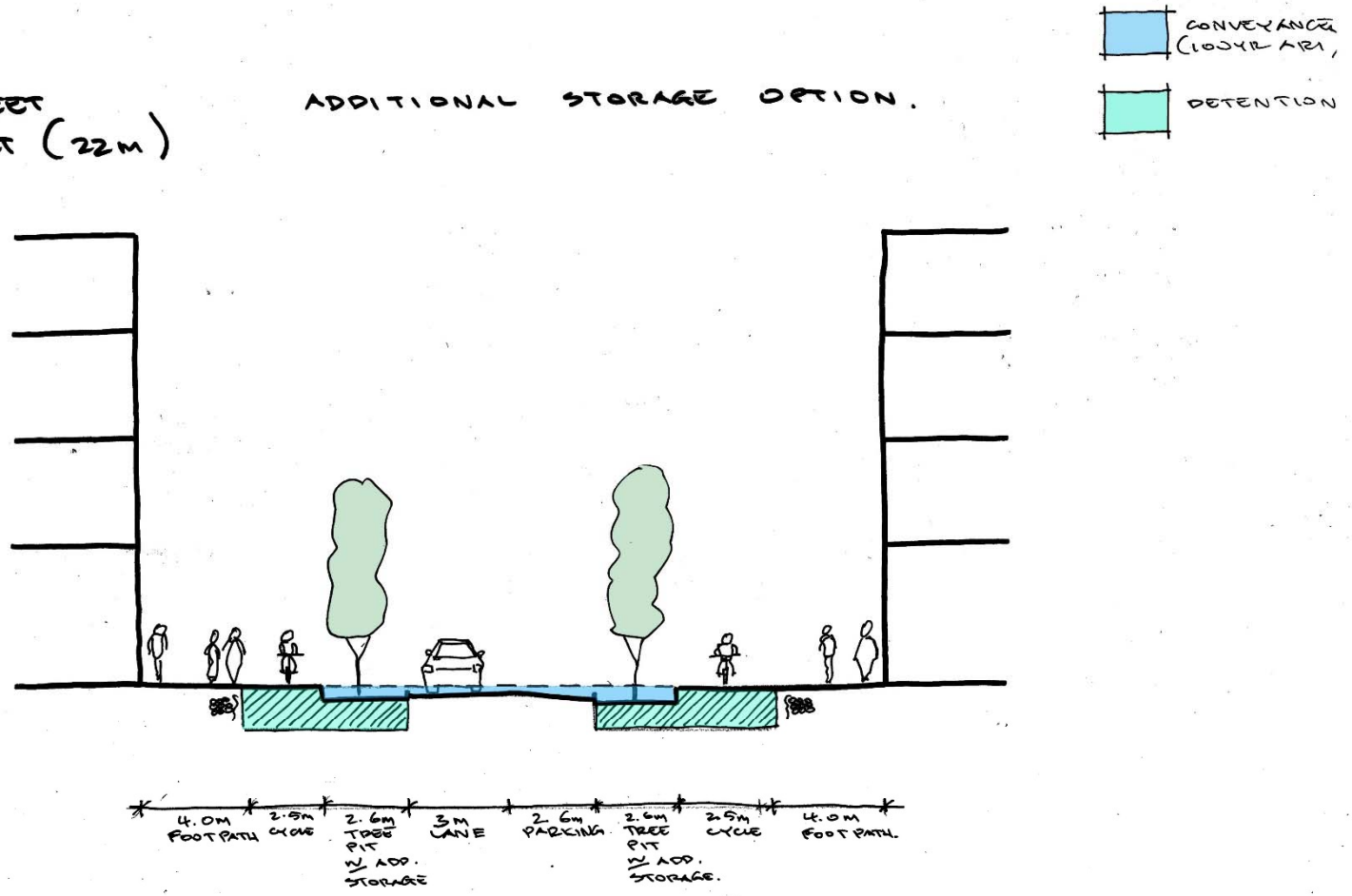
CoPP Green St (22 m) Review

GREEN STREET
NEW STREET (22m)

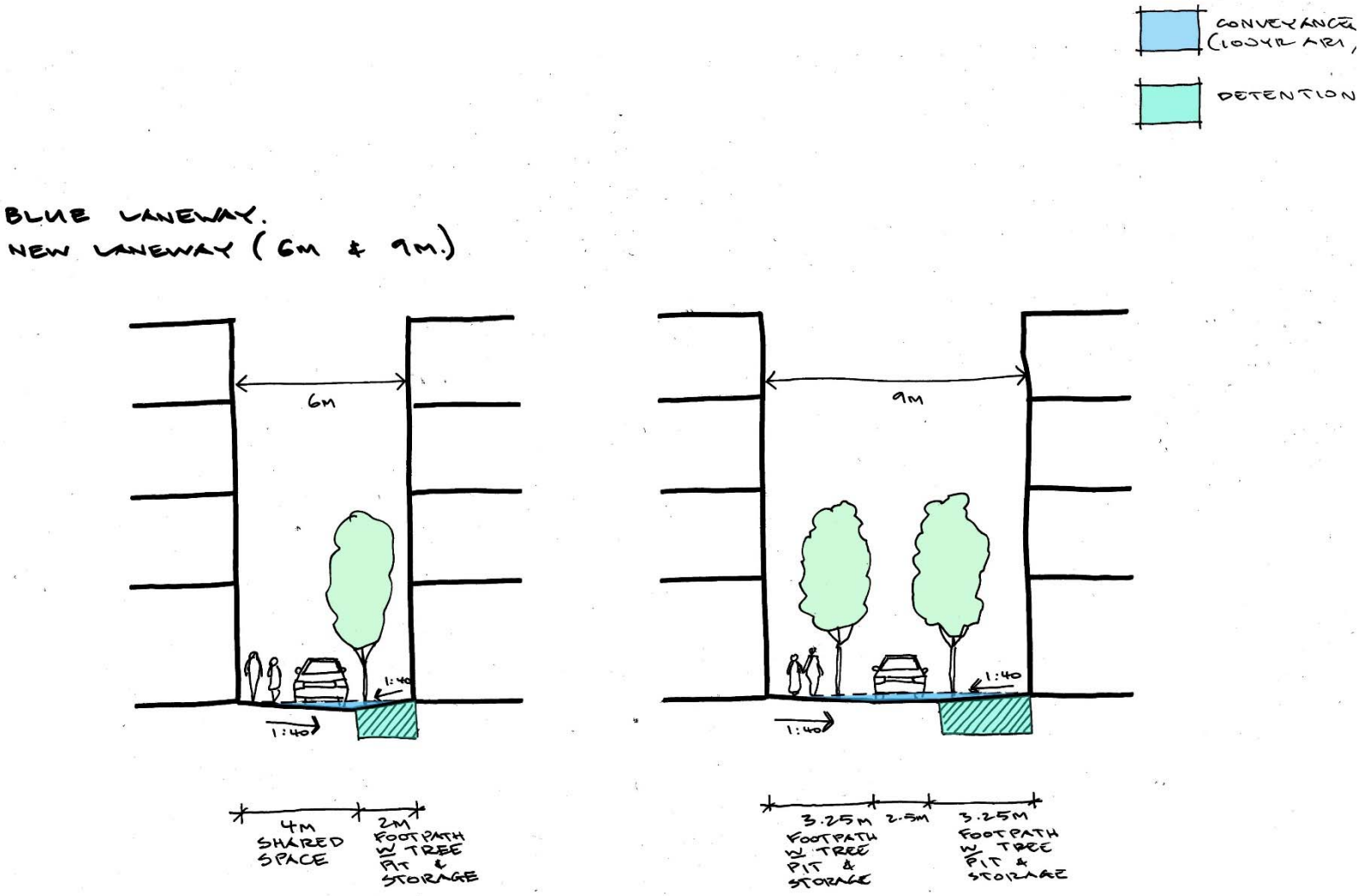


GREEN STREET
NEW STREET (22M)

ADDITIONAL STORAGE OPTION.



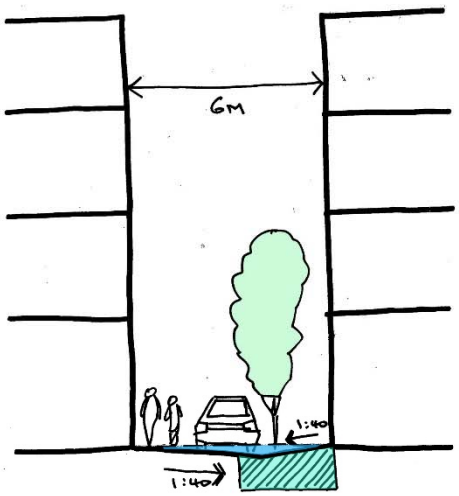
CoPP Blue Laneways (6 m & 9 m) Review

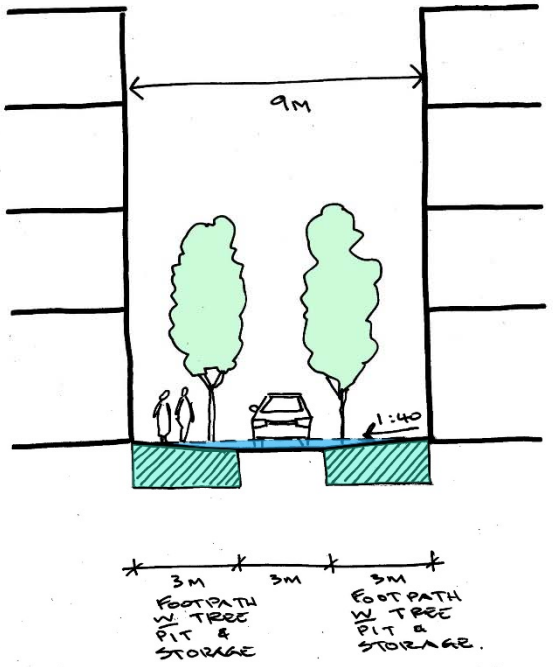

CONVEYANCE (100YR ARI)
DETENTION
BLUE LANEWAY.
NEW LANEWAY (6M & 9M.)
6M
1:40
1:40
4M SHARED SPACE
2M FOOTPATH W TREE PIT & STORAGE
9M
1:40
1:40
3.25M FOOTPATH W TREE PIT & STORAGE
2.5M
3.25M FOOTPATH W TREE PIT & STORAGE

CONVEYANCE (100YR ARI)

DETENTION

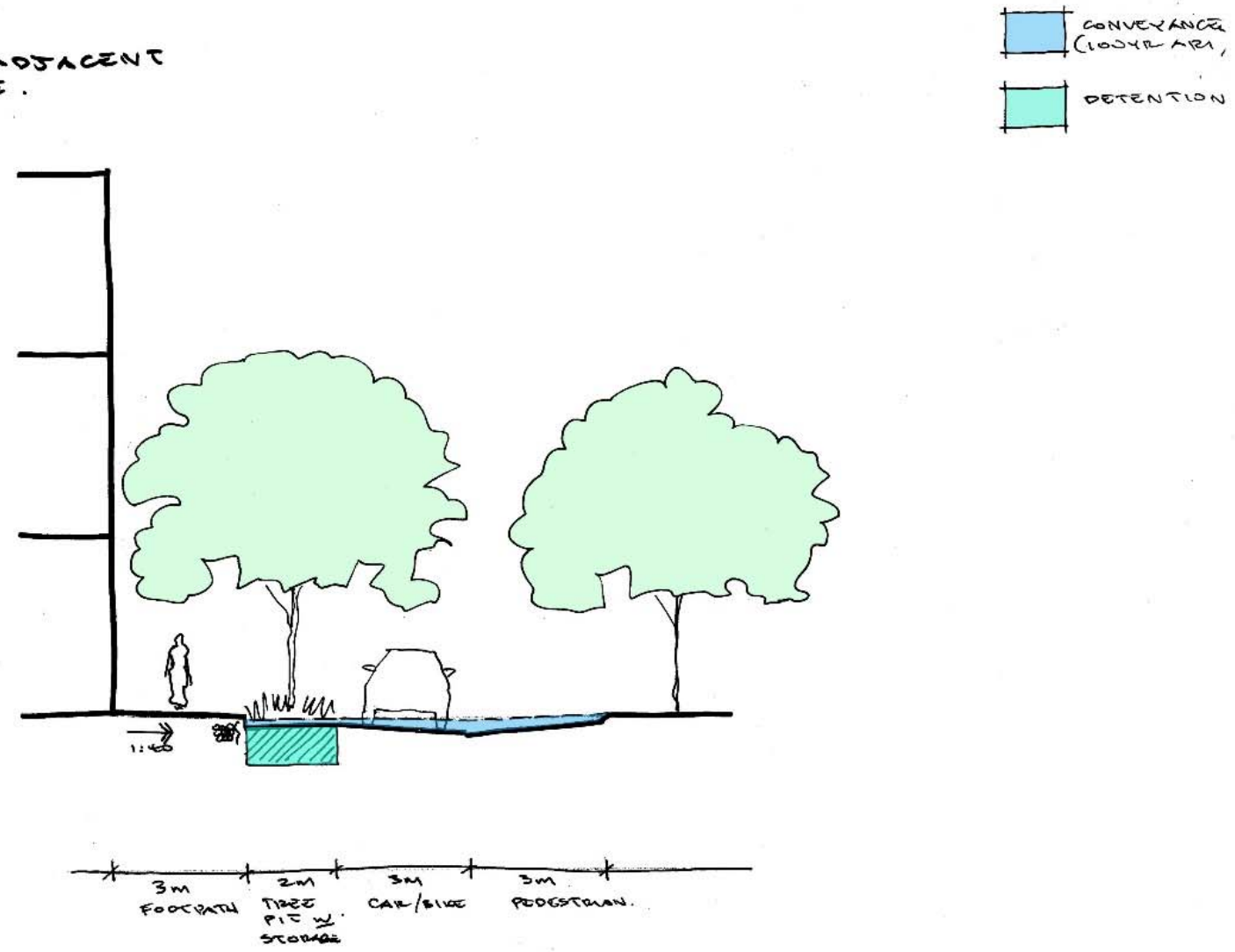
BLUE LANEWAY ADDITIONAL STORAGE OPTION
NEW LANEWAY (6M & 9M.)





CoM Section A Review

SECTION A
LOCAL STREET ADJACENT TO OPEN SPACE.



SECTION A
LOCAL STREET ADJACENT TO OPEN SPACE.
ADDITIONAL STORAGE OPTION.

CONVEYANCE (100YR ARI)

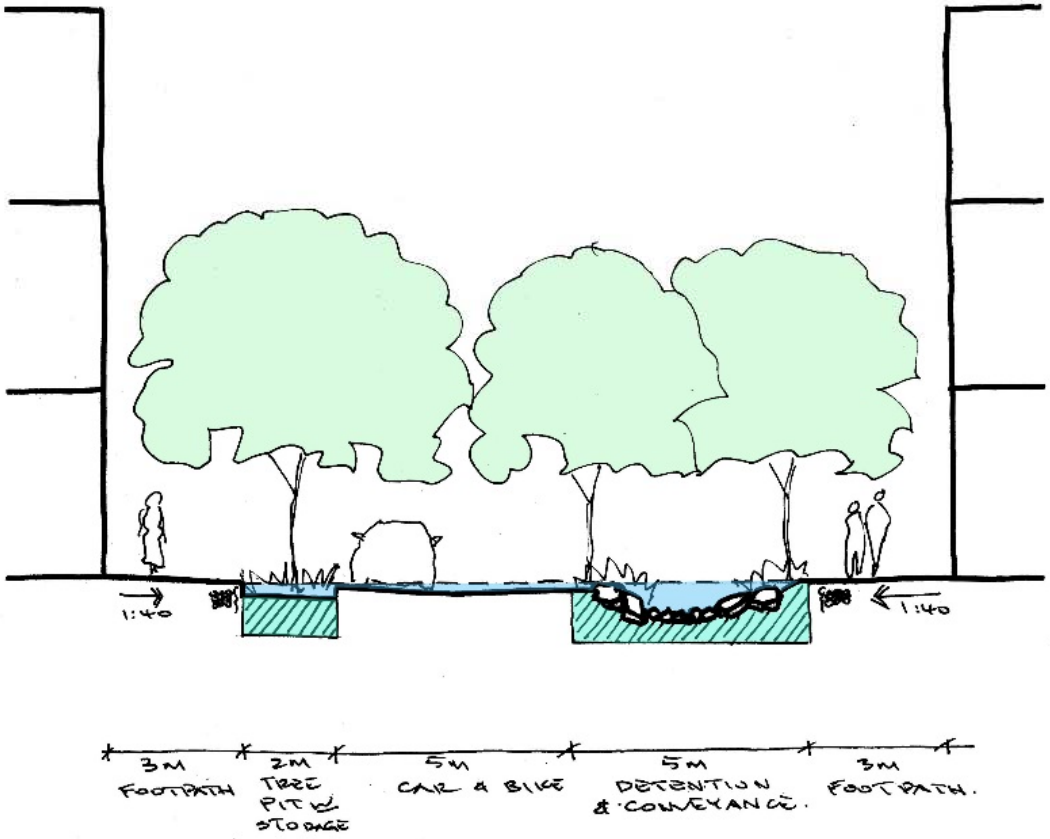
DETENTION

CoM Section B Review

CONVEYANCE (100YR ARI)

DETENTION

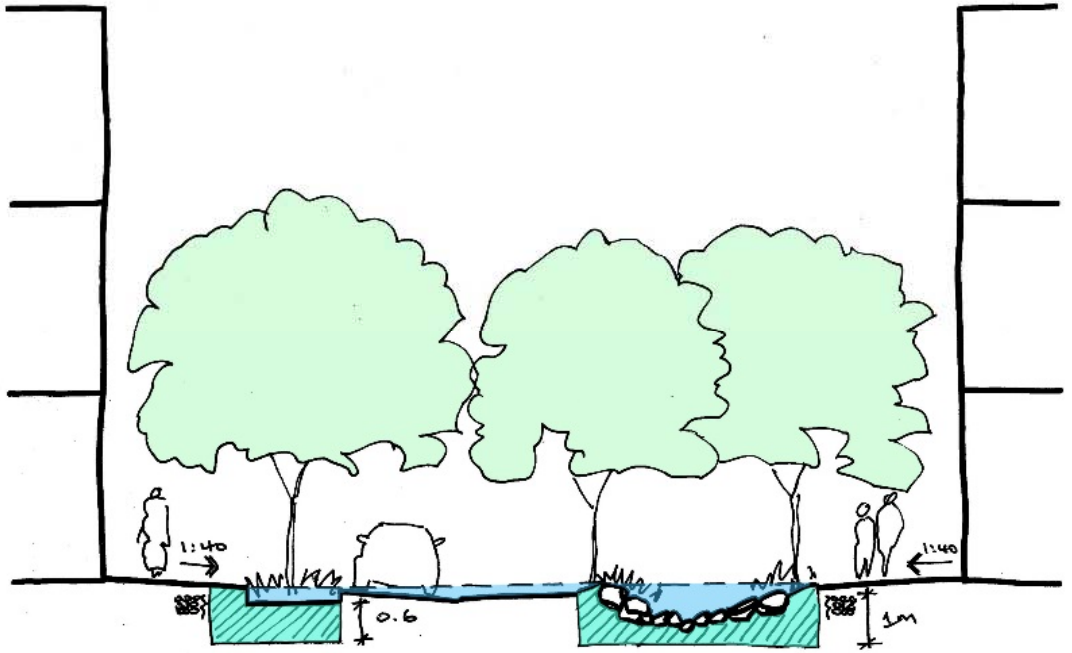
SECTION B
LOCAL STREET W LINEAR PARK.



CONVEYANCE (100YR ARI)

DETENTION

SECTION B
LOCAL STREET W LINEAR PARK.
ADDITIONAL STORAGE OPTION.

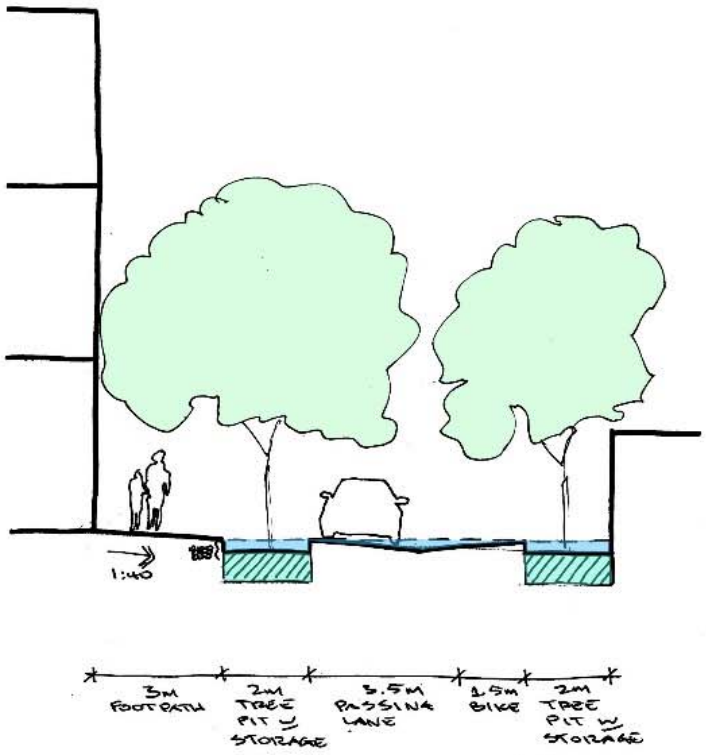


CoM Section C Review

CONVEYANCE (100YR ARI)

DETENTION

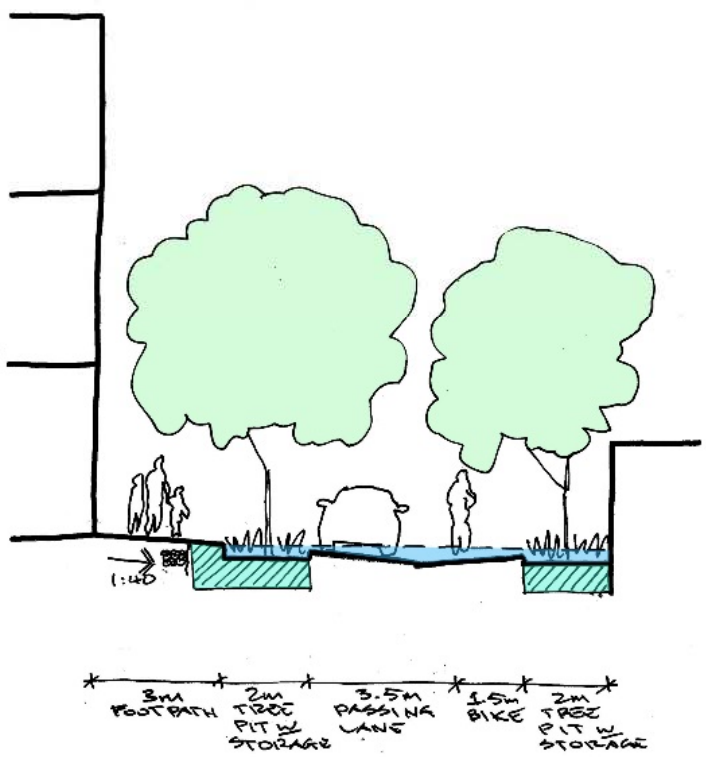
SECTION C
LOCAL STREET ADJ. TO TRAM BRIDGE



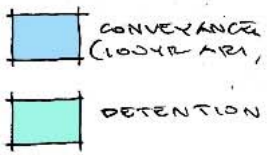
CONVEYANCE (100YR ARI)

DETENTION

SECTION C
LOCAL STREET ADJ. TO TRAM BRIDGE.
ADDITIONAL STORAGE OPTION.

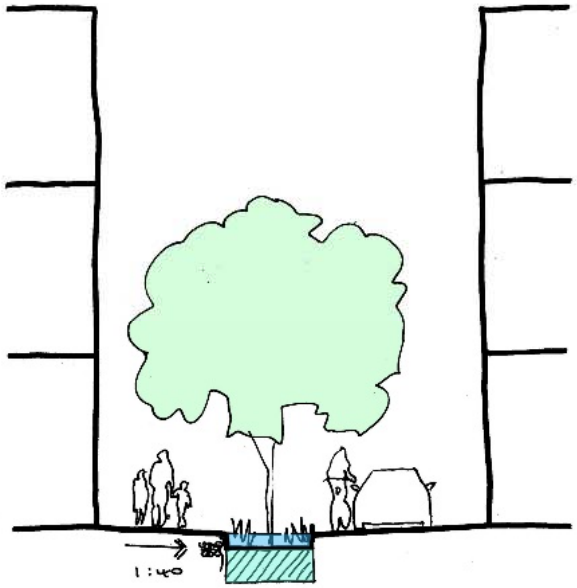


CoM Section D Review



SECTION D.

ONEWAY LANEWAY



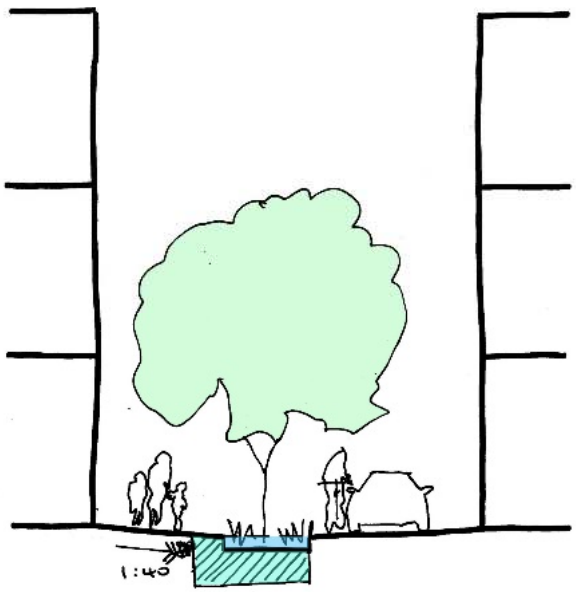
CONVEYANCE (100YR ARI)

DETENTION

SECTION D.

ONEWAY LANEWAY.

ADDITIONAL STORAGE OPTION.



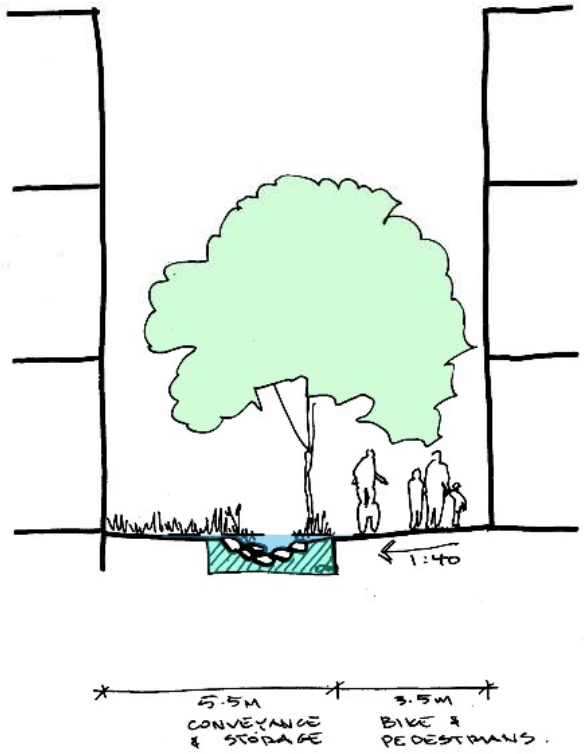
CoM Section E Review

CONVEYANCE (100YR ARI)

DETENTION

SECTION E

PEDESTRIAN LANEWAY.



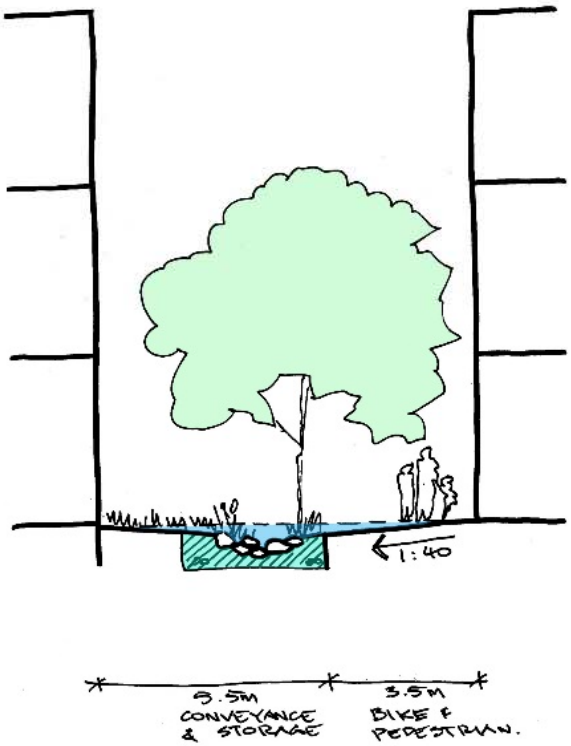
CONVEYANCE (100YR ARI)

DETENTION

SECTION E

PEDESTRIAN LANEWAY.

ADDITIONAL STORAGE OPTION.

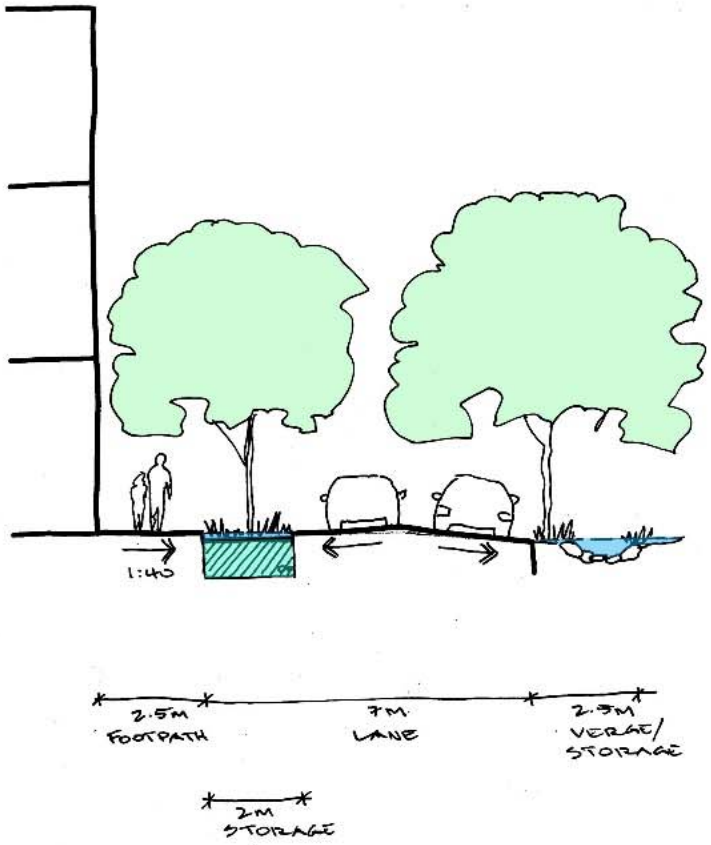


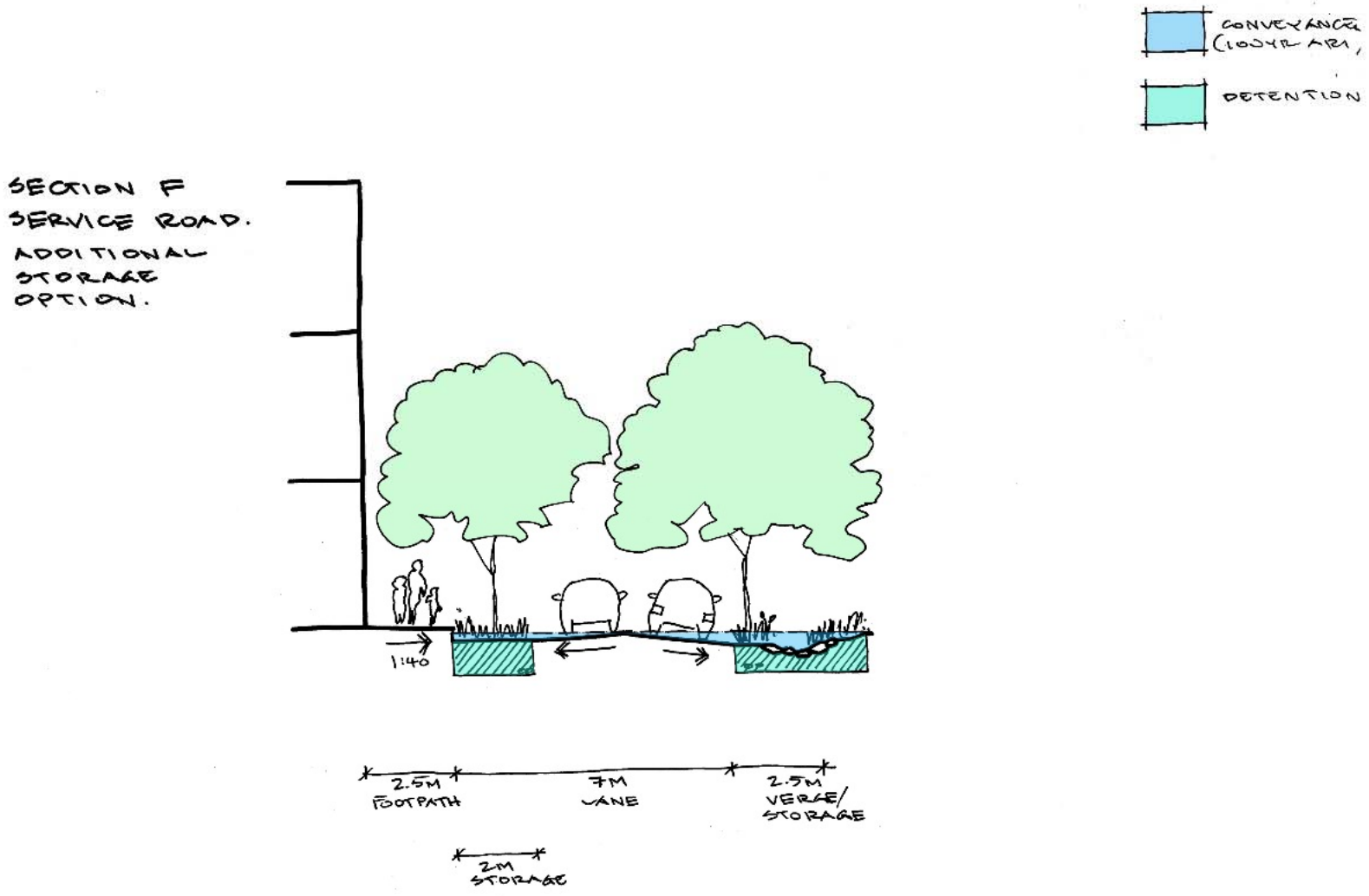
CoM Section F Review

CONVEYANCE (100YR ARI)

DETENTION

SECTION F
SERVICE ROAD.




CONVEYANCE (100YR ARI)
DETENTION
SECTION F
SERVICE ROAD.
ADDITIONAL
STORAGE
OPTION.
1:40
2.5M
FOOTPATH
7M
LANE
2.5M
VERGE/
STORAGE
2M
STORAGE

Next Steps

Attachment 10

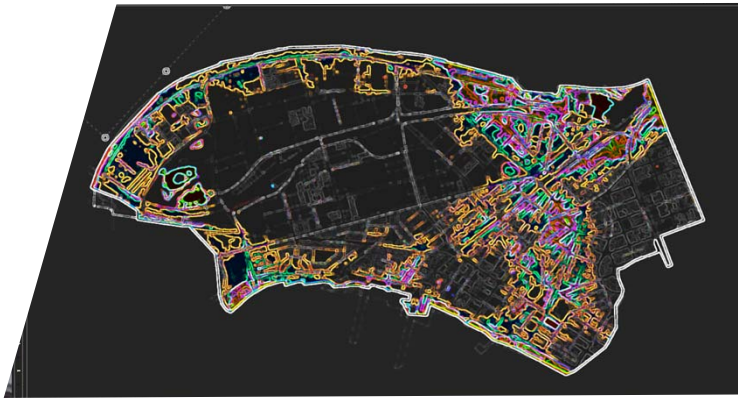
GHD Input Slides for 24th Oct Steering Committee Meeting

Fishermans Bend: Water Sensitive Drainage & Flood Management Strategy

Development of the Hybrid

Steering Committee Meeting 24.10.18

Greg Finlayson,
Senior Technical Director

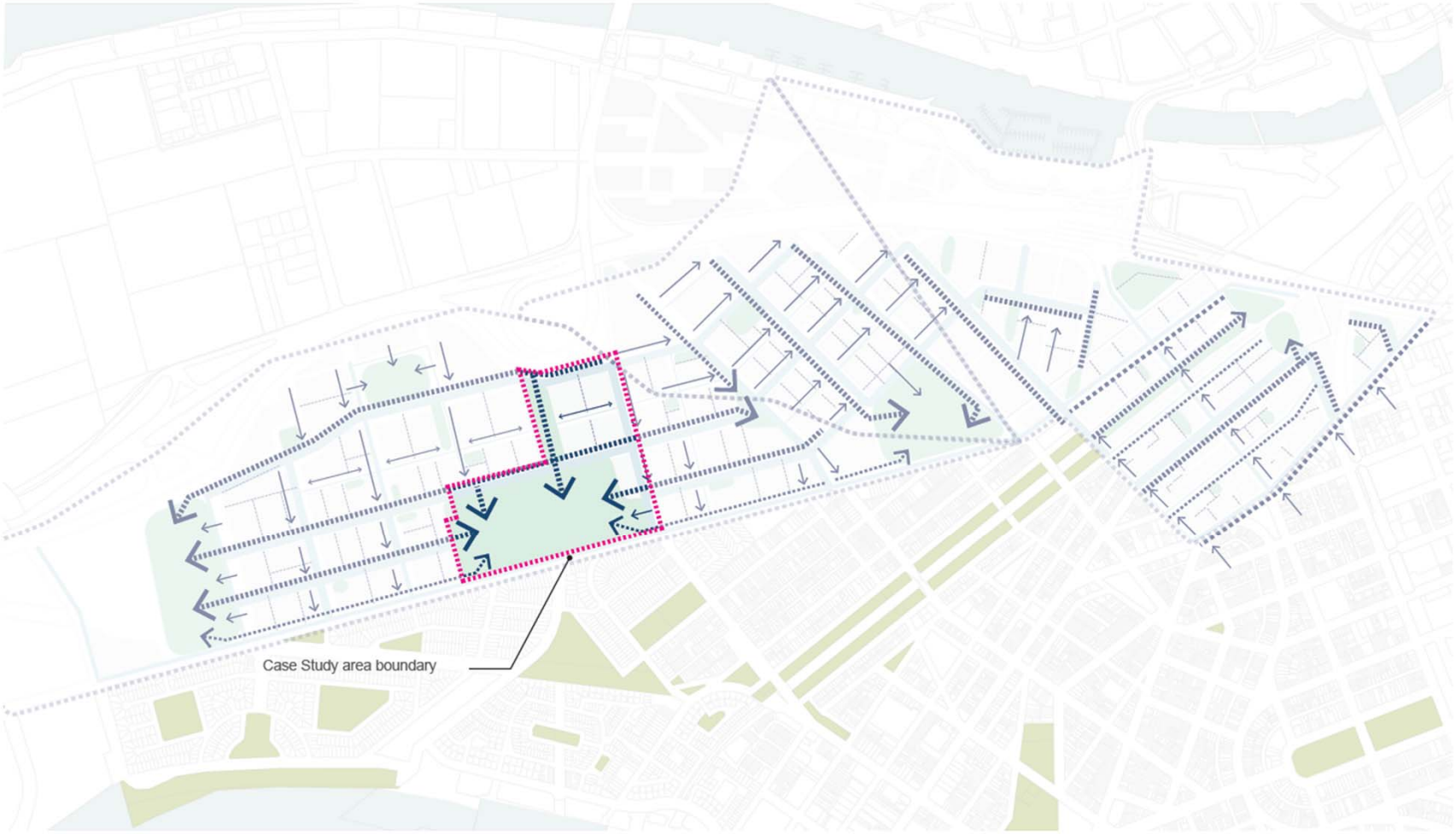


Core Questions

- How can we manage stormwater in the **Case Study Areas** while maintaining or enhancing the desired urban form?
- What are some options to achieve this goal?
- How would we choose between these options?
- How can the thinking from the Case Studies be extrapolated across the precincts?

Case Study Areas CoPP

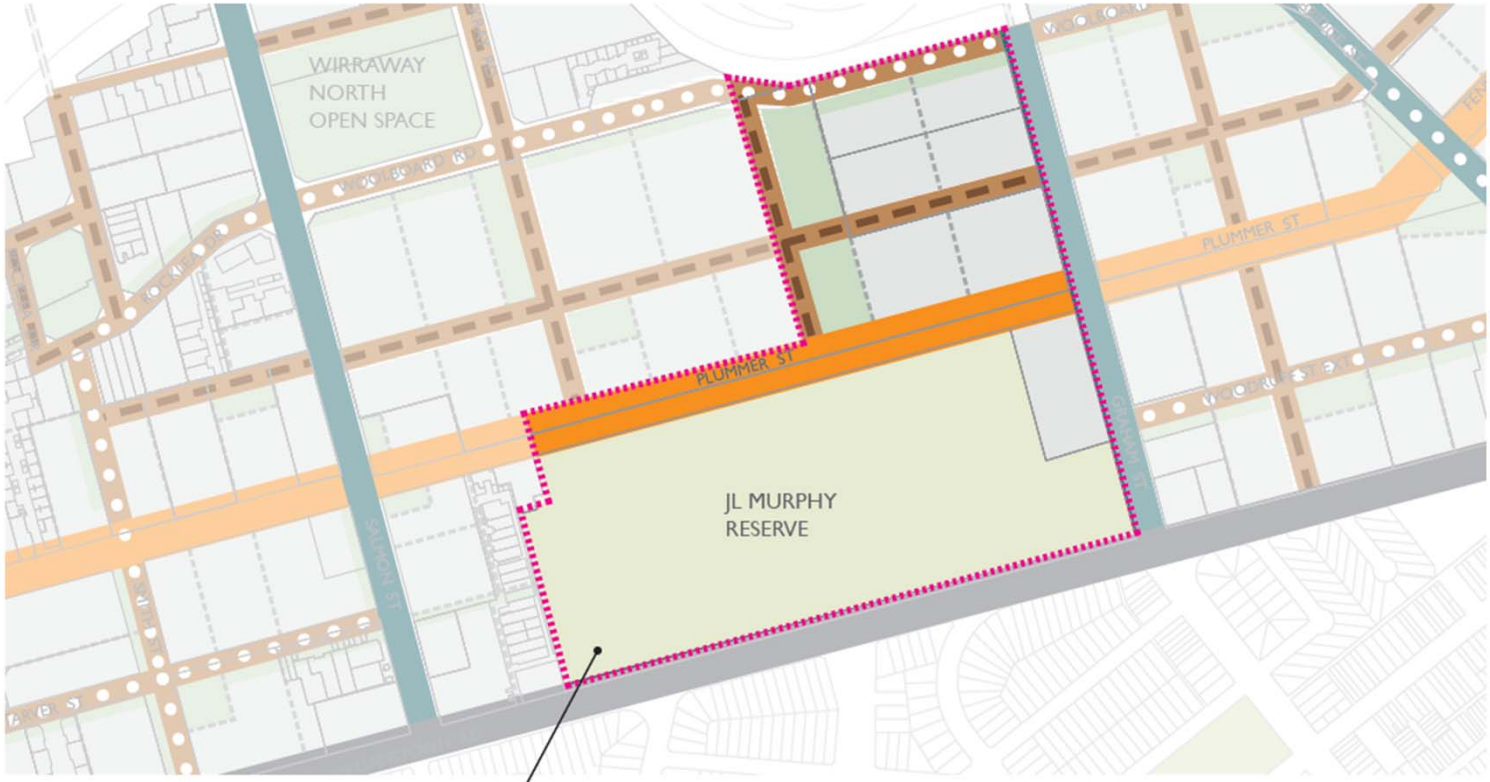
Case Study Area



Case Study Areas CoPP

Street hierarchy / types

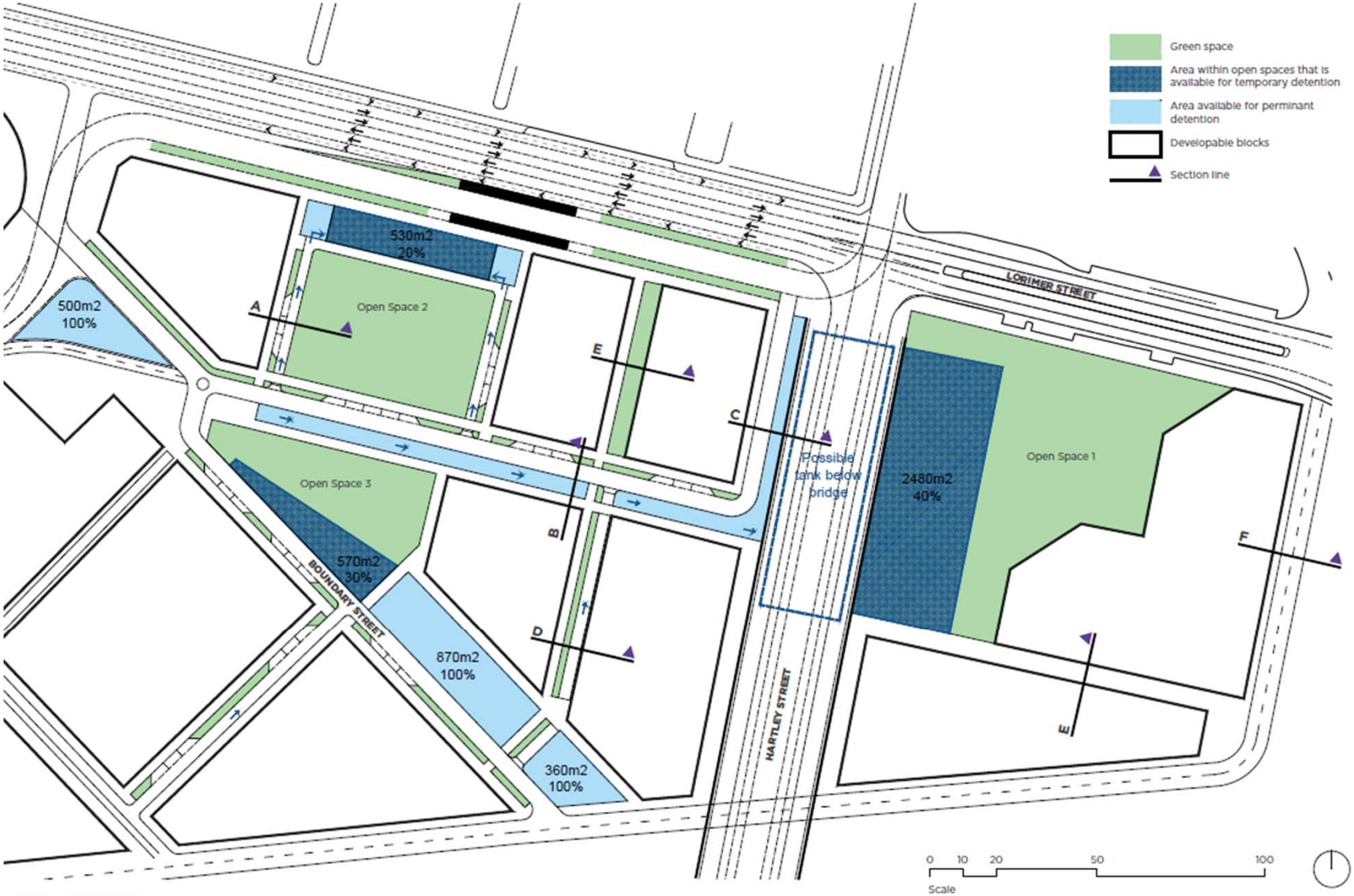
CoPP



Case Study Areas CoM

CONTEXT PLAN

Case Study Areas CoM

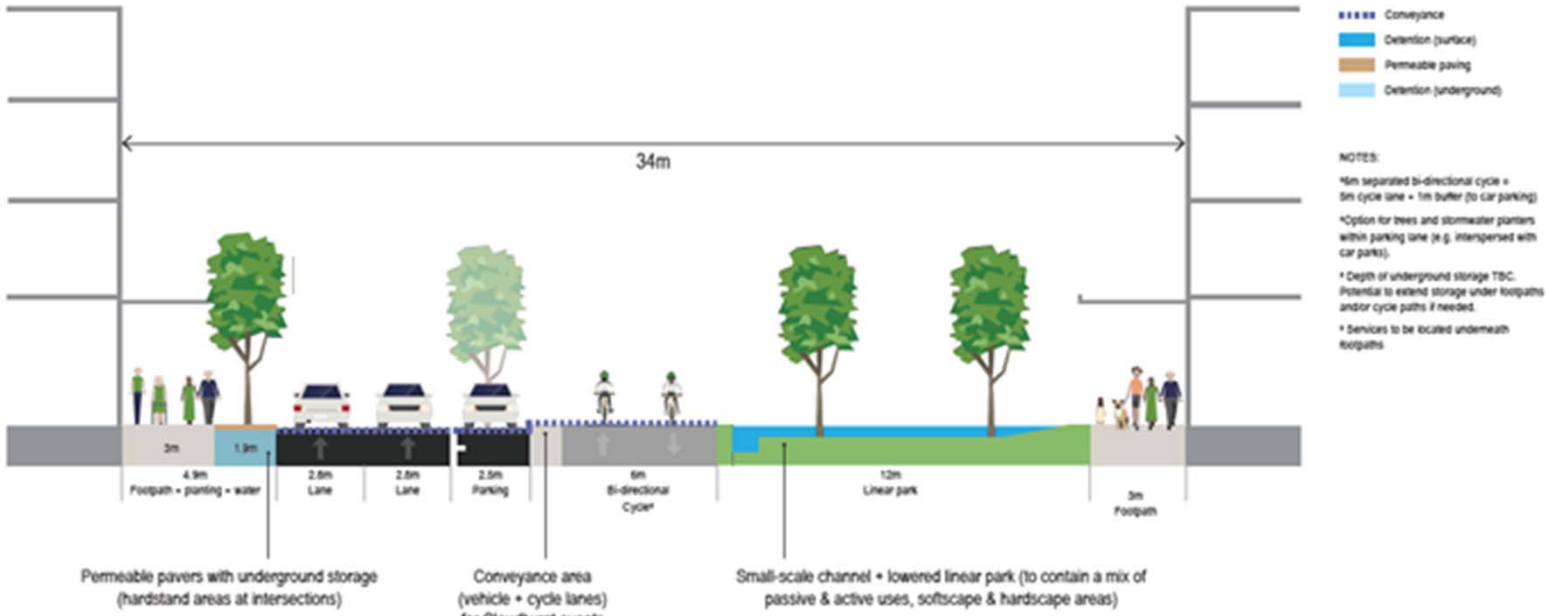


STUDY AREA PLAN

Proposed Cross Sections CoPP (Example)

Green Street

New street (34m with linear park)



Proposed Cross Sections CoM (example)

SECTION B

LOCAL STREET WITH LINEAR PARK

Function

Provides local experience, connection to destination and creates pedestrian-friendly block intervals.

Vehicle Movement + Access

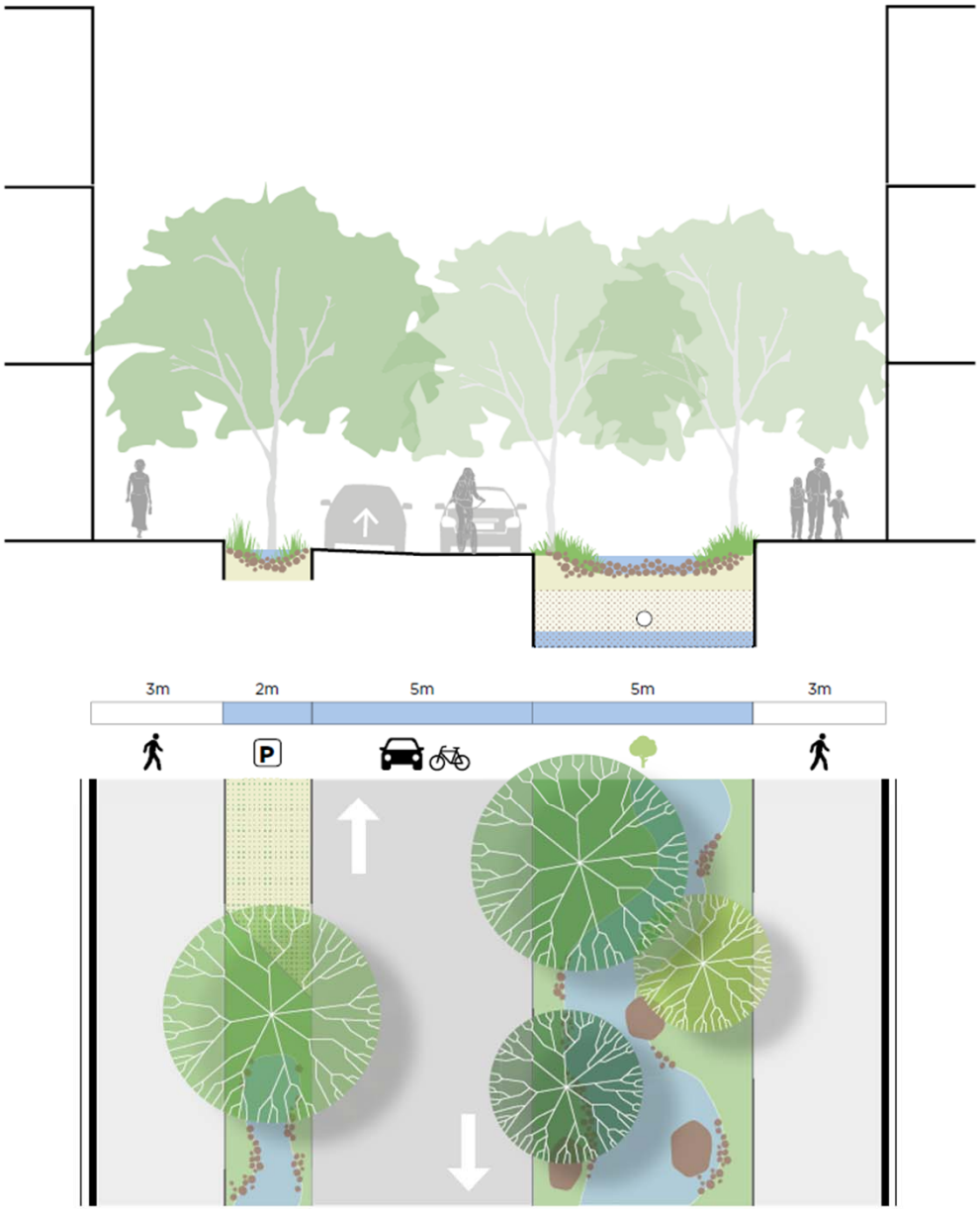
5 m width for bidirectional lanes, also known as yield lanes. On low-volume streets without transit routes, vehicles moving in opposite directions can yield to one another as they pass.

Water management

Working as a Cloudburst Street to convey waters to on street detention areas. Detention areas to operate during regular flood events, while the conveyance areas to work during greater than 1 in 20 year flood event (5 per cent AEP). Conveyance area defined to vehicular lane and linear park.

Parking

Restricted on street parking, with parking spaces limited to car share and delivery/service vehicles.



Principles for Work on Council's Concepts

- **Maintain the urban form** (incl. water sensitive city principles such as urban greening, UHI mitigation & visible water in the landscape)

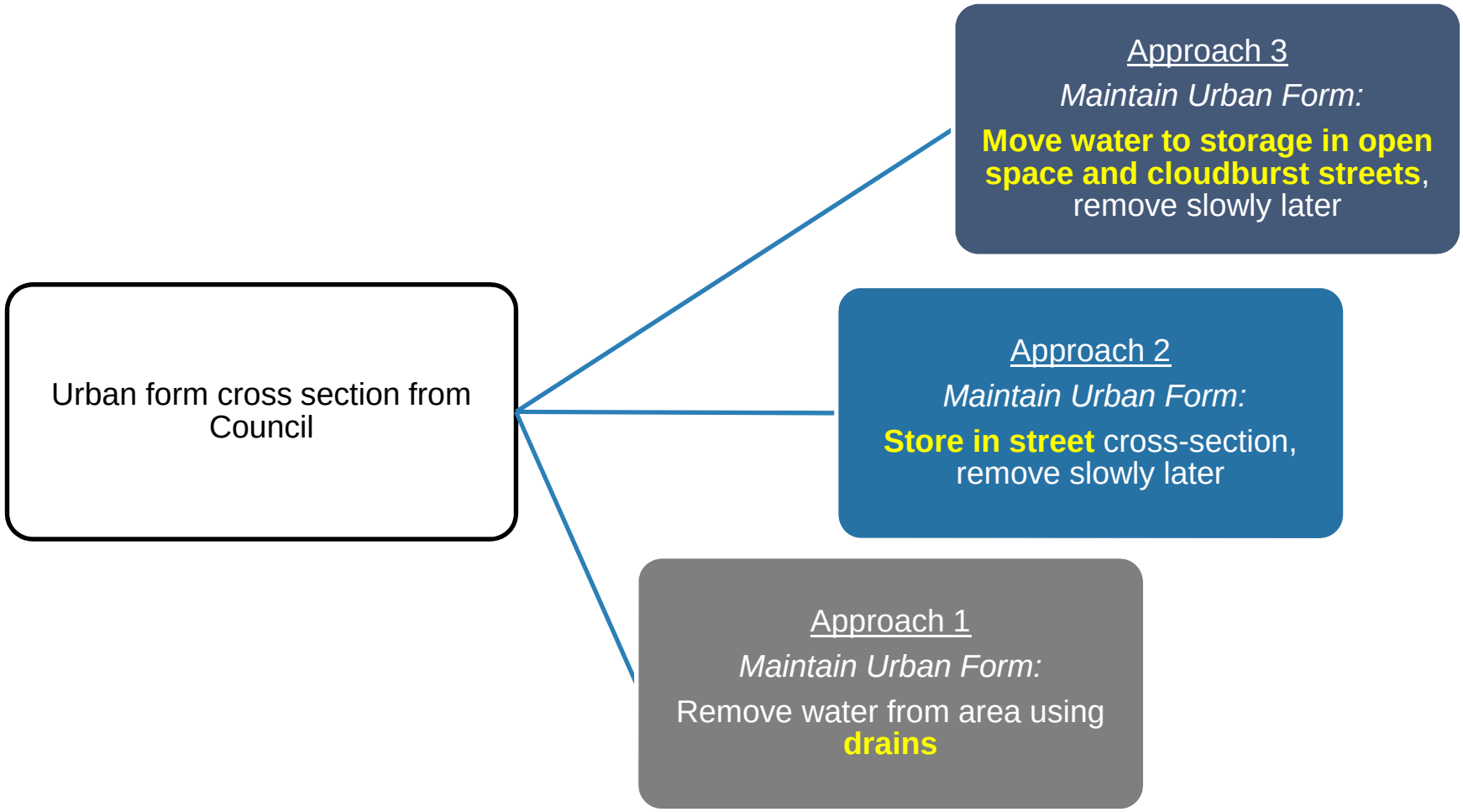
- Agreed level of service goals:
  - No significant flows **above ground** in less than 1:20 event
  - No flooding **onto private property** in less than 1:100 event

- Seek to achieve agreed 1:20 and 1:100 goals through **three different *flood management* approaches**

Baseline (Conveyance) vs Hybrid Option

Elements	Baseline (Conveyance) Option	Hybrid Option
Street trees, parks, greening, bike paths etc.	As per council street layouts. Note no water on footpaths in less than 1:100.	
Design LOS	No water on roads etc. in less than 1:20. No water on private property in less than 1:100.	
Levee	Consistent between Options	
Existing drainage (pits, pipes, pumps and the like)	Used to convey water and pump over levee	
Additional major drains, and additional pumps	Required	Approach is to minimise these
In street storage, storage in open spaces.	Minimal, or incidental	Approach is to maximise these, note they then drain slowly into existing drains
Flows up to 1:20	Conveyed along roads to get to drains.	Runoff captured by distributed storages, which discharge slowly into existing drains.
Flows above 1:20 up to 1:100	Conveyed along roads to get to drains.	Conveyed along roads to get to open space storages, which discharge slowly into existing drains.

Method - Step One (underway)

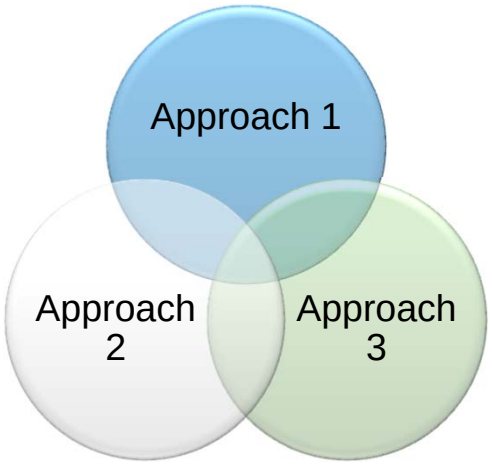


Further Description of Approaches

#	Approach	Driver
1	Enhance urban form **primarily for amenity with allowance for conveyance**	20 yr ARI carried via upgraded pipe/pump solution, 100 yr in streetscape
2	Enhance urban form **for both amenity and provision of stormwater detention and conveyance**	*Driver relative to option 1* – Scale of pipe/pump upgrades reduced by detention
3	Enhance urban form **for both amenity and maximising stormwater detention and conveyance**	*Driver relative to option 1 & 2* - Some streets can provide more detention/conveyance and can strategically take pressure off other streetscapes/pipes)

Method - Step Two (underway)

- Determine ‘best’ mix of approaches 1, 2 and 3 for the Case Study Areas.
- Framework for determining ‘best’ to be discussed in a few slides time.



Method - Step Three (to come)

- Look at agreed ‘best’ approach for case study areas and infer ‘Rules’ that can be extrapolated across the entire area.

- Extrapolate across the entire precinct.

Method - Step Four (to come)

- Will now have two overarching strategies for Fishermans Bend:
    I. Approach 1 across entire precinct, and
    II. ‘Best-practical’ mix of all Approaches (1, 2 and 3) based on analysis

- Compare the costs and benefits, advantages and disadvantages of the two overall strategies.

Note: Urban form and level of service remains the same between the two strategies.

Criteria for Comparison of Strategies Draft

Criteria	Method of Measurement or Assessment	Comment	Option 1	Option 2	Option 3
CAPITAL COSTS					
In property	Comparative Cost				
In Lanes, Streets etc					
Undergound pipes, pumps etc.					
Works in open spaces		Additional works to create lower areas to hold water			
MAINTENANCE COSTS					
In Streets	Comparative Cost	Need to clean and de-silt etc.			
In Underground network and pumps					
LIFE CYCLE COSTS					
Design life / Time between renewals	Time period	Could incorporate into TOTEX cost (CAPEX+OPEX)			
LAND TAKE					
Streets	m2 per lineal m	Is this a loss if more area for tree pits?			
Open Space	Ha or percentage	Is this really a land take loss if still useable space for most years?			
ENVIRONMENTAL IMPACTS/BENEFITS					
Energy	Qualitative				
Stormwater Quality					
Wastes					
SOCIAL IMPACTS/BENEFITS					
Urban Temperature	Qualitative				
Greening					
Visibility of Water					
Community views		Community views to be advised by stakeholders			
IMPLEMENTATION CONSIDERATIONS					
Difficulty of implementation given development timeline and process	Qualitative	If development is not continuous and linear, may be hard to make linear along street assets to work in the interim cases.			
Constructability issues					
Health & Safety issues					
RISK & RESILIENCE					
Risk of failure to work correctly, or be implemented as expected.	Qualitative	Risk of pump etc failure on one hand, on the other hand the risk of non success of street assets to work as expected.			
Adaptibility/Flexibility/Contingency		Ability to adjust to changed conditions			

Criteria for Comparison of Strategies Comments

CoPP:

- **[Re CAPEX]** Could we simplify this a little bit so that capital set up costs, maintenance and life cycle are line items under 'Economic' considerations' or similar.
- I would also add another qualitative line item that seeks to measure the economic benefits that may (or may not) come from improved amenity arising from having more water more present more often in the landscape.
- **[Re Maintenance]** Maintenance costs need to consider full make good costs rather than the typical approach which leaves the above ground infrastructure in a terrible state.
- **[Re Land take – Open space]** I wonder if this is adding much benefit as presently proposed.
- **[Re Environmental criteria]** Isn't this something that could be quantified [ie not just qualitative]
- **[Re Implementation – difficulty]** I think this consideration is going to be a problem either way so I question its inclusion.
- **[Re Resilience]** Any discussion around resilience needs to cover the benefits of having water stored in the landscape from a community resilience perspective (particularly above ground in Cloudburst Boulevards / streets that are not performing a large conveyance role. By this, I mean making storm events and water storage more present visually in the landscape.
- **[Re risk & Resilience]** I would group risk and resilience as currently explained in the comment on this category with the considerations in the land take section as 'Fit-for-purpose' or similar.

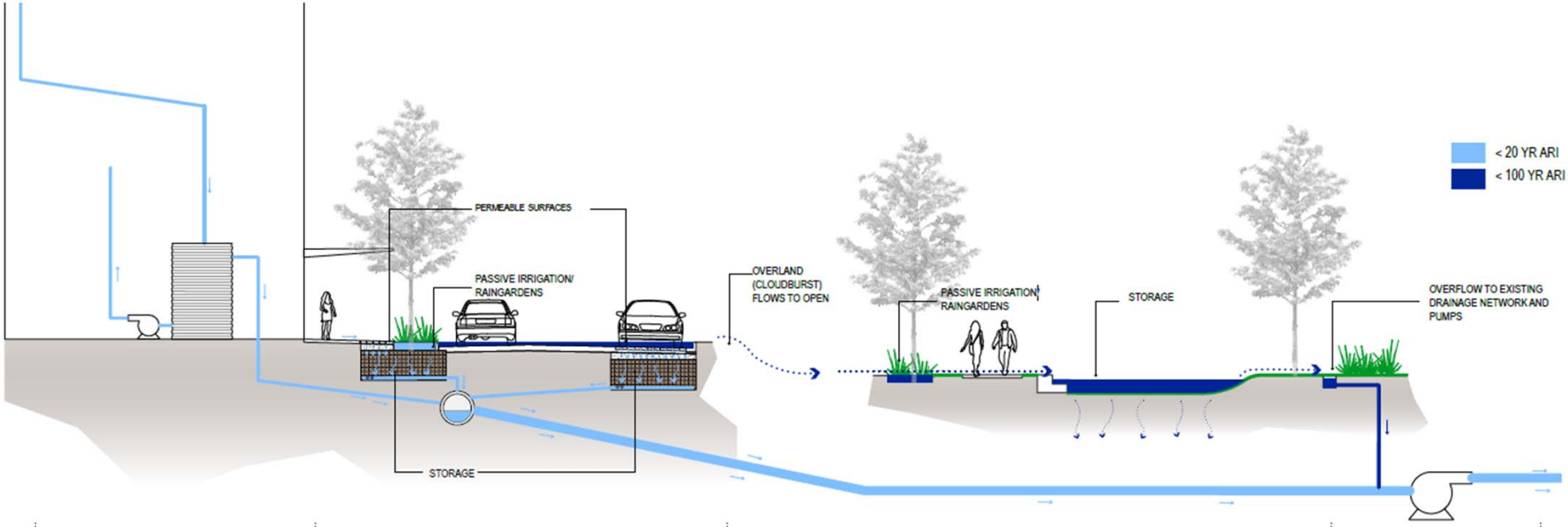
Working Group Meeting 23rd Oct:

- Below ground uptake of space, could affect available space remaining for other services or uses (likely under the Land take category)
- Water savings (eg through reduced irrigation), could be under Environmental Impacts
- Biodiversity (as long as this is attributed to the difference between options)
- Urban design outcomes (eg. access, trafficability issues due to above ground storages).

CRCWSC:

- Emphasising the importance of the 'water visibility' criteria as a core rationale for looking at the case studies to begin with. I.e. water visibility enables social resilience. Ensure this particular criteria is given prominence.

Current Thinking



PRIVATE REALM

RAIN TANKS
REUSE
ONSITE PERMEATION

PUBLIC STREET

PERMEABLE PAVING
RAINGARDENS
PASSIVE IRRIGATION
STORAGE

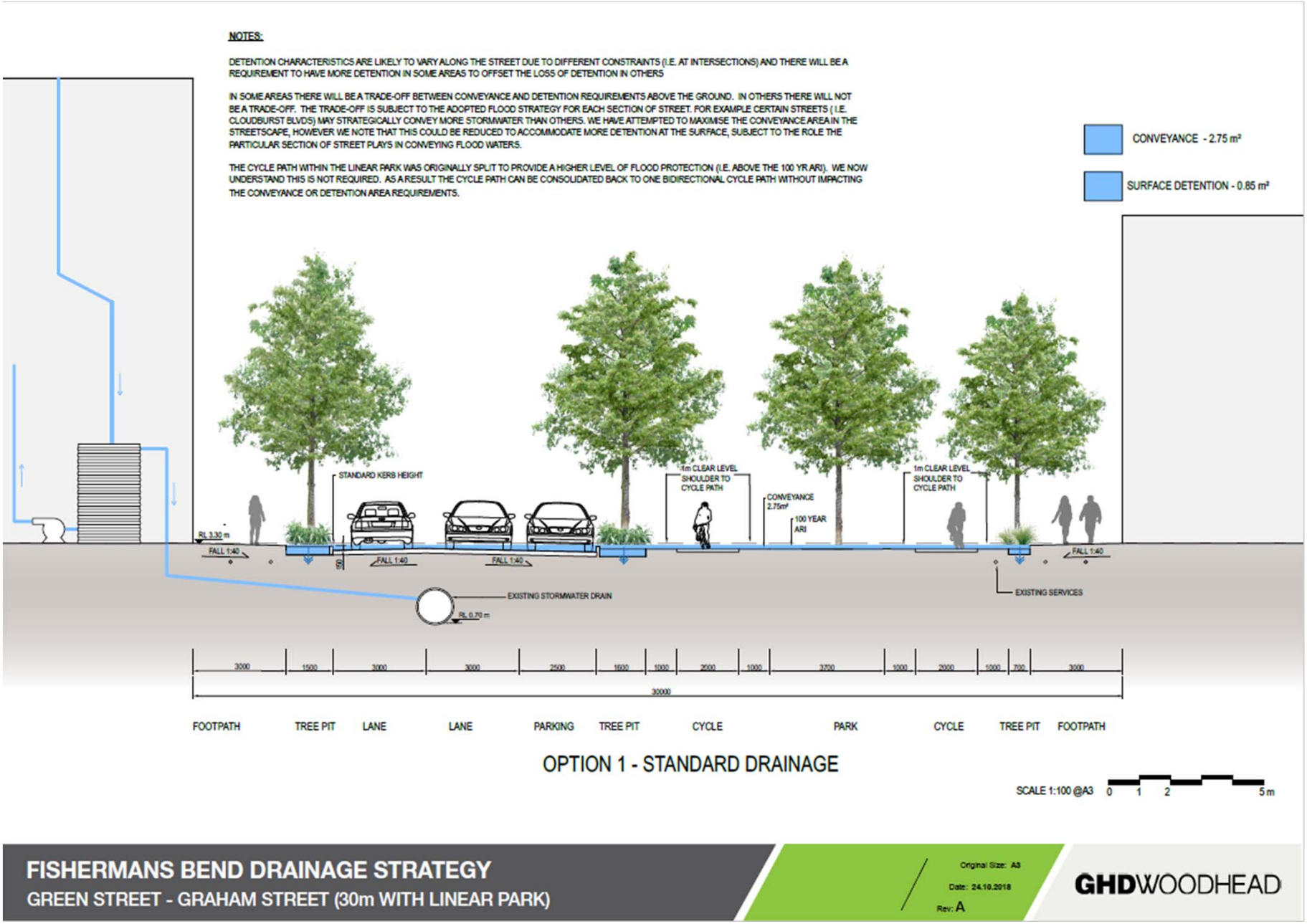
PUBLIC OPEN SPACE

STORAGE
PERMEABLE PAVING
RAINGARDENS
PASSIVE IRRIGATION

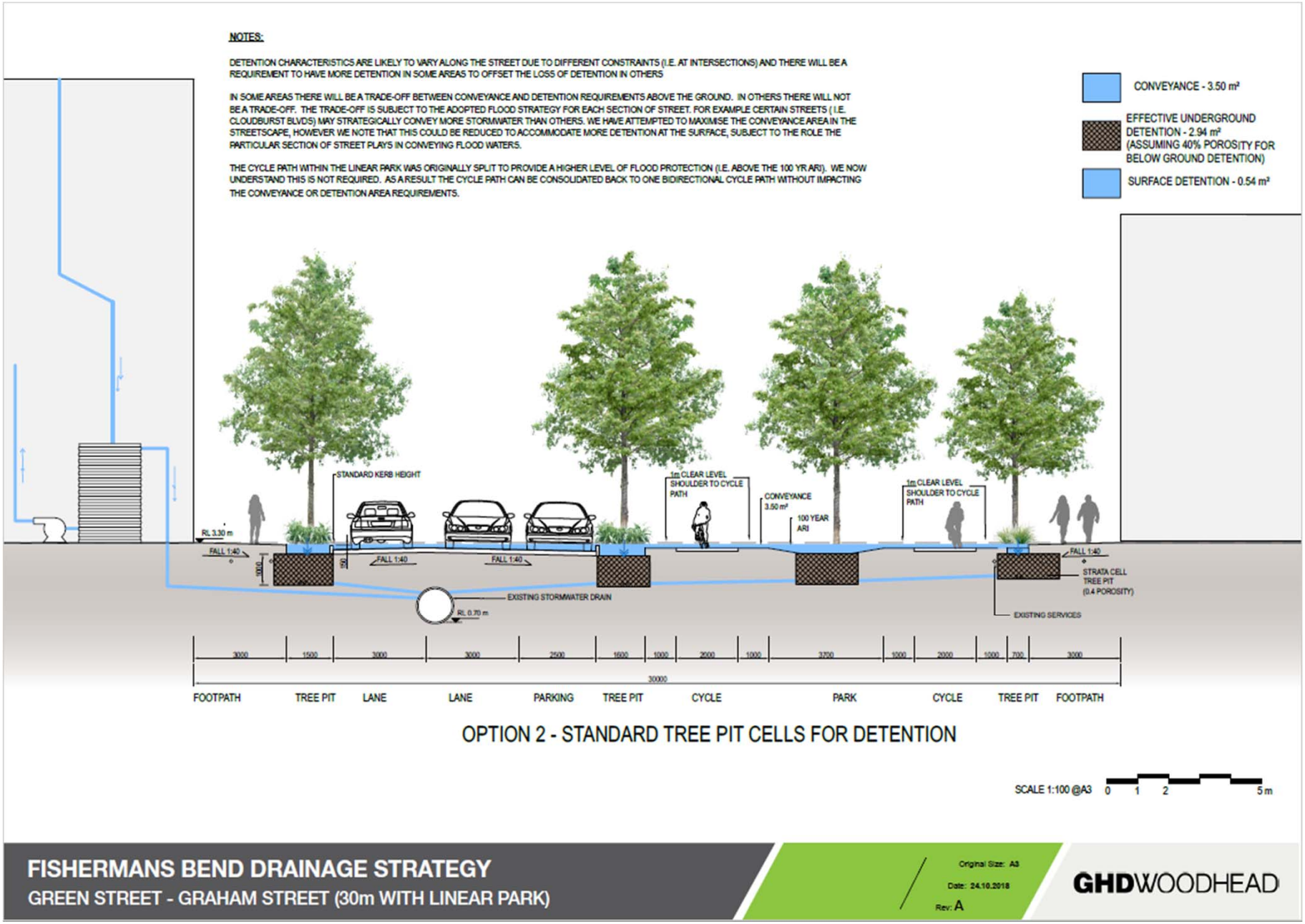
DRAINAGE INFRASTRUCTURE

PITS
PIPES
PUMPS

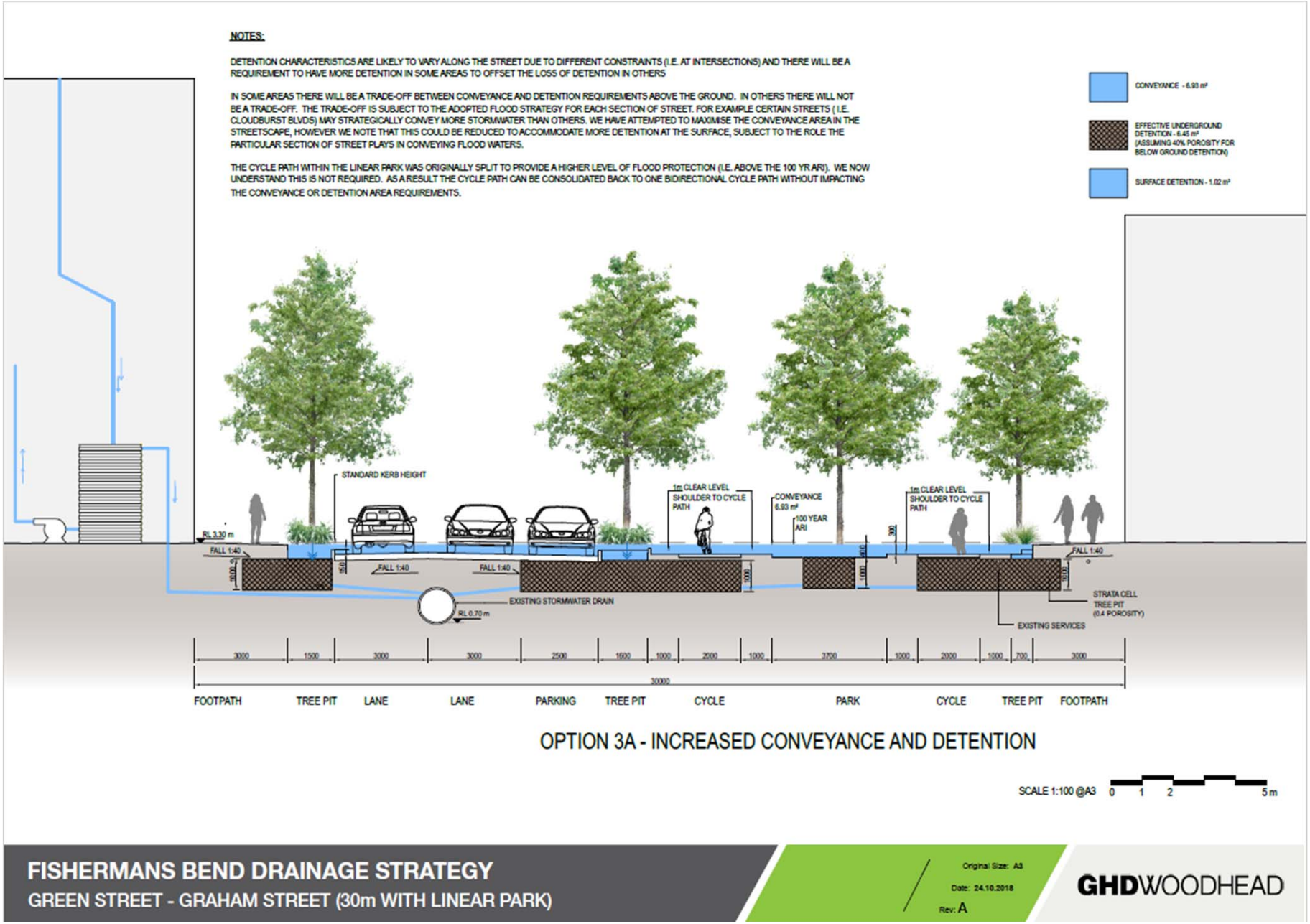
Green Street - Option 1



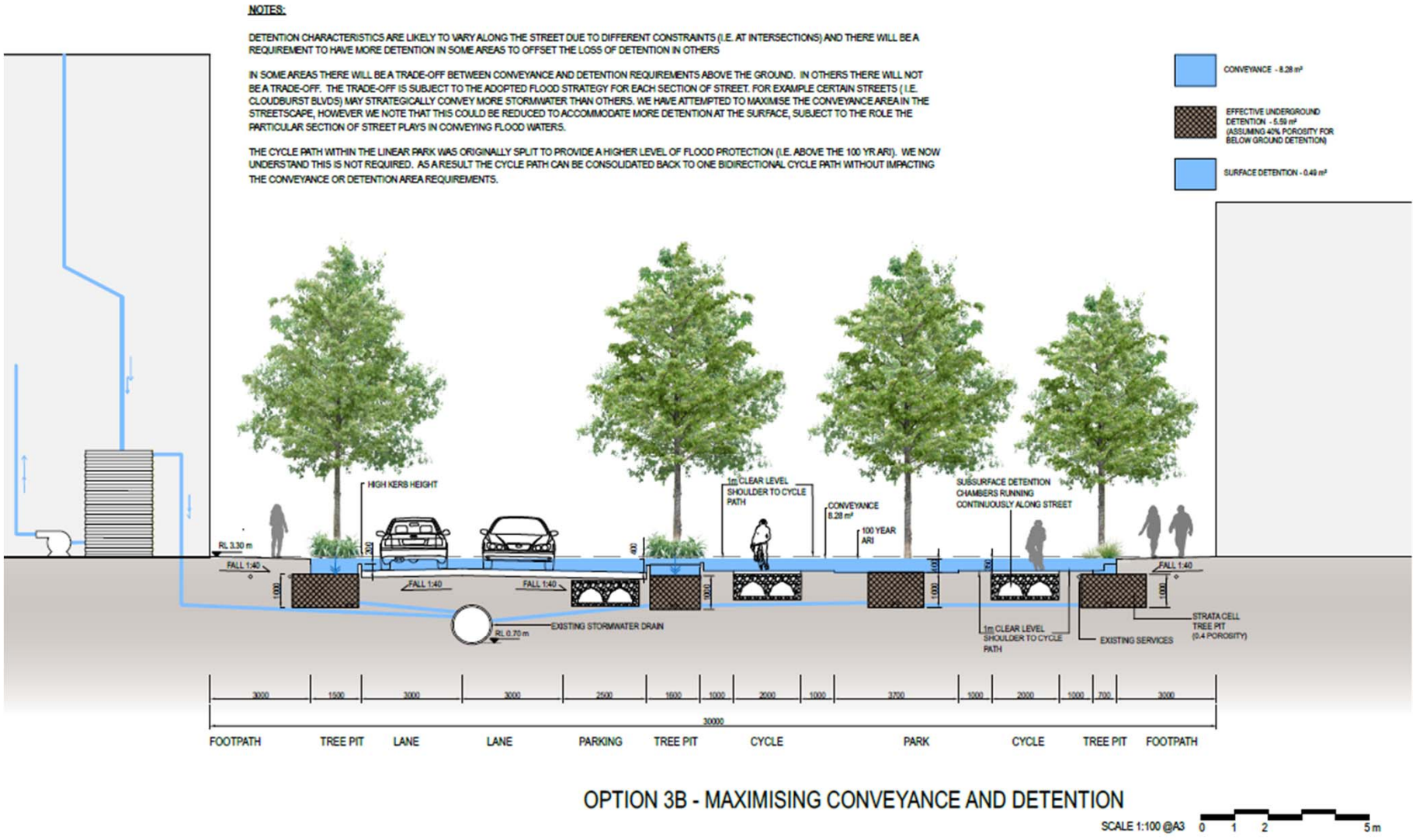
Green Street - Option 2



Green Street - Option 3A



Green Street - Option 3B



OPTION 3B - MAXIMISING CONVEYANCE AND DETENTION

SCALE 1:100 @A3 0 1 2 5 m

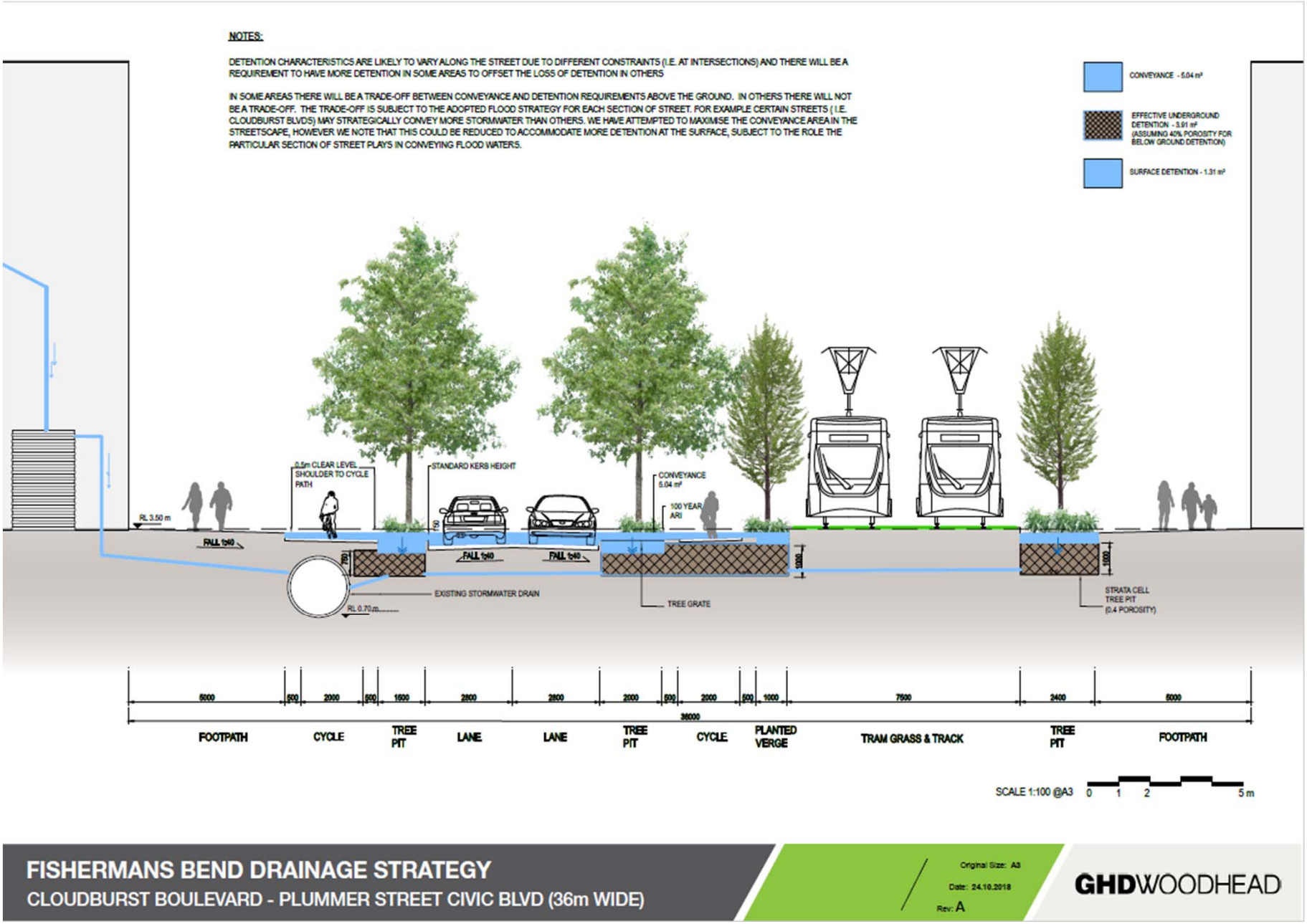
FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - GRAHAM STREET (30m WITH LINEAR PARK)

Original Size: A3
Date: 24.10.2018
Rev: A

GHDWOODHEAD

Cloudburst Boulevard - Plummer Street



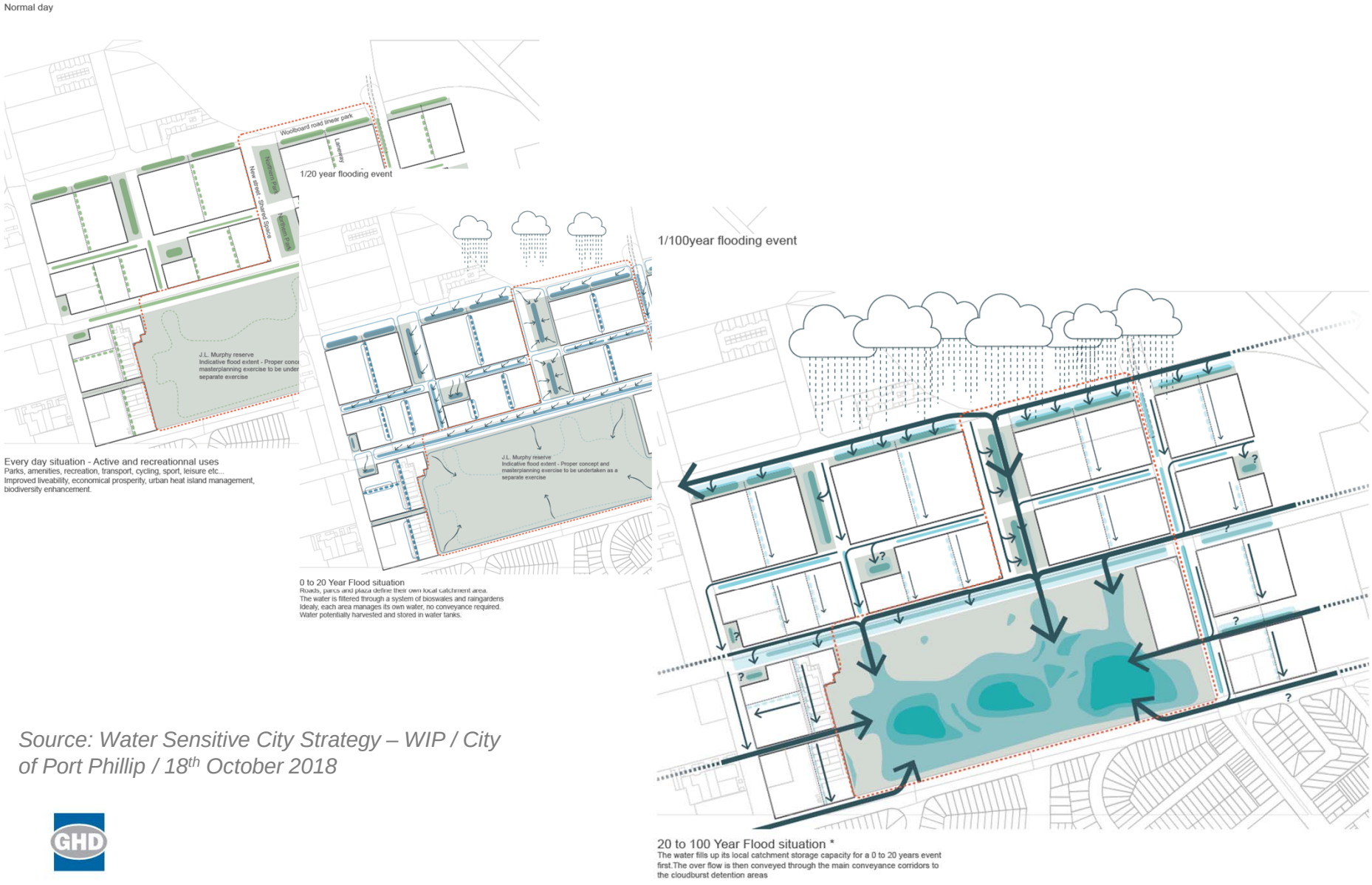
FISHERMANS BEND DRAINAGE STRATEGY

CLOUDBURST BOULEVARD - PLUMMER STREET CIVIC BLVD (36m WIDE)

Original Size: A3
Date: 24.10.2018
Rev: A

GHDWOODHEAD

Plan view of water flows – eg from CoPP



Source: Water Sensitive City Strategy – WIP / City of Port Phillip / 18th October 2018

Likely Trade-offs

- Adding storage in **areas which drain into new pumps next to the levee** will reduce flowrates, and therefore potentially reduce pipe diameters, and pump sizes. In some cases less pumping will be needed overall, if tide cycle allows.

- Adding storage **in areas which drain into existing drainage networks** will reduce the load on those downstream networks, and therefore reduce downstream flooding, or offset the need for future upgrades in those areas.

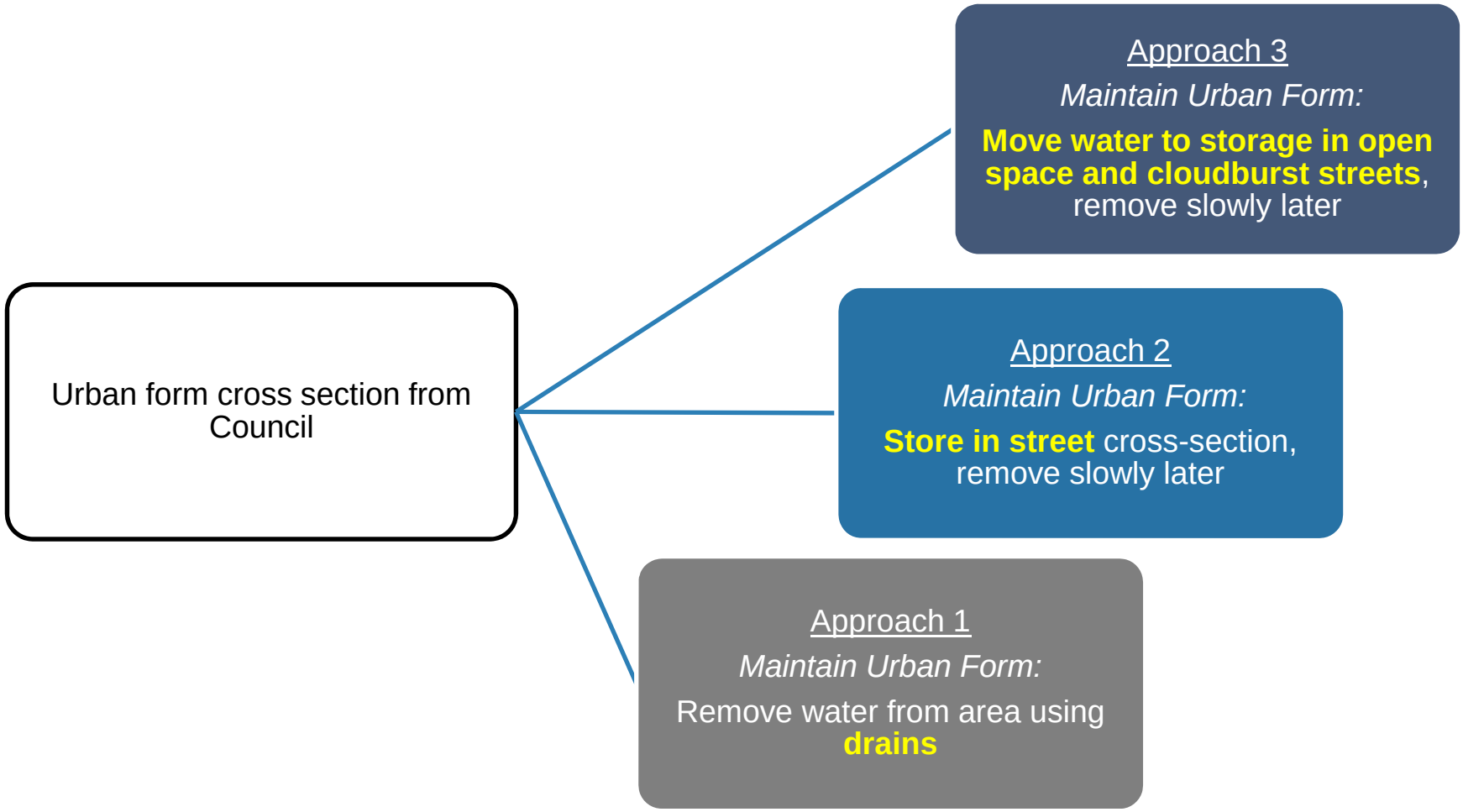
  [Also will potentially reduce the need for upgrades to existing pipe drainage within Fishermans Bend before it drains downstream.]

Possible Trade-offs

- A significant amount of storage might eliminate some pumps. In such a case, the risk related to pump failure is reduced, and this might affect the thinking on risk and floor levels.

- Larger storages might be related to other beneficial outcomes: such as providing volume for stormwater harvesting, or more room for tree root-ball health. These are likely to be location and detail specific.

Method - Step One (underway)

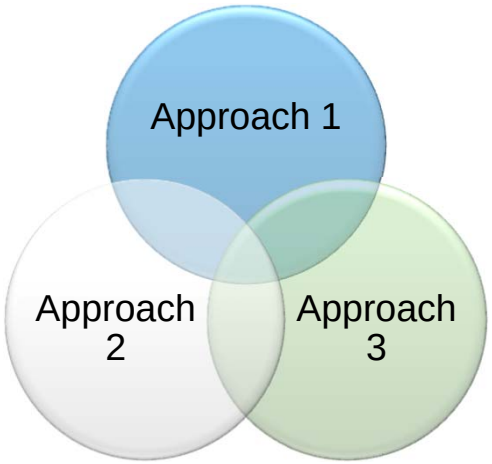


Further Description of Approaches

#	Approach	Driver
1	Enhance urban form **primarily for amenity with allowance for conveyance**	20 yr ARI carried via upgraded pipe/pump solution, 100 yr in streetscape
2	Enhance urban form **for both amenity and provision of stormwater detention and conveyance**	*Driver relative to option 1* – Scale of pipe/pump upgrades reduced by detention
3	Enhance urban form **for both amenity and maximising stormwater detention and conveyance**	*Driver relative to option 1 & 2* - Some streets can provide more detention/conveyance and can strategically take pressure off other streetscapes/pipes)

Method - Step Two (underway)

- Determine ‘best’ mix of approaches 1, 2 and 3 for the Case Study Areas.
- Framework for determining ‘best’ to be discussed in a few slides time.



Method - Step Three (to come)

- Look at agreed ‘best’ approach for case study areas and infer ‘Rules’ that can be extrapolated across the entire area.

- Extrapolate across the entire precinct.

Method - Step Four (to come)

- Will now have two overarching strategies for Fishermans Bend:
    I. Approach 1 across entire precinct, and
    II. ‘Best-practical’ mix of all Approaches (1, 2 and 3) based on analysis

- Compare the costs and benefits, advantages and disadvantages of the two overall strategies.

Note: Urban form and level of service remains the same between the two strategies.

Criteria for Comparison of Strategies Draft

Criteria	Method of Measurement or Assessment	Comment	Option 1	Option 2	Option 3
CAPITAL COSTS					
In property	Comparative Cost				
In Lanes, Streets etc					
Undergound pipes, pumps etc.					
Works in open spaces		Additional works to create lower areas to hold water			
MAINTENANCE COSTS					
In Streets	Comparative Cost	Need to clean and de-silt etc.			
In Underground network and pumps					
LIFE CYCLE COSTS					
Design life / Time between renewals	Time period	Could incorporate into TOTEX cost (CAPEX+OPEX)			
LAND TAKE					
Streets	m2 per lineal m	Is this a loss if more area for tree pits?			
Open Space	Ha or percentage	Is this really a land take loss if still useable space for most years?			
ENVIRONMENTAL IMPACTS/BENEFITS					
Energy	Qualitative				
Stormwater Quality					
Wastes					
SOCIAL IMPACTS/BENEFITS					
Urban Temperature	Qualitative				
Greening					
Visibility of Water					
Community views		Community views to be advised by stakeholders			
IMPLEMENTATION CONSIDERATIONS					
Difficulty of implementation given development timeline and process	Qualitative	If development is not continuous and linear, may be hard to make linear along street assets to work in the interim cases.			
Constructability issues					
Health & Safety issues					
RISK & RESILIENCE					
Risk of failure to work correctly, or be implemented as expected.	Qualitative	Risk of pump etc failure on one hand, on the other hand the risk of non success of street assets to work as expected.			
Adaptibility/Flexibility/Contingency		Ability to adjust to changed conditions			

Criteria for Comparison of Strategies Comments

CoPP:

- **[Re CAPEX]** Could we simplify this a little bit so that capital set up costs, maintenance and life cycle are line items under 'Economic' considerations' or similar.
- I would also add another qualitative line item that seeks to measure the economic benefits that may (or may not) come from improved amenity arising from having more water more present more often in the landscape.
- **[Re Maintenance]** Maintenance costs need to consider full make good costs rather than the typical approach which leaves the above ground infrastructure in a terrible state.
- **[Re Land take – Open space]** I wonder if this is adding much benefit as presently proposed.
- **[Re Environmental criteria]** Isn't this something that could be quantified [ie not just qualitative]
- **[Re Implementation – difficulty]** I think this consideration is going to be a problem either way so I question its inclusion.
- **[Re Resilience]** Any discussion around resilience needs to cover the benefits of having water stored in the landscape from a community resilience perspective (particularly above ground in Cloudburst Boulevards / streets that are not performing a large conveyance role. By this, I mean making storm events and water storage more present visually in the landscape.
- **[Re risk & Resilience]** I would group risk and resilience as currently explained in the comment on this category with the considerations in the land take section as 'Fit-for-purpose' or similar.

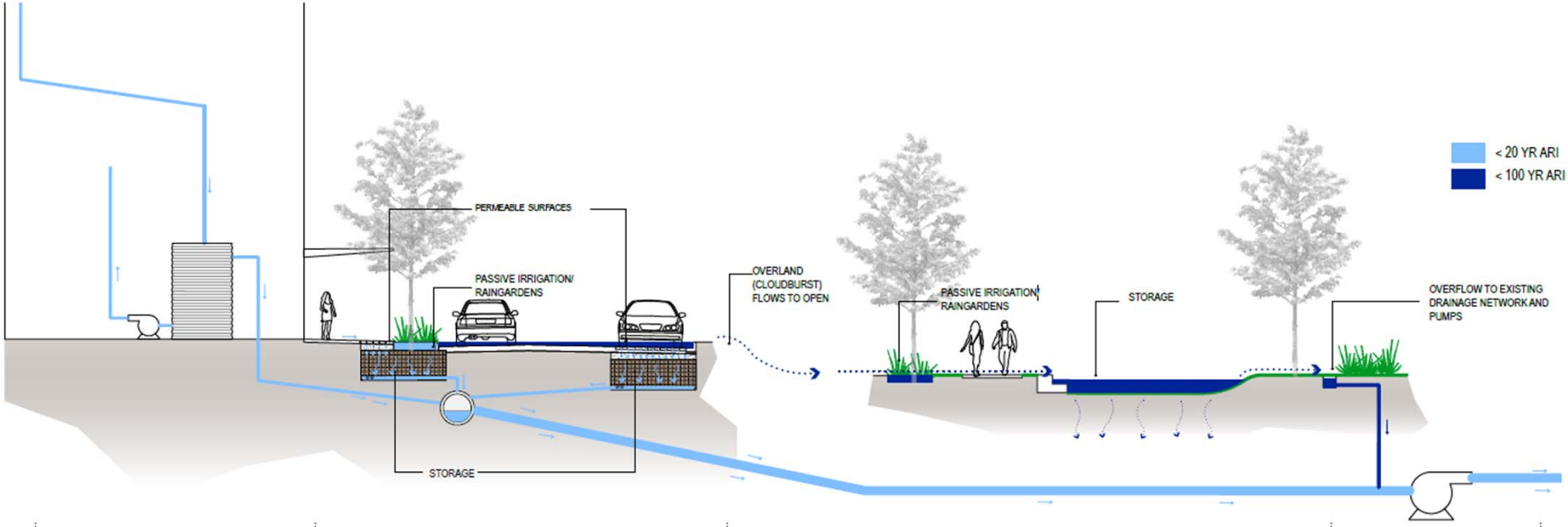
Working Group Meeting 23rd Oct:

- Below ground uptake of space, could affect available space remaining for other services or uses (likely under the Land take category)
- Water savings (eg through reduced irrigation), could be under Environmental Impacts
- Biodiversity (as long as this is attributed to the difference between options)
- Urban design outcomes (eg. access, trafficability issues due to above ground storages).

CRCWSC:

- Emphasising the importance of the 'water visibility' criteria as a core rationale for looking at the case studies to begin with. I.e. water visibility enables social resilience. Ensure this particular criteria is given prominence.

Current Thinking



PRIVATE REALM

RAIN TANKS
REUSE
ONSITE PERMEATION

PUBLIC STREET

PERMEABLE PAVING
RAINGARDENS
PASSIVE IRRIGATION
STORAGE

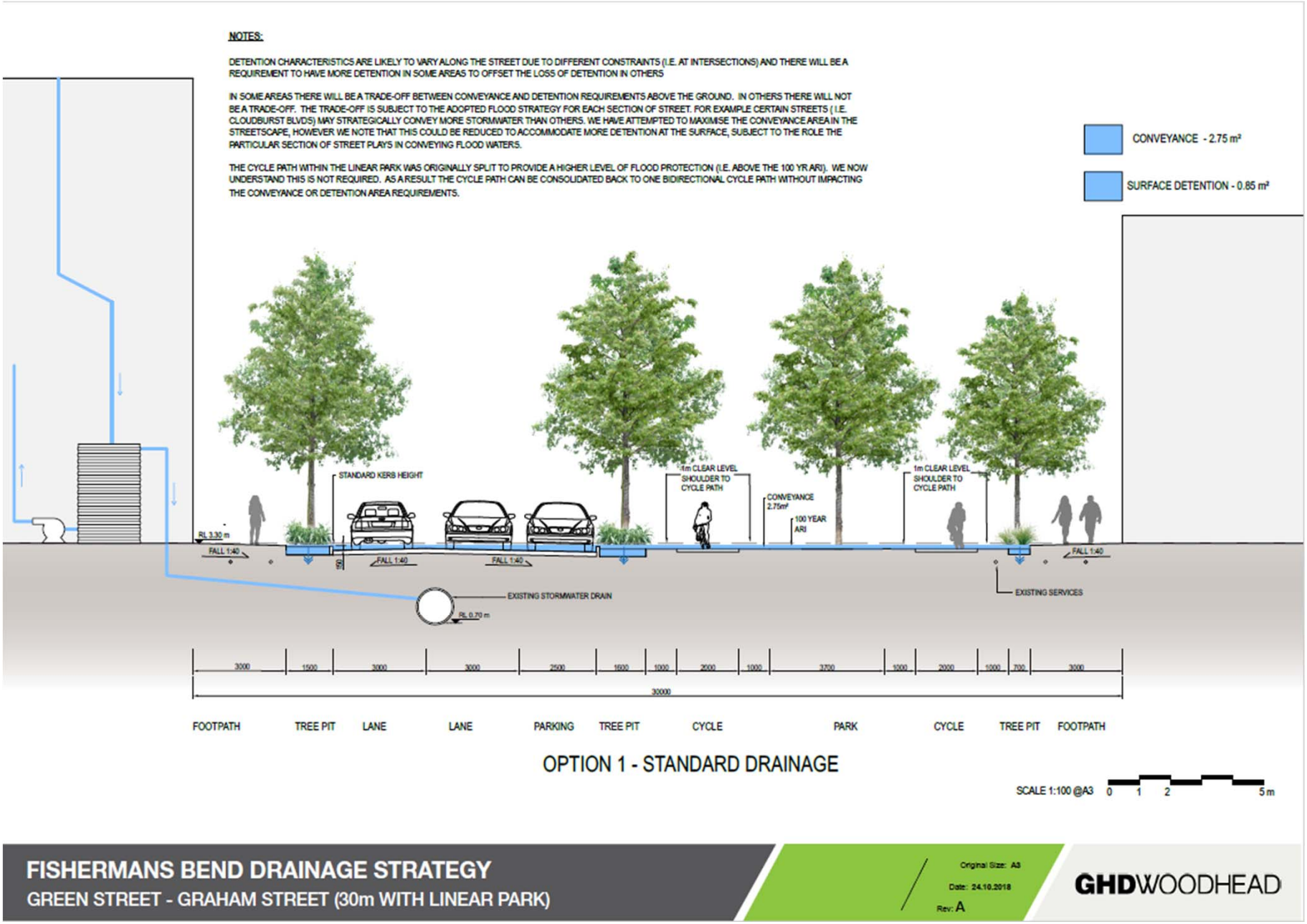
PUBLIC OPEN SPACE

STORAGE
PERMEABLE PAVING
RAINGARDENS
PASSIVE IRRIGATION

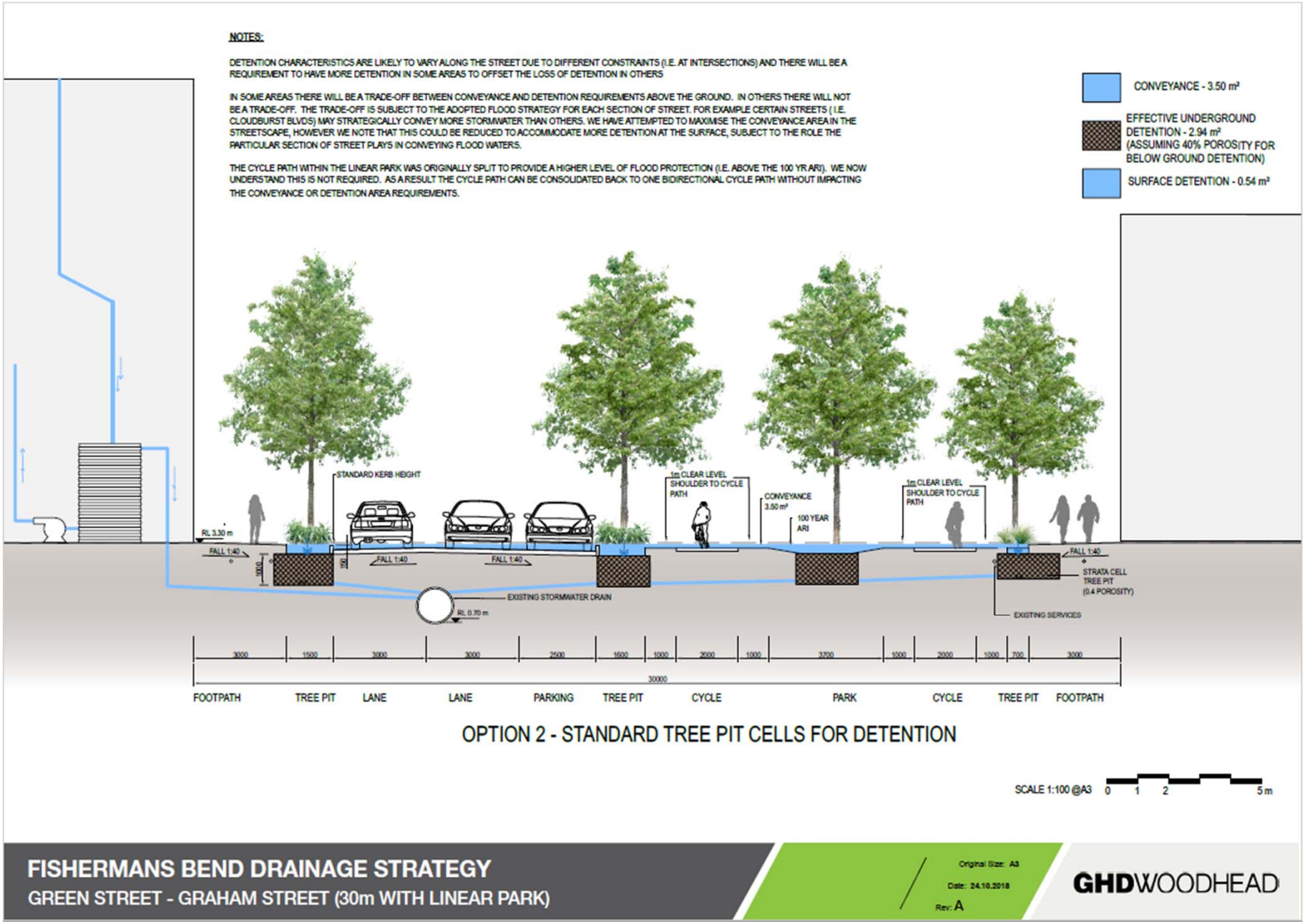
DRAINAGE INFRASTRUCTURE

PITS
PIPES
PUMPS

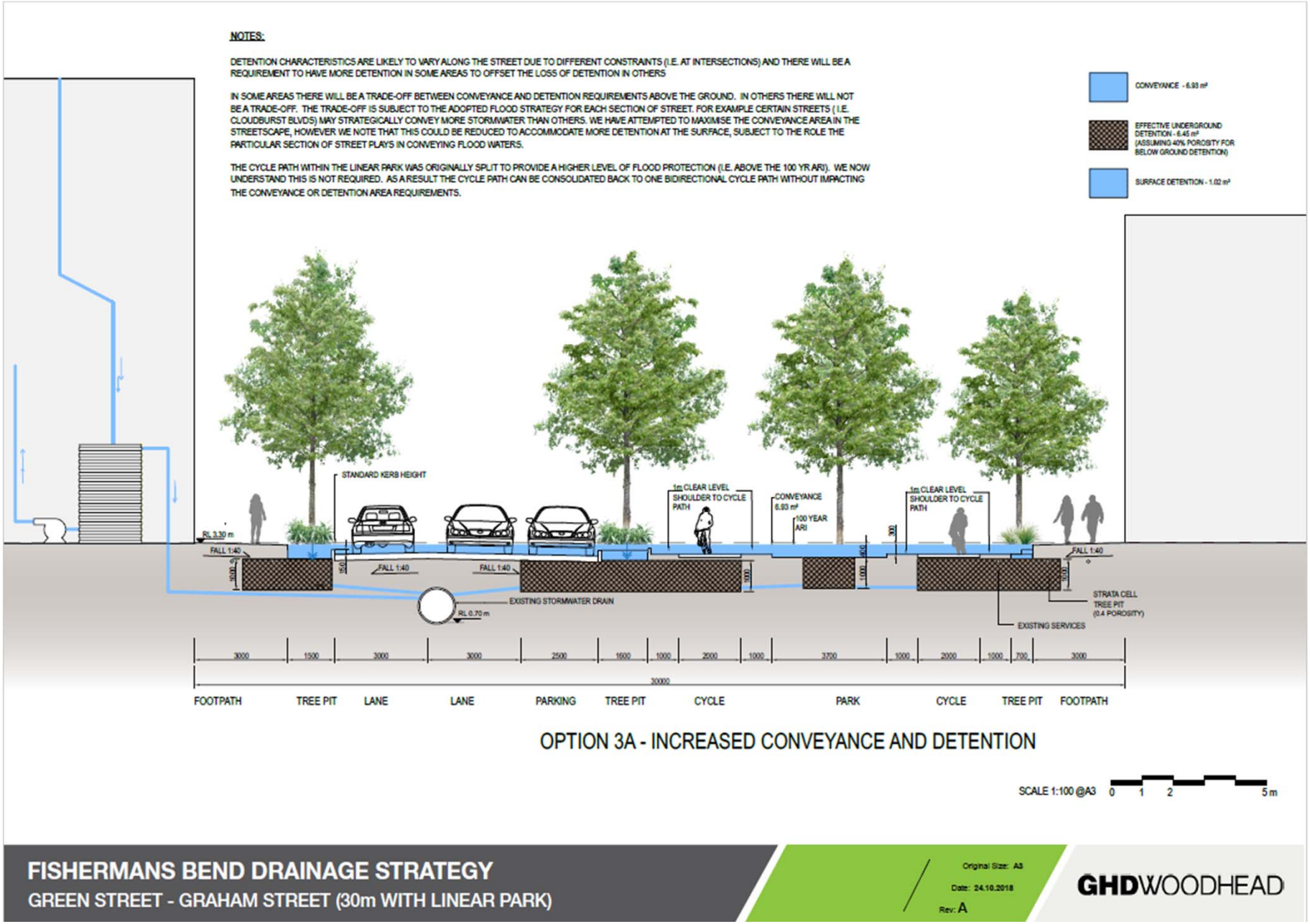
Green Street - Option 1



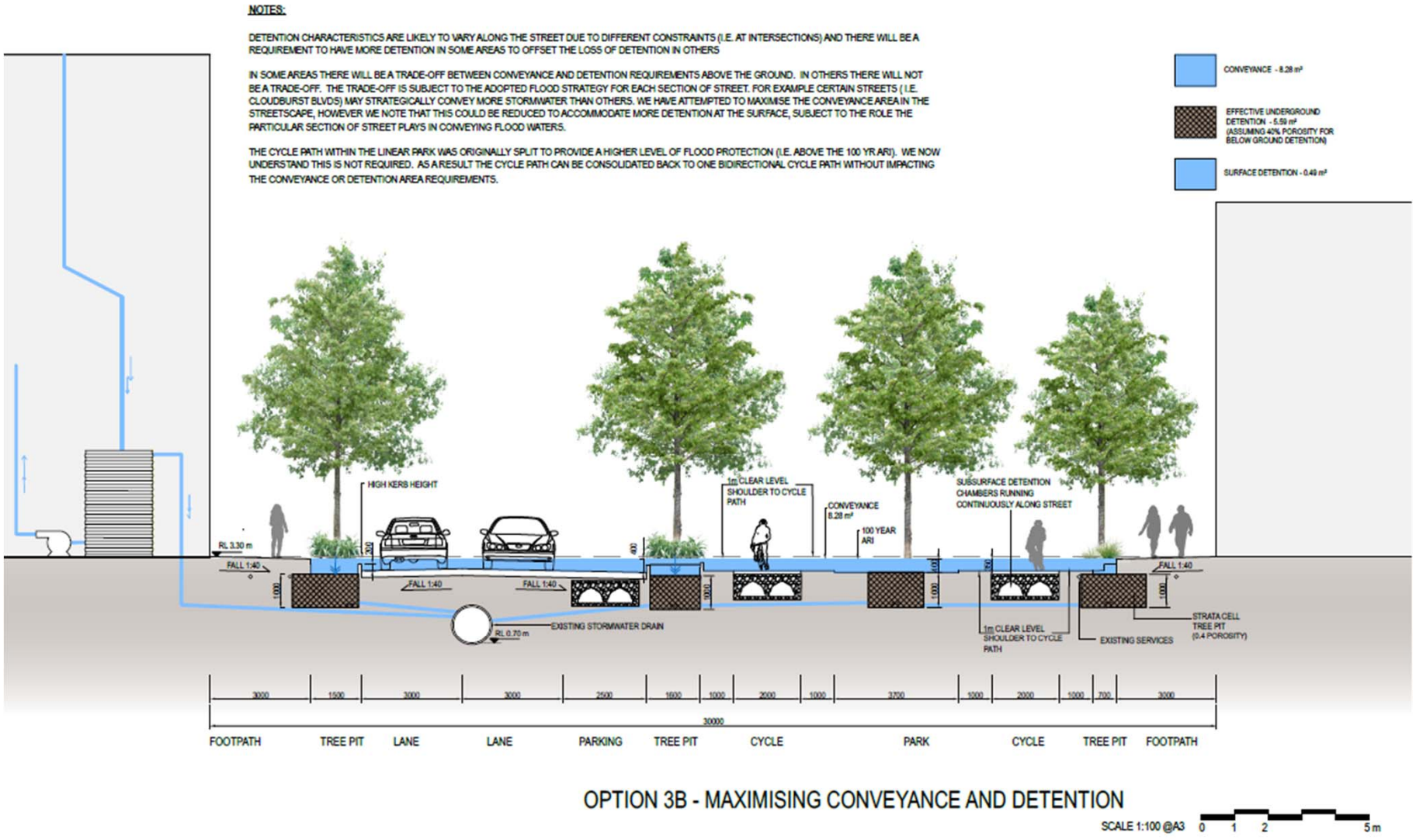
Green Street - Option 2



Green Street - Option 3A



Green Street - Option 3B



OPTION 3B - MAXIMISING CONVEYANCE AND DETENTION

SCALE 1:100 @A3 0 1 2 5 m

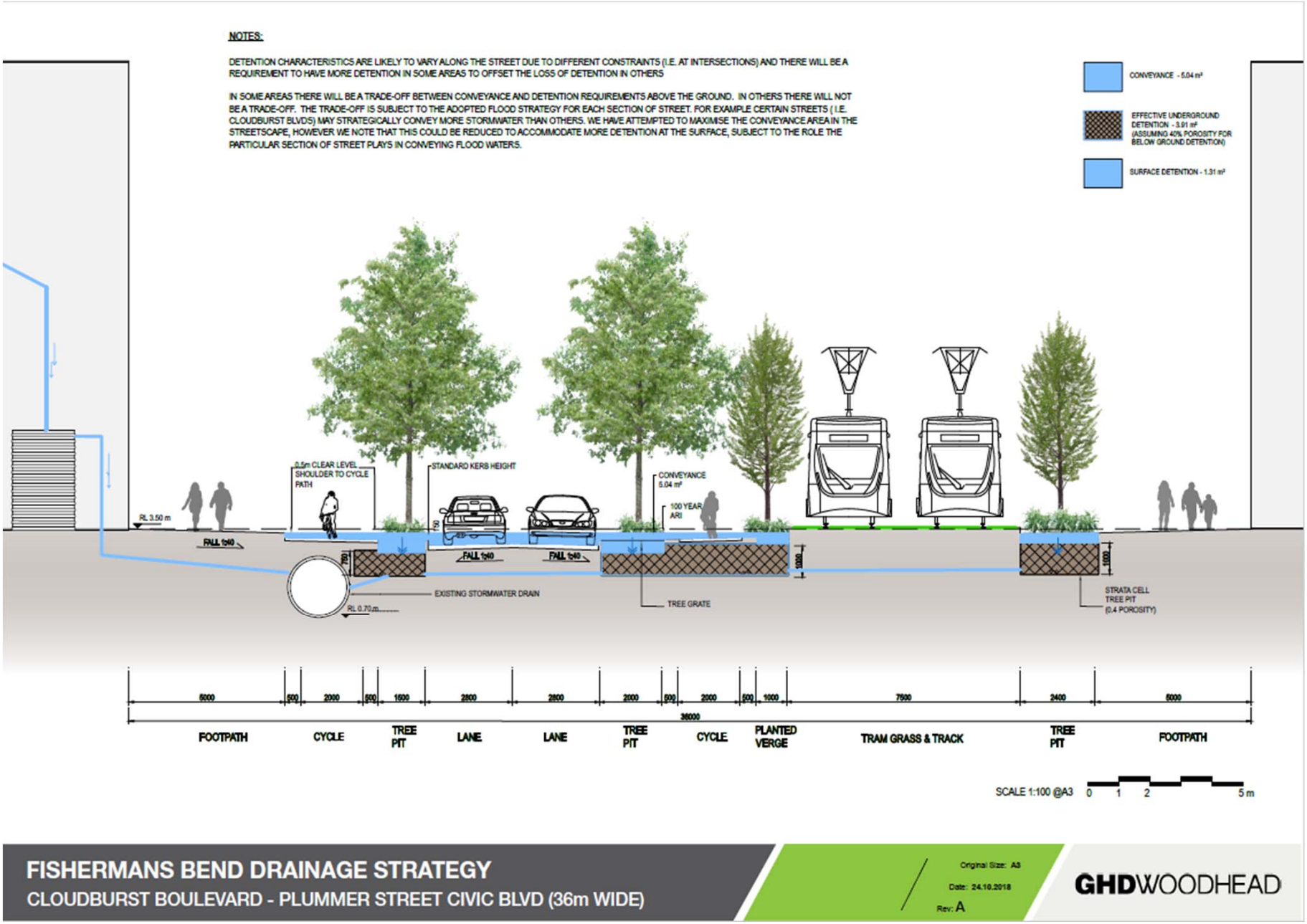
FISHERMANS BEND DRAINAGE STRATEGY

GREEN STREET - GRAHAM STREET (30m WITH LINEAR PARK)

Original Size: A3
Date: 24.10.2018
Rev: A

GHDWOODHEAD

Cloudburst Boulevard - Plummer Street



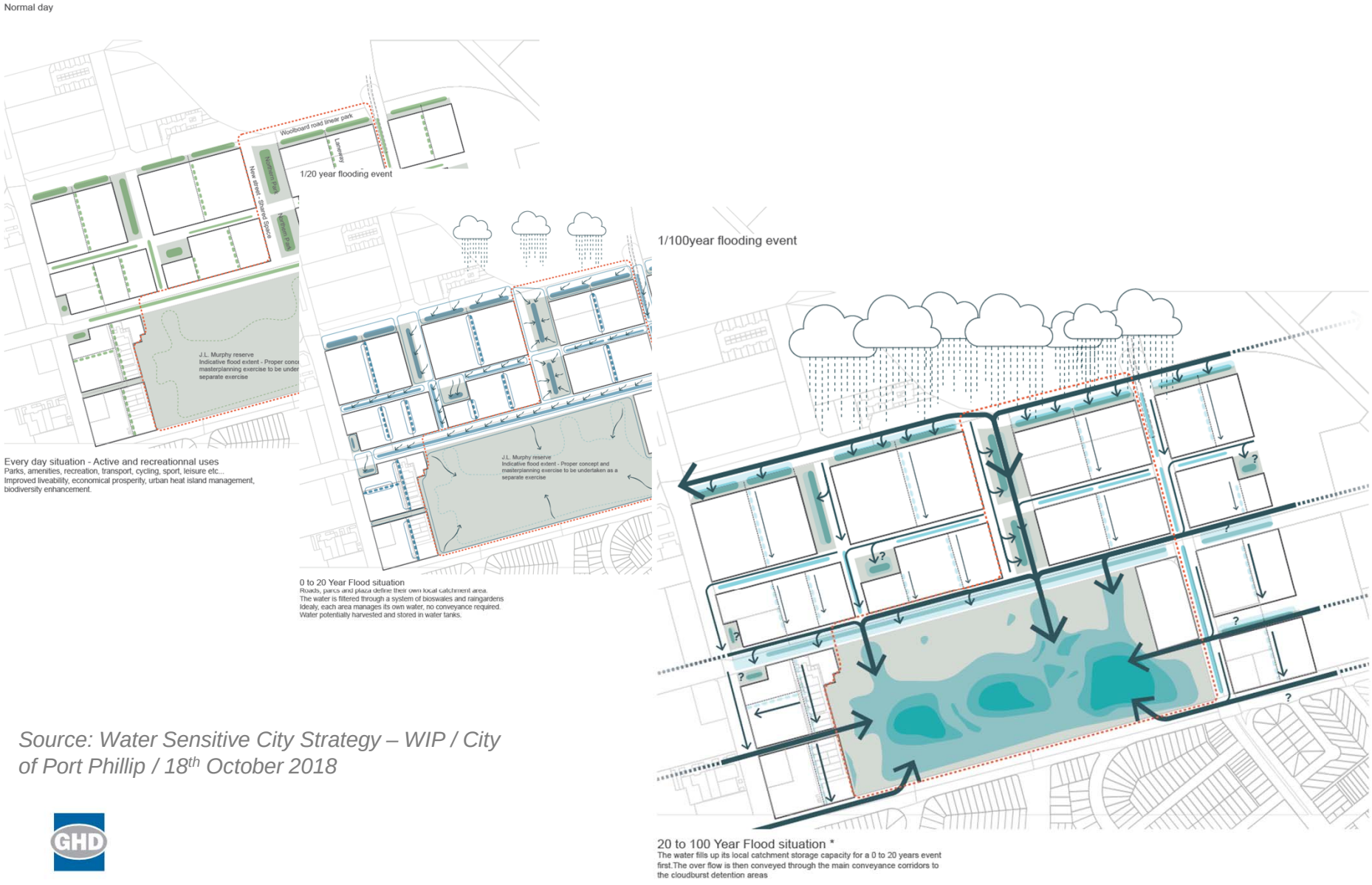
FISHERMANS BEND DRAINAGE STRATEGY

CLOUDBURST BOULEVARD - PLUMMER STREET CIVIC BLVD (36m WIDE)

Original Size: A3
Date: 24.10.2018
Rev: A

GHDWOODHEAD

Plan view of water flows – eg from CoPP



Source: Water Sensitive City Strategy – WIP / City of Port Phillip / 18th October 2018

Likely Trade-offs

- Adding storage in **areas which drain into new pumps next to the levee** will reduce flowrates, and therefore potentially reduce pipe diameters, and pump sizes. In some cases less pumping will be needed overall, if tide cycle allows.

- Adding storage **in areas which drain into existing drainage networks** will reduce the load on those downstream networks, and therefore reduce downstream flooding, or offset the need for future upgrades in those areas.

  [Also will potentially reduce the need for upgrades to existing pipe drainage within Fishermans Bend before it drains downstream.]

Possible Trade-offs

- A significant amount of storage might eliminate some pumps. In such a case, the risk related to pump failure is reduced, and this might affect the thinking on risk and floor levels.

- Larger storages might be related to other beneficial outcomes: such as providing volume for stormwater harvesting, or more room for tree root-ball health. These are likely to be location and detail specific.

Features which are (mostly) independent from Flood Management for 1:20 and 1:100 goals

- **Amount of trees, green spaces, rain gardens and the like, which in turn can mitigate the urban heat island effect** *(The number of these has been kept constant between the different approaches).*

- **Visibility and presence of water in the urban landscape.** The flood management is largely related to 1:20 year event or less frequent events, as the design standard is to avoid surface flows of water at more frequent events. Alterations in local urban design detail can provide visible water in more frequent events for all options. *(This will be featured in the longitudinal sections and plan views of all options for the case study areas)*

www.ghd.com

Attachment 11

Case Study Assessment Slides (CoPP)